Online Appendix

Forward Guidance and Expectation Formation: A Narrative Approach

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1 Data (additional notes)

This study combines two types of panel data. First, I use individual private-sector survey forecasts (subsection 1.1) of interest rates and individual private-sector survey forecasts of inflation, domestic output growth, and unemployment. Second, I construct a central bank policy data set (subsection 1.2) that includes forward guidance, policy rate decisions, quantitative easing, and central bank projections. The data are depicted in several figures below and summarized in Table 20.

1.1 Private-sector forecast data

As the purpose of this study is to determine how individual forecasters *revise* their forecasts of the policy rate in response to a signal provided by a central bank, we must track individual forecasters over time and calculate the changes in their forecasts on a monthly basis. The key challenge of tracking individual forecasts over time is naming conventions. Typically, there is no challenge because each forecaster is recorded using the same name each month. The challenge lies in the exceptions to this rule.

Least seriously, the names of the firms are occasionally misspelled in some months, which if not detected, would cause that monthly observation to be treated as separate from its correctly spelled counterparts from other months. Most seriously, the names of firms change over time. This is usually because of mergers, acquisitions, and bankruptcy. Accordingly, we must track individual forecasters across these events. Doing so is a nontrivial task and is likely one reason why most studies aggregate the data across forecasters. To track individual forecasters over time, I worked with the data provider to track firms through mergers and acquisitions by country across time. This allowed me to consolidate many individual forecaster time series that were seemingly separate into fewer, harmonized individual forecaster time series. The consequence of this consolidation is to decrease the total number of firms in the sample data and to increase the number of observations per firm.

An additional issue is that the uncertainty associated with fixed-horizon forecasts is fundamentally different from the uncertainty associated with fixed-event forecasts. The uncertainty associated with each fixed-horizon interest rate forecast is, all else equal, constant as each forecast looks either three or twelve months into the future. Conversely, the uncertainty associated with fixed-event inflation forecasts (i.e. the inflation rate for that year) should, all else equal, monotonically decrease as each month in the calendar year passes. Forecast uncertainty should be highest in January because the forecaster is either anticipating inflation for all twelve months of the current year or all twelve months of the next year. Forecast uncertainty is lower in July, for example, because the forecaster has already observed as many as six months of realized inflation data and therefore must only forecast six more months for the current year instead of twelve as in January; the forecast for next year's inflation is also a less distant prospect in, say, July than it was January.

Finally, as mentioned in the paper, the data come from twelve countries: Australia, Canada, France, Germany, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, the UK, and the US. Although Consensus Economics provides forecasts for the euro zone, it does not provide interest-rate forecasts for the euro zone. This is why France, Germany, Italy, the Netherlands, and Spain are used instead.

1.2 Central bank data

This section includes additional notes on the forward guidance data. This section also includes additional notes on effective lower bound periods and inflation-targeting periods.

1.3 Forward guidance data

I took a narrative approach to forward guidance categorization (Shiller (2017)). That is, I read about 32 years of monetary policy statements across eight central banks and, inter alia, identified all *changes* in forward guidance. These changes were categorized as either dovish (−1), neutral (0), or hawkish (+1). This narrative approach is similar in nature to that used in Istrefi (2016) and a follow-up paper Bordo and Istrefi (2018). "Istrefi (2017) collects the perceptions of Fed watchers and other analysts as reflected in the US media and builds a measure of policy preferences (a hawk–dove index) of the FOMC. The narrative record in the media is used as a public source and a filter of all relevant information about these policymaker's backgrounds, their political interests and supporters and their economic beliefs. These beliefs are expressed in their writings, testimonies and speeches before joining and during their time at the Fed and in their policy actions (votes and dissents). To build the Hawk-Dove measure, about 20,000 articles or reports, from more than 30 newspapers and business reports of Fed watchers, referencing to 130 FOMC members were consulted" (Bordo and Istrefi (2018)).

The first central bank to begin using forward guidance regularly in this data set was the Reserve Bank of New Zealand on December 1, 1996: "The prospects for further loosening in monetary conditions will depend on how quickly inflation pressures recede." Early forms of forward guidance tended to be somewhat subtler than contemporary forward guidance. Despite the prescience the Reserve Bank of New Zealand, it appears that the first instance of forward guidance in the data actually took place six years earlier in Australia by Governor Bernie Fraser on January 23, 1990: "Decisions in respect of any further easing in monetary policy will be made in the light of developments in the economy, especially demand and wage and price levels." This is more subtle than the more recent examples of forward guidance.

The terms dovish, neutral, and hawkish forward guidance refer to the future path of monetary policy. 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. To illustrate, on October 25, 2012, the Sveriges Riksbank stated "It is now more probable that the repo rate will be cut rather than being raised during the winter," and on May 10, 2018 the Reserve Bank of New Zealand stated that "The direction of our next move is equally balanced, up or down."

Generally, each term would correspond to an implicitly downward-sloping, flat, or upward-sloping path of future policy rates respectively. For example, the Federal Reserve's use of the statement "higher interest rates will be warranted" would be categorized as hawkish and implies an upward-sloping policy rate path. Helpfully, the Reserve Bank of New Zealand, the Norges Bank, and the Sveriges Riksbank release projections of the policy rate path, so the slope of these paths are actually explicitly stated rather than only implicitly articulated by the central bank. On rare occasions, verbal forward guidance and quantitative policy rate path projections differ somewhat. This difference does not necessarily reflect an inconsistency. Rather, verbal forward guidance tends to focus on the path of the policy rate in the short-run, whereas the quantitative policy rate path projection typically extends somewhat beyond the short-run.

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.

When the central bank policy rate is at the effective lower bound, individual forecasts of the T-bill rate in 12 months' time may not necessarily be at the effective lower bound as well. Figure 11 below illustrates this point. Sometimes individual one-year rate forecasts sit above the effective lower bound as forecasters expect the policy rate to be higher one year from now (e.g. the non-European countries) and sometimes those forecasts are actually below the effective lower bound (e.g. the European countries). In the latter case, forecasters could be anticipating that the effective lower bound will be revised lower (as indeed happened) and that policy rates will actually need to fall into (increasingly) negative territory (which also happened). As such, forward guidance can still influence short-term interest-rate expectations at the effective lower bound, albeit much less than away from the effective lower bound.

Once all of the published policy rate paths for each central bank were gathered, I also used these projections to help assign forward guidance values. To be clear, I consider central bank policy rate projections to be a subset of forward guidance. Each time a central bank policy rate projection is released, that period would automatically be considered to be a period with forward guidance. So a policy rate projection implies forward guidance in the data. Fortunately, this is an inconsequential assumption because central banks that release policy rate projections on a regular basis almost invariably also provide verbal forward guidance as well. Of course, the converse is not true: the provision of verbal forward guidance does not imply the availability of a central bank policy rate projection. Nor is the inverse true: the absence of a central bank policy rate does not imply the absence of verbal forward guidance. It is only the contrapositive that is generally true: the absence of verbal forward guidance generally implies the absence of a central bank policy rate projection.

The matrix below illustrates how numerical values were assigned to *changes* in forward guidance. For example, if a central bank shifted from no forward guidance (neutral) to forward guidance with a bias towards rate increases (hawkish), then a value of +1 would be assigned.

Table 1: **Transition matrix for the forward guidance variable (f_{ct})**

		To:		
		Dovish	Neutral	Hawkish
From:	Dovish	0	+1	+1
	Neutral	−1	0	+1
	Hawkish	−1	−1	0

Naturally, the measurement of forward guidance raises two questions. First, why not measure forward guidance using a more precise numerical measure? Indeed, I initially attempted to do so by scoring forward guidance in increments of 0.2 on a scale ranging from −1 to 1 (as in Feroli et al. (2017)). This required assigning the bias and forward guidance into one of eleven categories. Despite the guidance of a carefully created rubric intended to reduce the decisions to a relatively simple algorithm, the assignment of forward guidance to such narrowly defined categories resulted, in the author's opinion, in false precision. Hence, it was abandoned for a more practical, albeit less precise, methodology.

Second, is it really possible to measure forward guidance? Central banks strive to be clear in their communications. They tend to place more scrutiny on statements that are likely to be received as new signals. As such, it is typically very straightforward to glean whether a central bank has attempted to send a dovish signal, hawkish signal, or, far more often, no new signal at all. Indeed, financial and economic journalists do this on a regular basis and typically manage to reach consensus. Although there have been many instances of ambiguous forward guidance, these are greatly outnumbered by instances of clear forward guidance. Whether one dovish signal is stronger than another is, however, regrettably, hidden within the data.

The forward guidance periods in this paper have also been cross-referenced with the periods and categorizations disclosed in Gürkaynak et al. (2005), Rudebusch and Williams (2008), Svensson (2010), Campbell et al. (2012), Woodford (2013), Femia et al. (2013), Kool and Thornton (2015), Svensson (2015), Charbonneau and Rennison (2015), Obstfeld et al. (2016), Coenen et al. (2017), Moessner et al. (2017), Swanson (2017), Bhattarai and Neely (2018), Kuttner (2018), Hubert and Labondance (2018), Altavilla et al. (2019), Andrade et al. (2019), Swanson (2021), Hubert (2019), and Andrade and Ferroni (2020). Whenever a direct comparison can be made, the forward guidance periods in this paper are almost invariably consistent with those in the papers cited above, each of which covers only a small subset of the forward guidance periods covered here. Further, for every recorded example of forward guidance (and for quantitative easing for that matter), the corresponding text is stored in an adjacent cell in the data file. Sometimes this text is as short as a sentence and sometimes it is paragraphs long. As such, researchers will be able to determine exactly why every single example of forward guidance was assigned the labels and metadata that it was.

1.3.1 The timing of forward guidance relative to the private-sector forecaster data

In the sample data, forward guidance announcement dates typically take place on Tuesdays (13%), Wednesdays (37%), Thursdays (46%), and Fridays (4%) (collectively 99% due to rounding). In the sample data, the Consensus Economics survey deadline typically fell on a Monday (96%) or a Tuesday (3%) (collectively 99%). Based on a sample of submission patterns, Consensus Economics estimates that survey participants submit their surveys in the following pattern, where t is the survey deadline: $t-5$ (8%), $t-4$ (5%), $t-3$ (17%), $t-2$ (0%), $t-1$ (0%), t (66%), and $t+1$ (4%) (collectively 100%). The percentage of times a forward guidance announcement occurred close to a survey deadline is as follows, where t is the survey deadline: $t-5$ (6%), $t-4$ (28%), $t-3$ (1%), $t-2$ (0%), $t-1$ (0%), t (0%), and $t+1$ (0%) (collectively 36%).[1] Hence, it is possible that, on rare occasions, a forecaster may have submitted the firm's forecasts before a forward guidance announcement rather than after, as in the vast majority of cases. For robustness, I provide versions of the benchmark estimates where I drop all months with a forward guidance announcement that took place within either six, eleven, or sixteen days of the survey deadline or that occurred more than fifteen days before the survey deadline (see Table 3). The results are very similar to the benchmark estimates provided in the main paper.

1.3.2 State-contingent, time-contingent, and qualitative forward guidance

I also categorized all instances of forward guidance as either state-contingent, time-contingent, or qualitative. Time-contingent forward guidance is defined as a statement that provides information about the probable stance of monetary policy at a specific time in the future. State-contingent forward guidance is defined as a statement that provides information about the central bank's monetary policy reaction function that is either more specific than or substantially different from the central bank's mandate. Any language that simply reasserts the central bank's mandate, which is very common, cannot be considered state-contingent forward guidance because the central bank is not providing the public with any new information. Even less could such a reassertion be considered forward guidance with commitment because,

[1] The mean gap between a forward guidance announcement date and the Consensus Economics survey deadline is sixteen days.

in the case of an inflation-targeting central bank for example, achieving the central bank's inflation target is an ongoing commitment not something that can be invoked in times of need. Qualitative forward guidance is that which does not fall into either of these two categories, but nonetheless meets the definition of forward guidance above; it is much more vague in nature and more common. Interestingly, Blinder et al. (2017) find that central bank governors prefer qualitative forward guidance, while academics prefer state-contingent (data-based) forward guidance. The sample data reflect this preference, as qualitative forward guidance is the most common attribute.

Moessner et al. (2017) (p. 679) observe that "Qualitative, calendar-based and threshold-based forward guidance are also referred to as open-ended, time-contingent and state-contingent forward guidance, respectively." Indeed, qualitative and open-ended forward guidance appear to be equivalent although I favour the term qualitative forward guidance because it implies a clear counterpart, quantitative forward guidance, which as discussed below, has been used in practice. Conversely, it is not clear what closed-ended forward guidance would entail. The other terms should not be considered synonyms however. Threshold-based forward guidance, by contrast, is a special case of state-contingent forward guidance. It is far more common for a central bank to condition forward guidance on some (occasionally vague) future state than to define a numerical threshold, which is actually quite rare in practice. Similarly, calendar-based forward guidance is a special case of time-contingent forward guidance. Central banks often refer to a specific time in their forward guidance, but that time is seldom as specific as a calendar date or even a calendar month. More often, time-contingent forward guidance refers to something like a quarter or even a half of a year. Occasionally, central banks have referred to specific upcoming meetings, which could appropriately be considered calendar-based forward guidance.

Note that none of these definitions require any kind of commitment. Even some empirical studies of forward guidance suggest that commitment plays a role in these definitions. "When FG is time dependent, the central bank commits to a particular path for a given time horizon" (Kool and Thornton (2015)). Further, the forward guidance literature often suggests that forward guidance is *either* state-contingent or time-contingent, *either* Odyssean or Delphic. Such classifications, although useful, risk creating the perception of distinct instruments with distinct objectives and distinct outcomes. In fact, forward guidance is frequently multidimensional.

Mario Draghi observed at a Peterson Institute for International Economics Conference on October 12, 2017, "Our rate guidance has both time- and state-based dimensions since rates cannot rise until we see an improvement in the inflation outlook sufficient to end net asset purchases." Janet Yellen echoed this point shortly afterwards at the European Central Bank Communications Conference on November 14, 2017, "I believe every bit of forward guidance—even when it's been calendar-based over the years—the FOMC has used the words *we think such and such will be appropriate in light of the outlook for the economy.*" Bhattarai and Neely (2018) observed that forward guidance can be both Delphic and Odyssean in the same announcement.

Perhaps, then, we should begin discussing forward guidance in terms of overlapping *attributes* rather than *classes* (that is, categories or types that are considered to be mutually exclusive). This subtle shift in the debate would allow for a more nuanced discussion of forward guidance and better recognize its multi-faceted nature. If we cannot agree on what constitutes a particular attribute of forward guidance, then it will be very difficult to reach consensus about the particular effects of such attributes. Without such a consensus, when monetary policy committees draft forward guidance language, they will inevitably be engaging in some amount of guesswork.

In Figure 3, the data are filtered to show only revisions that occurred immediately following forward guidance changes. The data are also colour-coded. Separate colours are used for hawkish and dovish forward guidance changes as well as changes to forward guidance. Similarly, in Figure 4, the data are filtered to show only revisions that occurred immediately following forward guidance changes. These data are also colour-coded so that separate colours are used for hawkish and dovish forward guidance changes as well as time-contingent and state-contingent forward guidance changes.

1.3.3 Forward guidance with commitment

All instances of forward guidance are also categorized as either with or without commitment, which are defined as follows.[2] Forward guidance with commitment is a statement that clearly indicates a *commitment* to a state of monetary policy in the future. By contrast, forward guidance is a statement that provides direct information about the *probable* state of monetary policy in the future. These definitions are closely related to but not identical to Delphic and Odyssean forward guidance. Delphic forward guidance is more predictive and Odyssean forward guidance is more promissory. The words *clearly indicates a commitment* are used because it is extremely unlikely that a central bank would ever issue a binding commitment on the future state of monetary policy. Slightly relaxing the definition from *Odyssean forward guidance* to *forward guidance with commitment* allows it to transition from purely theoretical to practical.

A clear lesson emerges from this exercise: forward guidance has been overwhelmingly noncommittal (more Delphic). Moessner et al. (2017) argue that there is a disconnect between the theoretical forward guidance literature and the applied forward guidance literature. They observe that most theoretical studies of forward guidance assume commitment (closely related to Odyssean forward guidance). In practice, however, central banks almost never use forward guidance with commitment. “Instead, there have been few if any occasions on which such Odyssean forward guidance has been attempted.” (Campbell et al. (2012), p. 69)

I identified a small number of instances of forward guidance with commitment as defined above in the sample data: one each from the Bank of Canada, the Sveriges Riksbank, the Reserve Bank of New Zealand, and the Reserve Bank of Australia. Each is discussed further below.

On April 21, 2009 the Bank of Canada used the following header for the press release announcing the monetary policy decision of the Governing Council.

> “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.”

Clearly, the Governing Council made a commitment. Of course, this commitment was not unconditional. This conditionality illustrates that the forward guidance was also state-contingent. The clear reference to a specific date demonstrates that the forward guidance was also time-contingent. Two statements contained in the press release also have distinctly Delphic attributes. “The Bank of Canada today announced that it is lowering its target for the overnight rate by one-quarter of a percentage point to 1/4 per cent, which the Bank judges to be the effective lower bound for that rate.” “Today’s decision to lower the

[2] “Mishkin also thought the paper should distinguish more clearly between management of expectations and commitment. Managing public expectations is part of normal Federal Reserve policymaking, and it can do this in various standard ways, or it can manage expectations through commitment.” (Campbell et al. (2012), p. 78).

policy rate by 25 basis points brings the cumulative monetary policy easing to 425 basis points since December 2007. It is the Bank's judgment that this cumulative easing, together with the conditional commitment, is the appropriate policy stance to move the economy back to full production capacity and to achieve the 2 per cent inflation target." These statements suggest that it is unlikely that the policy rate will be lowered further. The use of the word *judgement* illustrates the probabilistic nature of the statements making them much more Delphic than Odyssean. The next example reinforces the point that forward guidance is frequently multifaceted.

On October 28, 2014, the Riksbank included the following text in its press release announcing that the Executive Board decided to cut the repo rate by 0.25 percentage points to zero per cent:

> "**Zero repo rate until inflation clearly picks up**
> It is important that inflation rises towards the target of 2 per cent. The repo rate is therefore being cut by 0.25 percentage points to zero per cent. The low repo rate increases demand in the economy, which contributes to higher inflationary pressures. The highly-expansionary monetary policy may also contribute to keeping inflation expectations anchored around 2 per cent by sending a clear signal that monetary policy is focused on inflation approaching the inflation target.
>
> The repo rate needs to remain at this level until inflation has clearly picked up. Slow increases in the repo rate are expected to begin until the middle of 2016 and it should reach 1.75 per cent towards the end of 2017. This is an unusually low repo rate at a time when economic activity is good, resource utilisation is close to its normal level and CPIF inflation is 2 per cent."

The statement "Zero repo rate until inflation clearly picks up" is the phrase that suggests a commitment. Of course, the commitment is less explicit than the one discussed above, but the language is certainly suggestive. The strength of the statement is echoed in the later sentence "The repo rate *needs* to remain at this level until inflation has clearly picked up." (emphasis added). These statements about the path of the repo rate are also stronger than those used in the previous (September) press release, which included a similar sentence, "The repo rate needs to remain low for a long period of time for inflation to rise towards the target," but did not include the stronger statement, "Zero repo rate until inflation clearly picks up."

The October 2014 forward guidance also has aspects of both time-contingent and state-contingent forward guidance. First, the Executive Board makes it clear that the repo rate will stay at zero until inflation has clearly picked up. In other words, the level of the repo rate is most concerned with the low rates of inflation. Second, the statement includes a clear reference to a date at which we can expect the repo rate to increase. Of course, because the Executive Board releases its projections of the path for the repo rate, this time-contingent forward guidance is not extraordinary but, for the Riksbank, a regular feature.

The next example of forward guidance with commitment came from the Reserve Bank of New Zealand on March 16, 2020. This forward guidance can be considered commitment-based because the Monetary Policy Committee stated that the policy rate "will remain at this level for at least the next 12 months." Such strong language and such specifics are extremely rare.

> "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."

Another example of forward guidance with commitment came from the Reserve Bank of Australia on April 7, 2020. This forward guidance can be considered commitment-based because the Board stated that it "will not" increase the policy rate. Again, such strong language is extremely rare.

> "The Board will not increase the cash rate target until progress is being made towards full employment and it is confident that inflation will be sustainably within the 2–3 per cent target band."

On July 15, 2020 the Bank of Canada implemented forward guidance with commitment for a second time. The Governing Council used the following header for the press release announcing the monetary policy decision.

> "Bank of Canada will maintain current level of policy rate until inflation objective is achieved, continues program of quantitative easing."

In the press release, the Governing Council goes further by once again explicitly labelling its forward guidance as a commitment. Whereas the Governing Council's forward guidance with commitment from 2009 to 2010 had both state-contingent and time-contingent attributes, its second iteration of forward guidance with commitment does not provide an explicit time horizon for its forward guidance but it is once again state-contingent.

> "The Governing Council will hold the policy interest rate at the effective lower bound until economic slack is absorbed so that the 2 percent inflation target is sustainably achieved. In addition, to reinforce this commitment and keep interest rates low across the yield curve, the Bank is continuing its large-scale asset purchase program at a pace of at least $5 billion per week of Government of Canada bonds."

None of these examples of forward guidance with commitment comes from the Federal Reserve or the European Central Bank although the literature often assumes otherwise. Up to this point at least, they have not. The examples frequently considered to be Odyssean or commitment-based forward guidance, such as the Federal Reserve's (2012-2014) or The Bank of England's (2013-2014) state-contingent forward guidance that included thresholds use only conditional language and no language that could be considered a commitment. In those cases, as well as many others, those central banks publicly clarified that their forward guidance did not a represent commitment. Because they are such famous examples, they have also come to typify state-contingent forward guidance. In fact, they represent the exception rather than the rule. On December 12, 2012 the Federal Open Markets Committee included the following statement in its press release announcing the monetary policy decision:

> "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. The Committee views these thresholds as consistent with its earlier date-based guidance."

The first sentence is considered qualitative forward guidance due to the open-ended nature of the phrase "considerable time." The second sentence is considered state-contingent forward guidance because of the phrase "at least as long as the unemployment rate remains above 6-1/2 percent." This particular instance of forward guidance has been referred to as threshold-based forward guidance in the literature as well. The third sentence references "earlier date-based guidance." This refers to a phrase that was used in the statements leading up to this FOMC meeting, "In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015." This reference illustrates that the Committee has shifted from time-contingent forward guidance to state-contingent forward guidance.[3]

Although it is tempting to consider this episode of forward guidance Odyssean or commitment-based because of the use of an explicit threshold, the statement is in fact rather Delphic. The phrase "currently anticipates that" indicates that this forward guidance is far more predictive than promissory. The later sentences also make it clear that the threshold of a 6-1/2 percent unemployment rate is one of many guidelines and that the committee intends to use numerous macroeconomic indicators to reach its future decisions.[4] Janet Yellen later reinforced these inferences two months later in a speech on February 11, 2013 in Washington:

> "It deserves emphasis that a 6-1/2 percent unemployment rate and inflation one to two years ahead that is 1/2 percentage point above the Committee's 2 percent objective are thresholds for possible action, not triggers that will necessarily prompt an immediate increase in the FOMC's target rate. In practical terms, it means that the Committee does not expect to raise the federal funds rate as long as unemployment remains above 6-1/2 percent and inflation one to two years ahead is projected to be less than 1/2 percentage point above its 2 percent objective. When one of these thresholds is crossed, action is possible but not assured."

Later, on August 7, 2013 the Bank of England took a similar step:

> "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."

The Monetary Policy Committee (MPC) goes on to outline a set of three so-called knockout conditions that would render the forward guidance obsolete along with some qualitative and balance sheet forward guidance.[5] Once again, we see state-contingent forward guidance by use of a threshold. And once again, this forward guidance is clearly more Delphic than Odyssean because of the use of the word "intends" as well as the addition of the knockout conditions. In his first speech as Governor of the Bank of England, Mark Carney made the following remarks about the threshold:

> "Furthermore, thinking unemployment will come down faster than we expect isn't enough to believe interest rates will rise soon. As I said earlier, the 7% threshold is a staging post to assess the economy. Nobody should assume that it is a trigger for raising rates."

[3] Indeed, this earlier date-based guidance was classified as time-contingent forward guidance.

[4] The forward guidance above is immediately followed by the following lines, "In determining how long to maintain a highly accommodative stance of monetary policy, the Committee will also consider other information, including additional measures of labor market conditions, indicators of inflation pressures and inflation expectations, and readings on financial developments. When the Committee decides to begin to remove policy accommodation, it will take a balanced approach consistent with its longer-run goals of maximum employment and inflation of 2 percent."

[5] The full text of the forward guidance can be found on page 7 of the MPC's August 2013 Inflation Report.

Charles Bean made it even more clear that this forward guidance was not a commitment at a speech at the Jackson Hole Symposium:

> "This guidance is intended primarily to clarify our reaction function and thus make policy more effective, rather than to inject additional stimulus by pre-committing to a time-inconsistent "lower for longer" policy path in the manner of Woodford (2012). While such a time-inconsistent policy may be desirable in theory, in an individualistic committee like ours, with a regular turnover of members, it is not possible to implement a mechanism that would credibly bind future members in the manner required."

Further, simply using commitment-based language does not necessarily constitute forward guidance with commitment either. On July 29, 2020 the FOMC included the following statement in its post-meeting press release:

> The Federal Reserve is committed to using its full range of tools to support the U.S. economy in this challenging time, thereby promoting its maximum employment and price stability goals.

Although the FOMC clearly used commitment-based language, the Committee did not commit to a particular future policy rate path. In the same statement, the Committee makes it clear that a constant future policy rate path is only an expectation rather than a commitment by using the word "expects":

> The Committee expects to maintain this target range until it is confident that the economy has weathered recent events and is on track to achieve its maximum employment and price stability goals.

1.4 Effective lower bound periods

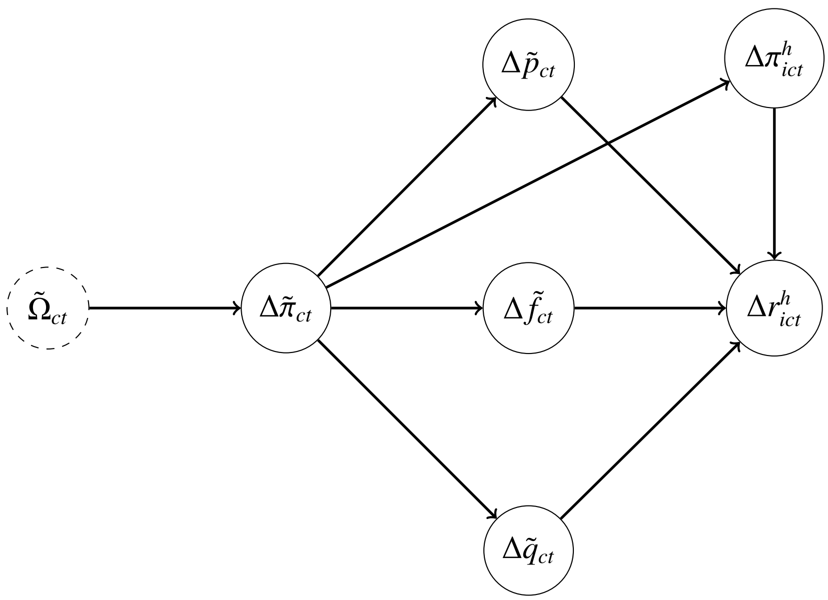
Effective lower bound periods are identified in a number of ways. First, if the central bank has made no statements about its views on the level of the effective lower bound, then the zero lower bound is considered to be the effective lower bound. If the central bank has made statements about its views 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, the 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 statement onwards.

2 Estimation (additional notes)

2.1 Framework

Figure 1 below depicts the *key* channels that influence private-sector short-term interest rate expectations in an inflation-targeting regime.

Figure 1: **How changes to forward guidance influence private-sector interest-rate forecast revisions**
$\tilde{\Omega}_{ct}$ denotes the central bank ($\sim$) information set in country c at time t. $\Delta\tilde{\pi}_{ct}$ denotes a change to central-bank projections of inflation (π). $\Delta\pi^h_{ict}$ denotes a change to a private-sector inflation forecast by forecaster i in country c made at time t. The forecast horizon, h, is twelve months. $\Delta\tilde{f}_{ct}$ represents a change to forward guidance. $\Delta\tilde{q}_{ct}$ denotes a change to quantitative easing. Δr^h_{ict} denotes a change to a private-sector interest-rate forecast, r (the three-month Treasury bill rate), at a forecast horizon of $h = 12$ months. The arrows imply a causal relationship. The absence of arrows implies the lack of a causal relationship. Nodes with unbroken lines represent observable data.



The figure begins with the information set of a central bank in country c in month t, $\tilde{\Omega}_{ct}$. The $\sim$ denotes a central bank policy variable. This includes the information available and relevant to an inflation-targeting central bank about to make a monetary policy decision. The most important components are the central bank's internal macroeconomic projections, but it also includes all other relevant factors, such as geopolitics, judgment, and uncertainty (for simplicity, in this figure, central bank growth and employment projections are embedded in $\tilde{\Omega}_{ct}$). $\tilde{\Omega}_{ct}$ represents the set of inputs that allows the central bank to update its inflation projections, $\tilde{\pi}_{ct}$. As an inflation-targeting central bank, $\Delta\tilde{\pi}_{ct}$ determines the change in the central bank's policy rate, $\Delta\tilde{p}_{ct}$, the change in the central bank's forward guidance, $\Delta\tilde{f}_{ct}$, and the change in the central bank's quantitative easing, $\Delta\tilde{q}_{ct}$. $\Delta\tilde{\pi}_{ct}$ also serves as an input to the forecast of inflation over the next 12 months by private-sector forecaster i in country c in month t, π^h_{ict}.

The key component of Figure 1 is that $\Delta\tilde{f}_{ct}$, which represents a change to a central bank's forward guidance in country c in month t, has a causal effect on Δr^h_{ict}, which represents a change to a private-sector interest rate forecast, r (the three-month Treasury bill rate), at a forecast horizon of $h = 12$ months. I use the three-month Treasury bill rate as a proxy for policy rate expectations.[6] In other words, private-sector forecasters adjust their forecasts of future policy rates in direct response to central banks' updates to their forward guidance. Naturally, any change to the central bank policy rate, $\Delta\tilde{p}_{ct}$ also affects forecasts of the short-term interest rate, Δr^h_{ict}.

It is also possible that the initiation of, a change to, or the cessation of a central bank's quantitative easing program, $\Delta\tilde{q}_{ct}$, affects Δr^h_{ict} as well. Again, we will consider the change to the signal, that is, a *change* to a central bank's quantitative easing program. Similarly, $\Delta\tilde{q}_{ct} \in \{-1, 0, 1\}$ where -1 represents a dovish signal, 0 represents no signal, and 1 represents a hawkish signal. Coenen et al. (2017) emphasize the importance of considering the roles of quantitative easing and forward guidance together. Eggertsson and Woodford (2004) suggest that central bank asset purchases will only be successful insofar as they support the signal value of forward guidance. The assumptions above about the main causes of interest rate forecast revisions are well aligned with the literature on the effects of unconventional monetary policy. "These dimensions represent the three aspects of FOMC announcements that had the greatest systematic effect on asset prices over the sample; intuitively, these three dimensions are likely to correspond to changes in the federal funds rate, changes in forward guidance, and changes in LSAPs" (Swanson (2017)).[7]

A change to a private-sector forecast of inflation over the next twelve months, $\Delta\pi^h_{ict}$, also has a causal influence on Δr^h_{ict}. So, private-sector forecasters ultimately adjust their forecasts of future policy rates in direct response to their *own* revisions to their own inflation forecasts. Because this paper utilizes matching individual private-sector macroeconomic forecasts, it is possible to estimate this behaviour. In an inflation-targeting regime, information about the future path of inflation should provide important information about the future path of policy rates. Hence, to isolate the causal effect of $\Delta\tilde{f}_{ct}$ on Δr^h_{ict}, we must condition on, *inter alia*, $\Delta\pi^h_{ict}$. We can condition on $\Delta\pi^h_{ict}$, $\Delta\tilde{\pi}_{ct}$, or both because each could have an effect on Δr^h_{ict}. However, $\tilde{\pi}_{ct}$, the central bank's latest inflation forecast should be embedded in π^h_{ict} as depicted in Figure 1.

2.2 Forward guidance measurement error

In this paper, model parsimony is critical because the main variable of interest, forward guidance ($\Delta\tilde{f}_{ct}$), 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}. Let $\Delta\tilde{F}_{ct}$ represent the unobservable, *true state* of forward guidance in a given country at a given time and let ν_{ct} represent the measurement error, where $\Delta\tilde{F}_{ct} \in [-1, 1]$.

$$\Delta\tilde{f}_{ct} \equiv \Delta\tilde{F}_{ct} + \nu_{ct} \qquad [1]$$

As discussed in the paper, $\Delta\tilde{f}_{ct} \in \{-1, 0, 1\}$ and assume that $\mathbb{E}_t[\Delta\tilde{F}_{ct}] = 0$, $\mathbb{E}_t[\Delta\tilde{f}_{ct}] = 0$, and $\mathbb{E}_t[\nu_{ct}] = 0$. $\Delta\tilde{F}_{ct}$, the true state, should follow a fairly symmetric, continuous distribution between -1 and $+1$, whereas $\Delta\tilde{f}_{ct}$ follows a fairly symmetric, discrete, trinomial distribution $\{-1, 0, 1\}$. The rounding that necessarily occurs with $\Delta\tilde{f}_{ct}$ actually implies that $Cov(\Delta\tilde{f}_{ct}, \nu_{ct}) > 0$ and that $Cov(\Delta\tilde{F}_{ct}, \nu_{ct}) < 0$. ν_{ct} is assumed to be uncorrelated with all other regressors, $\mathbf{x}_{ict}$, $Cov(\mathbf{x}_{ict}, \nu_{ct}) = 0$, and the error term in the benchmark regressions, ϵ_{ict}, $Cov(x_{ict}, \epsilon_{ct}) = 0$. In this case, because $Cov(\Delta\tilde{f}_{ct}, \nu_{ct}) \neq 0$, the probability

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

[7] Large-scale asset purchases (LSAPs) is another term for quantitative easing in this context.

limit of $\beta_{\Delta\tilde{f}_{ct}}$ (from the benchmark regressions) can be characterized as follows (Wooldridge (2010)):

$$plim(\beta_{\Delta\tilde{f}_{ct}}) = \beta_{\Delta\tilde{f}_{ct}} \left(\frac{\sigma^2_{\omega_{ct}}}{\sigma^2_{\omega_{ct}} + \sigma^2_{\nu_{ct}}} \right) \quad [2]$$

where ω_{ct} is the error term from the following linear projection and where $\mathbf{x}_{ict}$ is the vector of other covariates from the benchmark regressions in the paper,

$$\Delta\tilde{f}_{ct} = x_{ict} + \omega_{ct} \quad [3]$$

The addition of relatively extraneous covariates will tend to introduce attenuation bias into the measurement of β because, to the extent that such additional regressors have positive correlation with $\Delta\tilde{f}_{ct}$ and weak or no positive partial correlation with the dependent variable, Δr^h_{ict}, those additional regressors will tend to capture some of the signal value of $\Delta\tilde{f}_{ct}$ and further attenuate the partial correlation between Δr^h_{ict} and $\Delta\tilde{f}_{ct}$, thereby biasing β towards zero. Conversely, the omission of useful regressors that have positive correlation with $\Delta\tilde{f}_{ct}$ and positive partial correlation with Δr^h_{ict} will tend to introduce positive omitted variables bias. β would be biased upwards as it would inappropriately capture some of the positive effect attributable to the omitted, useful regressor. So we are faced with the trade-off between attenuation bias and omitted variables bias. Hence, in this paper, I aim to strike a balance between parsimony and completeness and to exercise caution when deciding which regressors to condition on and which to omit.

2.3 Simultaneous Equations

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, 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, we would introduce simultaneity bias. The approach to managing this problem (below) is adapted from Altavilla and Giannone (2017) who use a similar line of reasoning (see pp 959-960). The authors 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)."

To illustrate the point, consider the following simple system of structural equations representing both interest rate forecast revisions, Δr^h_{ict}, and inflation forecast revisions, $\Delta\pi^h_{ict}$. Below, it is useful to bear in mind that monetary policy operates with a lag (assumed to be twelve months or more), that both forward guidance and quantitative easing are themselves forward-looking in nature, that t denotes month, and that the forecast horizon here is twelve months ($h = 12$). Let Δz_{ict} be a revision to forecaster i's (internal) estimate of the output gap, z, in country c at time t made by forecaster i.

$$\Delta r^h_{ict} = f(\Delta\pi^{h-12}_{ict}, ..., \Delta\pi^h_{ict}, ..., \Delta\pi^{h+j}_{ict}, ..., \Delta\pi^{h+T}_{ict}, \Delta\tilde{p}_{ct}, \Delta\tilde{f}_{ct}, \Delta\tilde{q}_{ct}) \qquad j, T \in \mathbb{N} \quad j < T \quad [4]$$

$$\Delta\pi^h_{ict} = f(\Delta z_{ic,t-T}, ..., \Delta z_{ic,t-j}, ..., \Delta z_{ic,t+h-1}, \Delta\tilde{p}_{ct}, \Delta\tilde{f}_{ct}, \Delta\tilde{q}_{ct}) \qquad j, T \in \mathbb{N} \quad j < T \quad [5]$$

where $z_{ic,t-j}$ represents an estimate of the output gap in a past month and $z_{ic,t-T}$ represents an estimate of the output gap in the most distant past month that could still influence $\Delta\pi^h_{ict}$. Of course, the output gap is itself affected by the stance of monetary policy. We can observe the following exclusion restrictions. An inflation-targeting regime, revisions to forecasts of the short-term interest rate at some point in the future, h, are a function of revisions to the forecasted path of inflation at and beyond that point. They are also a function of changes to the policy rate, forward guidance, and quantitative easing respectively. By contrast, revisions to forecasts of the inflation rate at some point in the future, h, are a function of revisions to estimates of the path of the output gap up to that point, and changes to the policy rate, forward guidance, and quantitative easing. Roughly, the policy rate is forward-looking while the inflation rate is more backward-looking. Hence, if we only include $\Delta\pi^h_{ict}$ with forecast horizons, h, that do not cross into the future periods in which Δr^h_{ict} can influence inflation ($t + h + 12$ because of the assumed twelve-month lag of the influence of monetary policy), then we avoid the endogeneity of inflation forecast revisions.

The identification assumptions elucidate the importance of the structure of Equation 4 and Equation 5. Were these equations to include expected interest rates, expected inflation rates, and the presence of forward guidance in *levels* form, then most or all of these assumptions would be implausible. However, the equations relate *revisions* of expectations of interest rates to *revisions* of expectations of inflation rates and *changes* in central banks' forward guidance, quantitative easing, and policy rates respectively.

2.4 Monetary policy factors

Equation 6 includes a group of variables that are somewhat analogous to the factors described in Gürkaynak et al. (2005) and Swanson (2017). The benchmark model is as follows:

$$\Delta r^h_{ict} = \beta\Delta\tilde{f}_{ct} + \gamma\Delta\tilde{q}_{ct} + \phi\Delta\tilde{p}_{ct} + \varphi\tilde{e}_{ct} + \delta_1\Delta\pi^h_{ict} + \delta_2\Delta g^h_{ict} + \delta_3\Delta u^h_{ict} + \alpha_i + \alpha_t + \epsilon_{ict} \qquad [6]$$

$\tilde{p}_{ct}$ is analogous to the target factor (Gürkaynak et al. (2005)). $\tilde{f}_{ct}$ is analogous to the path factor or the forward guidance factor (Gürkaynak et al. (2005) and Swanson (2017)). $\tilde{q}_{ct}$ is analogous to the quantitative easing (LSAP) factor (Swanson (2017)). The factors in Gürkaynak et al. (2005) and Swanson (2017) are, by construction, orthogonal to one another. The analogous vectors used in this study, while not orthogonal to one another, have very low correlation.

Table 2: **Correlation matrix of central bank policy variables**

	$\Delta\tilde{p}_{ct}$	$\Delta\tilde{f}_{ct}$	$\Delta\tilde{q}_{ct}$
$\Delta\tilde{p}_{ct}$	1	0.08	0.04
$\Delta\tilde{f}_{ct}$	0.08	1	0.15
$\Delta\tilde{q}_{ct}$	0.04	0.15	1

3 Figures

Below I present the main data from the regressions graphically. Figure 2 includes scatter plots by country that show private-sector policy rate forecast revisions on the y-axis and private-sector current-year inflation forecast revisions on the x-axis. These forecast revisions are colour-coded to illustrate whether they coincided with either no change in forward guidance in their respective country, a hawkish change in forward guidance, or a dovish change in forward guidance. This allows us to visually consider the effect the changes in forward guidance may have had on private-sector forecast revisions. Indeed, we can see that positive interest rate forecast revisions tend to coincide with hawkish forward guidance and that negative interest rate forecast revisions tend to coincide with dovish forward guidance.

Figure 2: **Private-sector policy rate and inflation forecast revisions colour-coded by forward guidance change value**

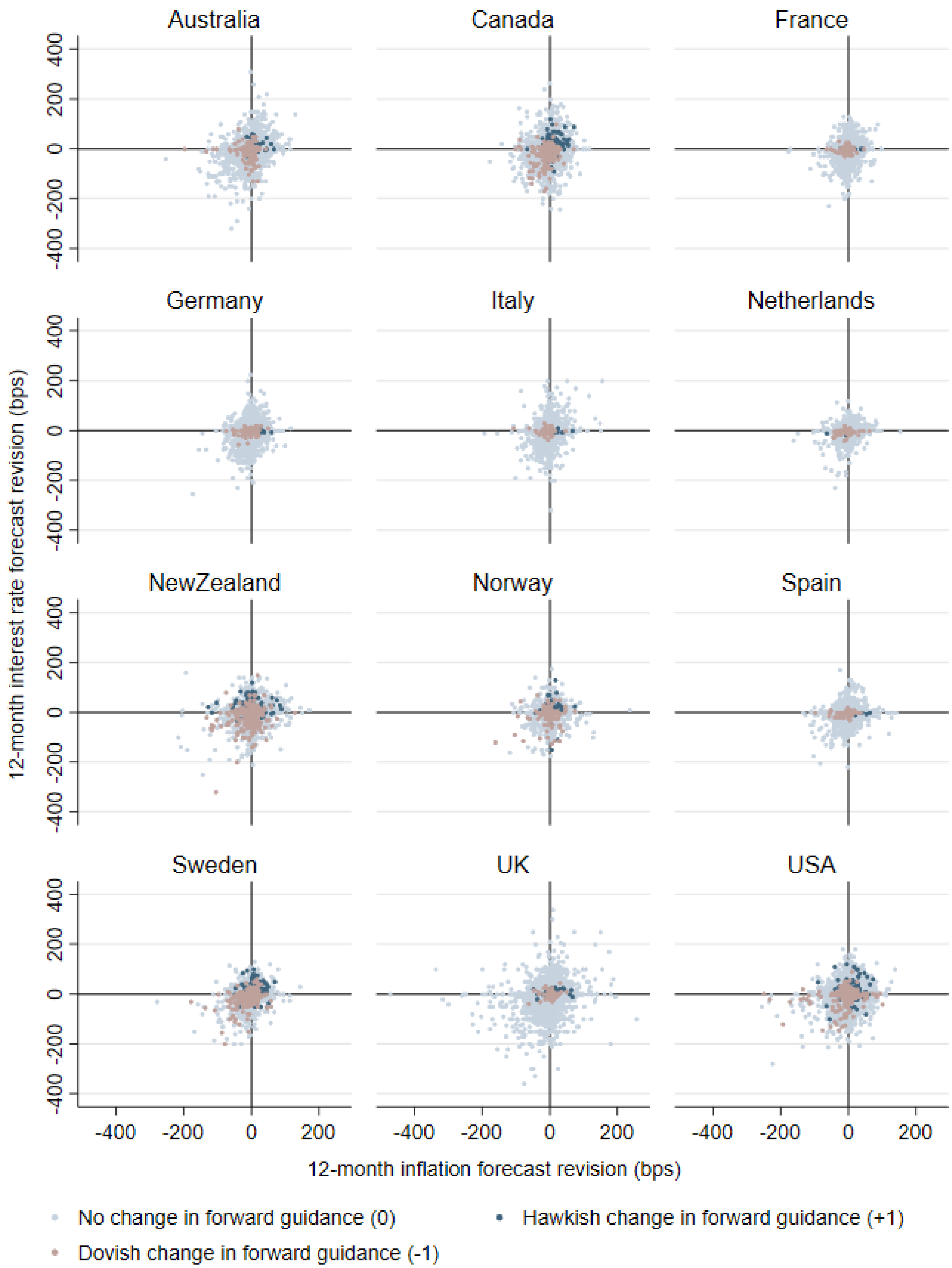


Figure 3: **Private-sector policy rate and inflation forecast revisions colour-coded by type of forward guidance change value**

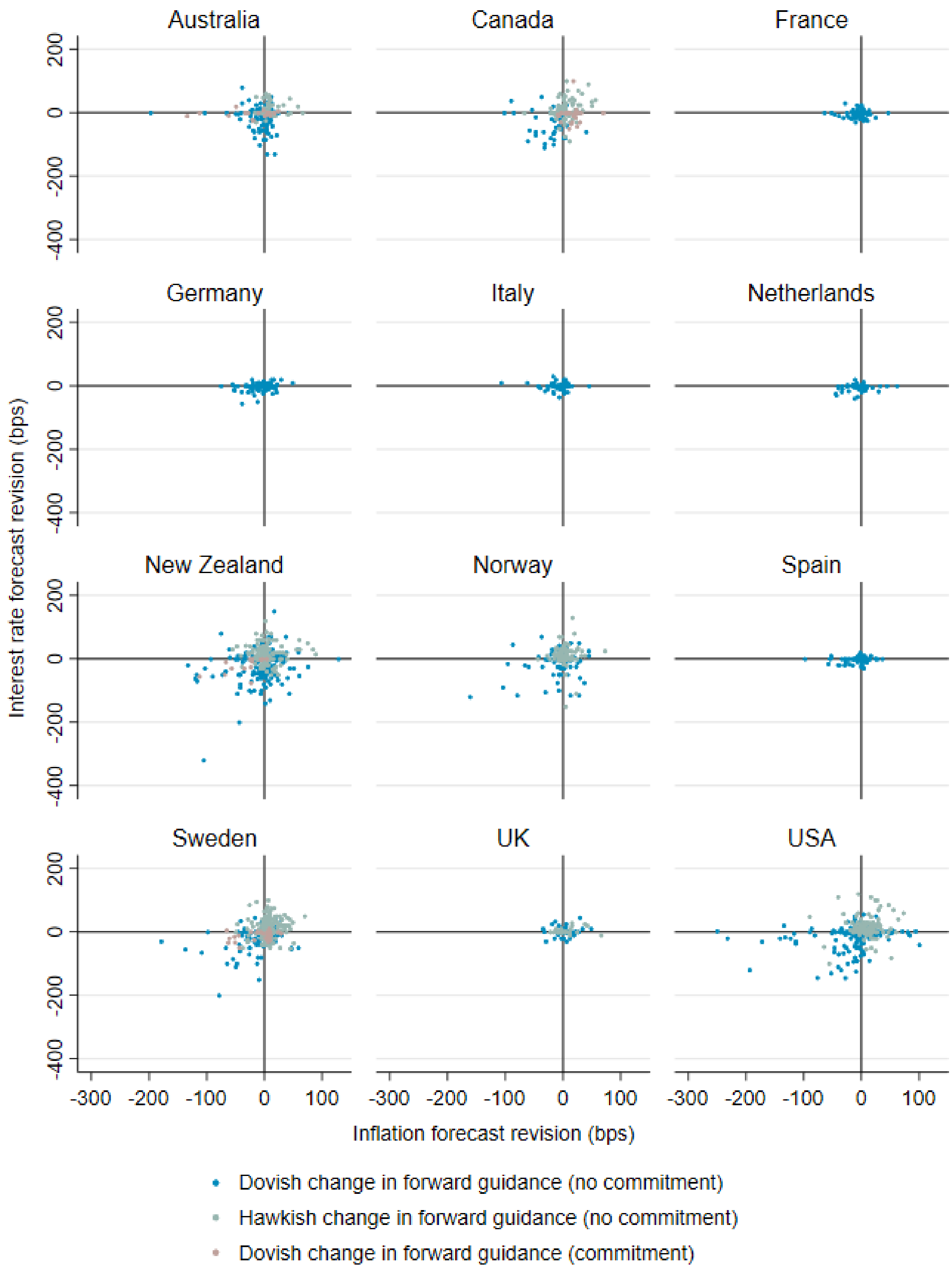


Figure 4: **Private-sector policy rate and inflation forecast revisions colour-coded by type of forward guidance change value**

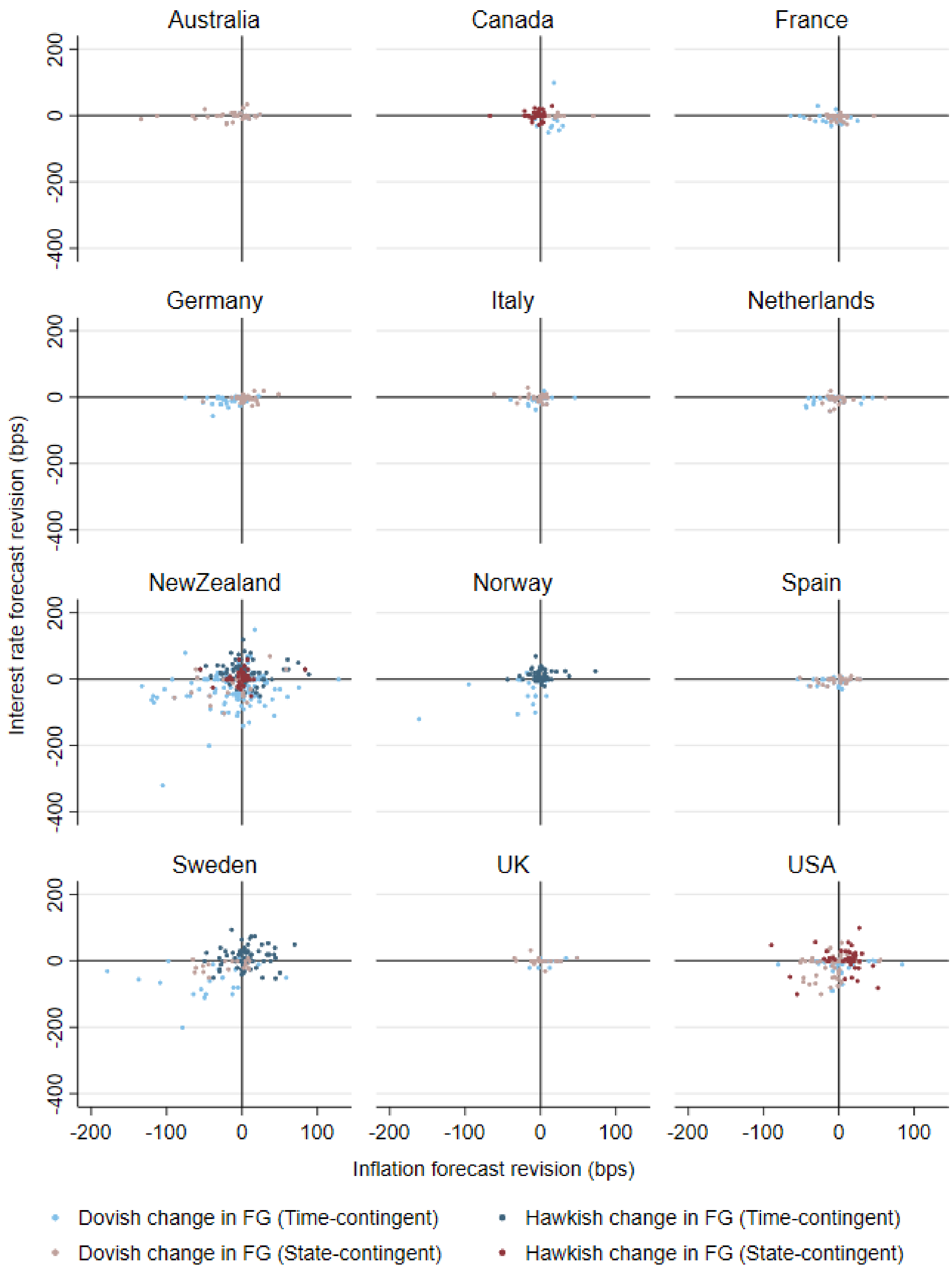


Figure 5: **Quantitative easing changes and forecasts of the policy rate**

Each figure in the panel charts changes to quantitative easing, central bank policy rates, and individual private-sector forecasts of the policy rate at the one-year horizon.

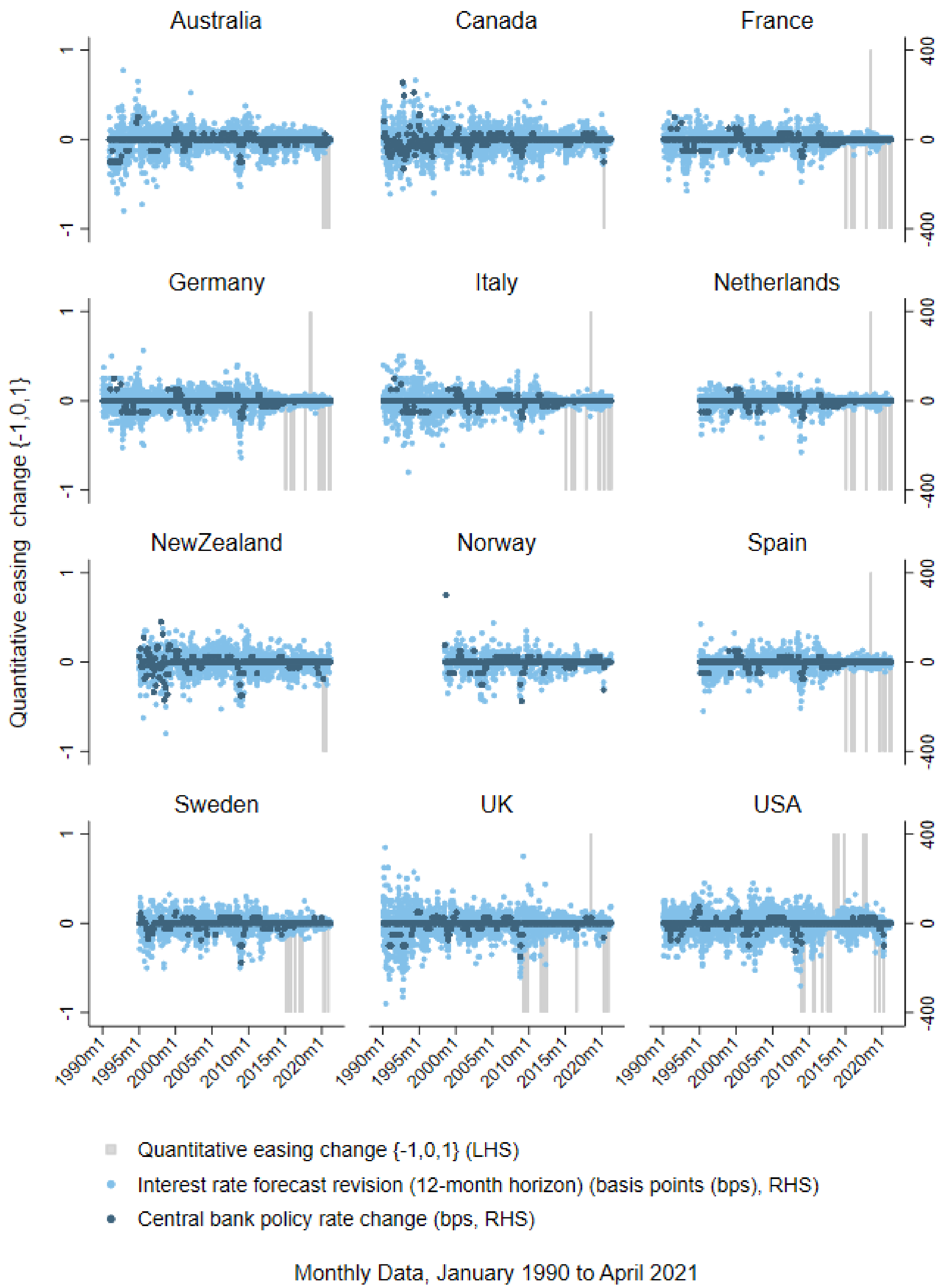
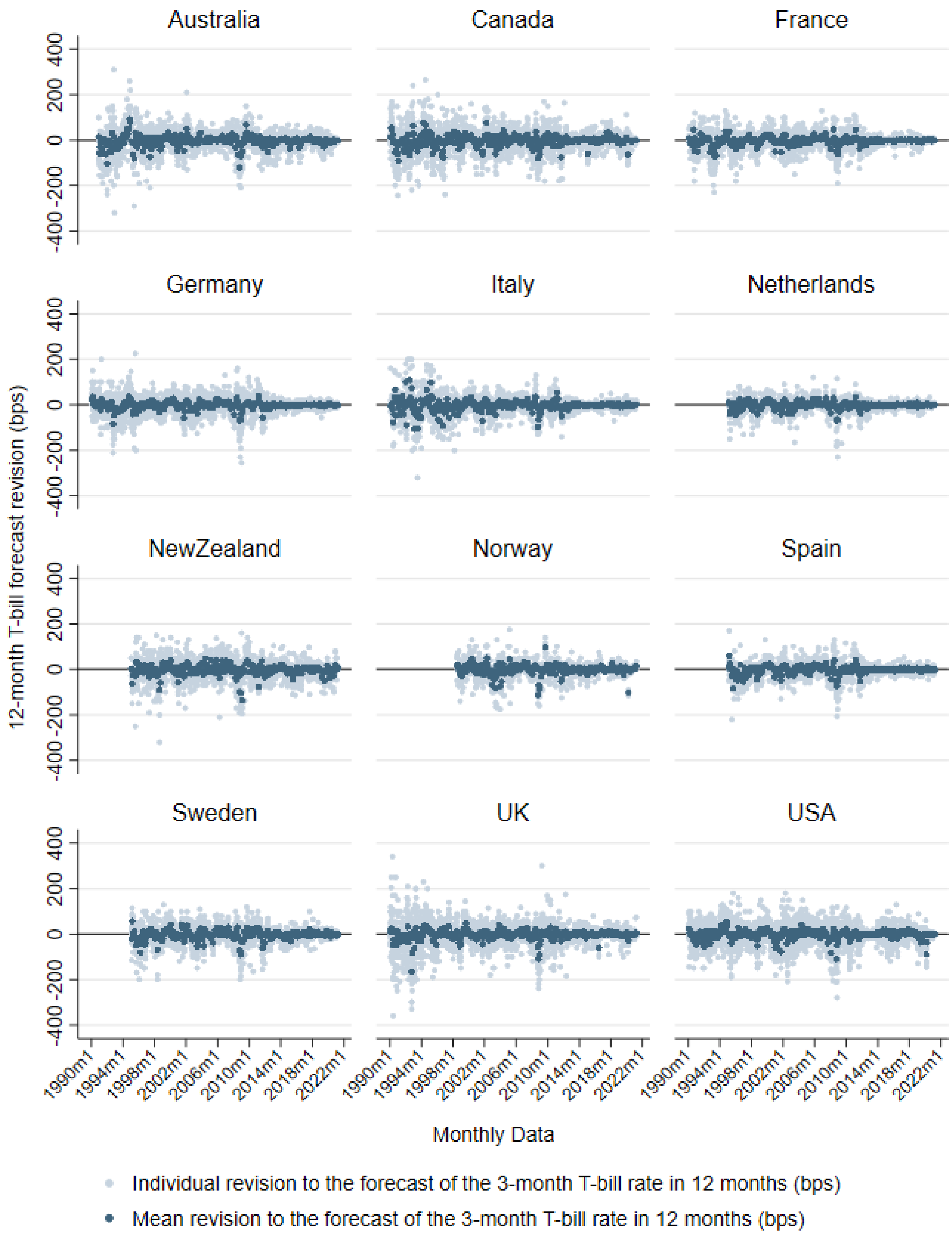


Figure 6: **Individual versus mean revision to the forecast of the 3-month T-bill rate in 12 months (bps)**



Each light-blue dot represents an individual forecaster's forecast revision.

Figure 7: **Individual private-sector versus central bank revisions to inflation forecasts at the 12-month forecast horizon (bps)**

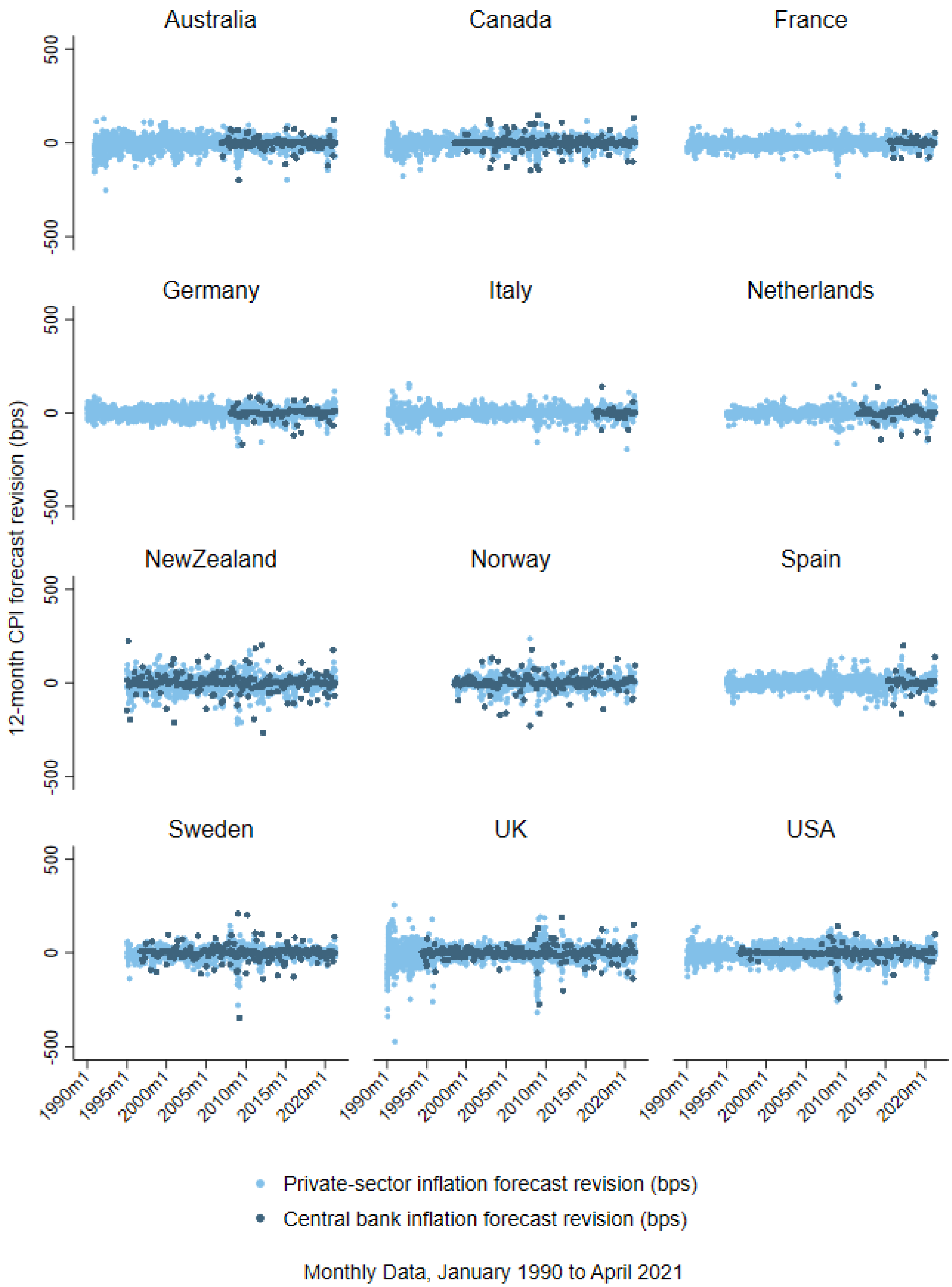


Figure 8: **Individual private-sector versus central bank revisions to domestic growth forecasts at the 12-month forecast horizon (bps)**

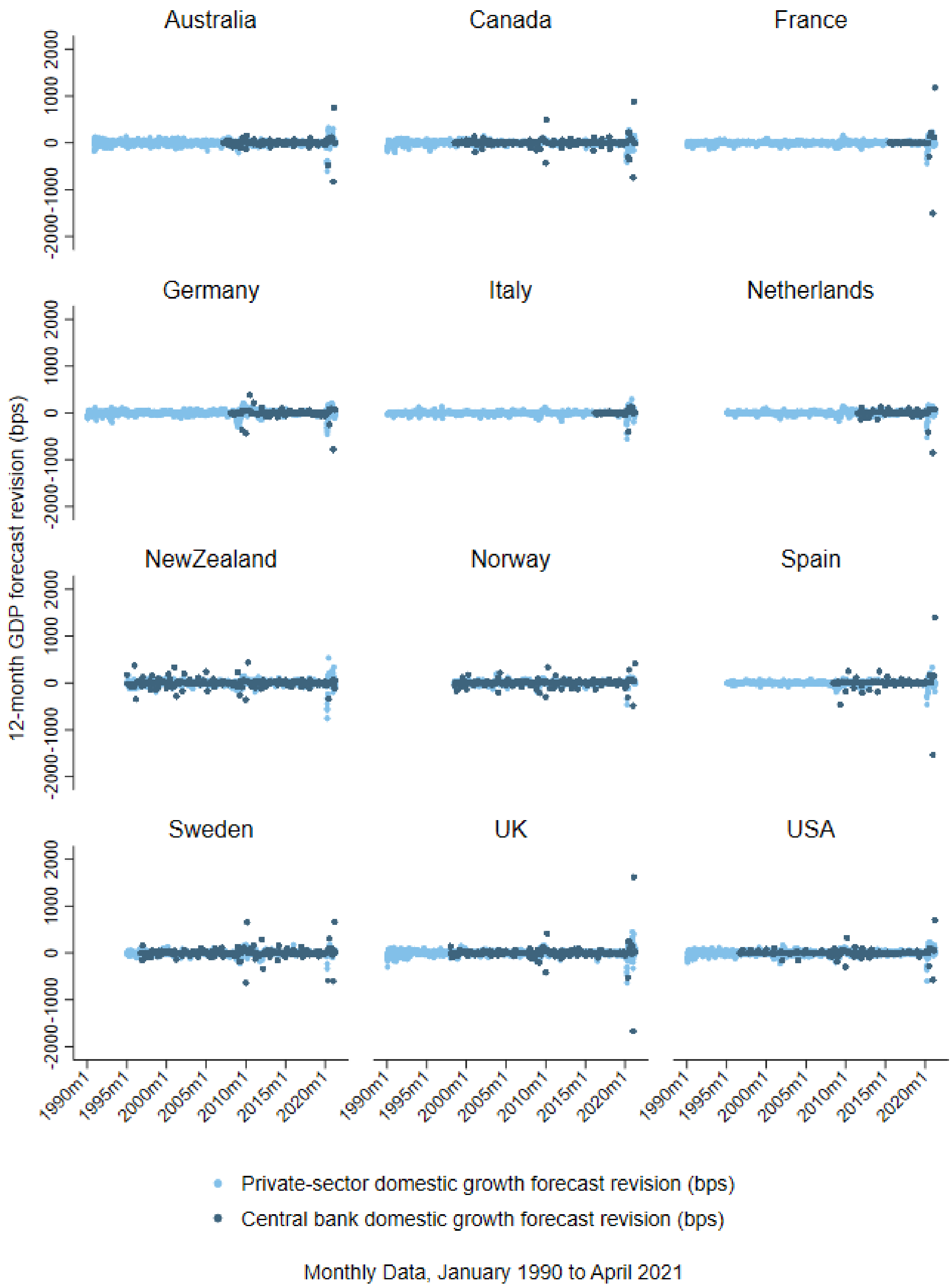


Figure 9: **Individual private-sector versus central bank revisions to interest rate forecasts at the 12-month forecast horizon (bps)**

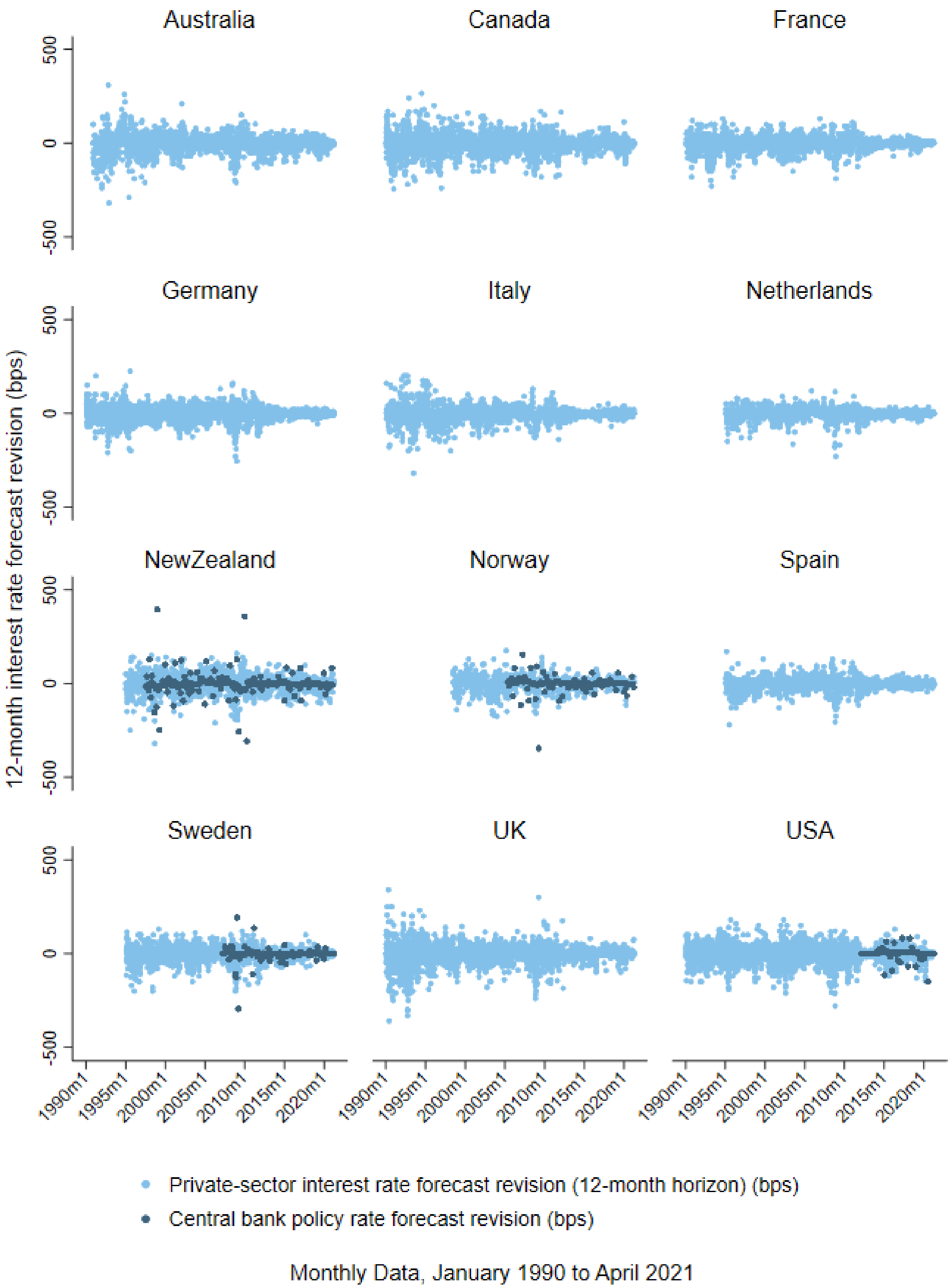
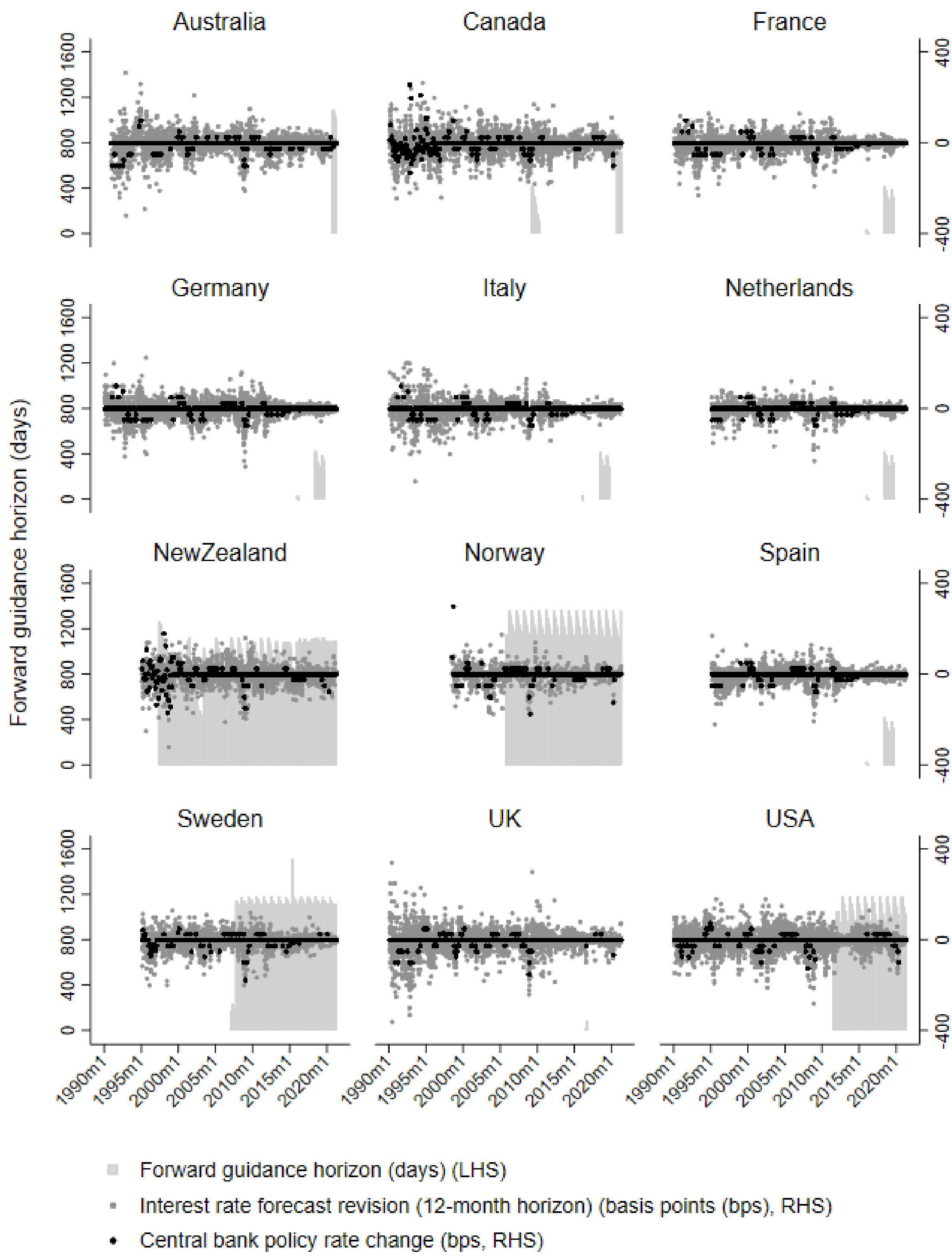
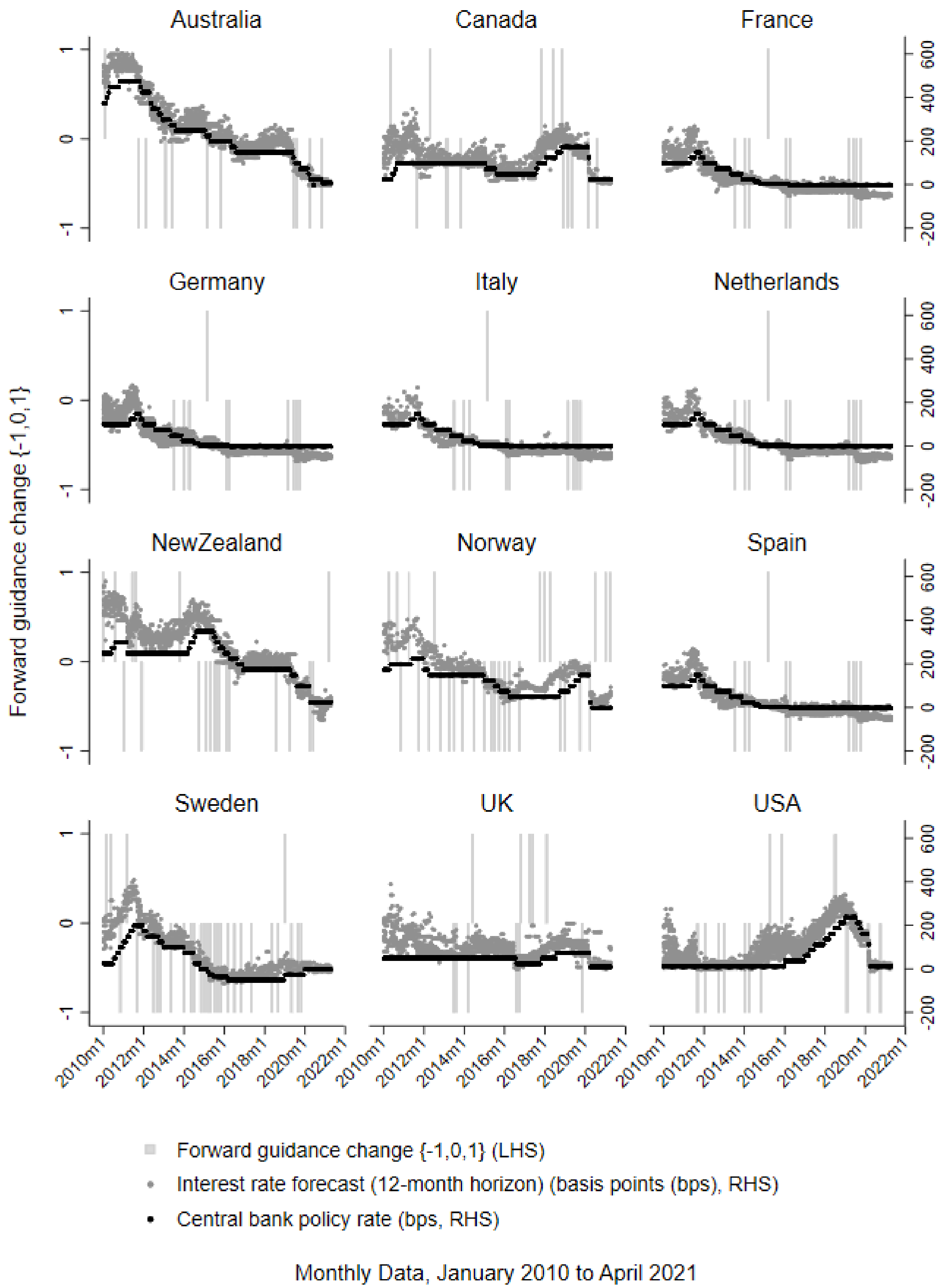


Figure 10: **Forward guidance horizon length (days))**



Monthly Data, January 1990 to April 2021

Figure 11: **Individual forecasts of the 3-month T-bill rate in 12 months versus the central bank policy rate (bps)**



4 Robustness

4.1 Robustness: survey dates

It is possible that, on rare occasions, a forecaster may have submitted the firm's forecasts just before a forward guidance announcement rather than after as in the vast majority of cases. For robustness, below I provide versions of the benchmark estimates where I drop all months with a forward guidance announcement that took place within either six, eleven, or sixteen days of the survey deadline or that occurred more than 15 days before the survey deadline.

Table 3: **Benchmark econometric model with variations in the allowed gap between FG announcement dates and Consensus Economics survey dates**

	[1]	[2]	[3]	[4]
(1) Forward guidance $\{-1, 0, 1\}$ change (+1)	5.61***	4.08**	3.31**	7.48***
	(1.09)	(1.44)	(1.35)	(1.14)
(2) Policy rate (PR) change (+25 bps)	6.91***	6.86***	6.87***	7.17***
	(0.78)	(0.76)	(0.75)	(0.67)
(3) Private inflation forecast revision (+25 bps)	3.38***	3.38***	3.38***	3.43***
	(0.40)	(0.42)	(0.42)	(0.41)
(4) Private GDP growth forecast revision (+25 bps)	3.11***	3.09***	3.07***	3.18***
	(0.22)	(0.22)	(0.21)	(0.25)
(5) Quantitative easing $\{-1, 0, 1\}$ change (+1)	-2.52**	-2.26**	-2.77***	-2.26**
	(0.83)	(0.85)	(0.87)	(0.85)
(6) Effective lower bound $\{0, 1\}$	0.54*	0.40	0.22	0.34
	(0.28)	(0.27)	(0.27)	(0.22)
Adjusted R^2	0.20	0.20	0.20	0.20
N	48328	48059	47626	47475

Dependent variable: revisions to individuals' forecasts of the 3-month T-bill rate in 12 months (bps).
[1] Benchmark after dropping observations with FG changes that occur within 6 days of a CE survey deadline.
[2] Benchmark after dropping observations with FG changes that occur within 11 days of a CE survey deadline.
[3] Benchmark after dropping observations with FG changes that occur within 16 days of a CE survey deadline.
[4] Benchmark after dropping observations with FG changes that occur more than 15 days before a CE survey.
Clustered standard errors (at the country level) are shown in parentheses.
This table shows summary statistics from panel regressions with both firm and month fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2 Robustness: individual versus consensus forecasts

In the table below, I provide evidence that the use of individual forecasts provides additional information beyond just using consensus (mean) forecasts. This idea is discussed in detail and demonstrated in Baker et al. (2020) and Bordalo et al. (2020).

Table 4: **Benchmark results after averaging individual forecaster data across forecasters**

	[1]	[2]
Forward guidance $\{-1, 0, 1\}$ change (+1)	5.33***	5.24***
	(1.06)	(1.17)
Private inflation forecast revision (+25 bps)	3.37***	
	(0.40)	
Private GDP growth forecast revision (+25 bps)	3.13***	
	(0.23)	
Policy rate change (+25 bps)	6.93***	6.91***
	(0.77)	(0.79)
Quantitative easing $\{-1, 0, 1\}$ change (+1)	-2.49**	-2.66***
	(0.87)	(0.83)
Effective lower bound {0, 1}	0.72**	0.48*
	(0.24)	(0.26)
Mean private inflation forecast revision		4.73***
		(1.18)
Mean private GDP growth forecast revision		4.28***
		(0.54)
Adjusted R^2	0.20	0.59
N	48911	48911

Dependent variable [1]: revisions to individuals' forecasts of the 3-month T-bill rate in 12 months (bps).
Dependent variable [2]: the country-specific, month-specific **mean** of dependent variable [1].
In [2], the mean inflation and growth forecast revisions were also averaged by country, by month.
Clustered standard errors (country level) in parentheses. Includes both firm and month fixed effects.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3 Robustness: 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)).[8] 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 control for information effects directly by using the central bank projections publicly released alongside monetary policy announcements.[9]

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 far 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.

First, I gather data from Jain and Sutherland (2020) who 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. Second, the data were updated to 2021 and converted from quarterly to monthly data. Third, I omit all periods from the sample data in which a central bank used an endogenous policy rate to produce its projections and re-estimate the key central bank information effects results in the main paper. Several central banks in the sample had significant periods with either a constant policy rate assumption or a market-based policy rate assumption. The Reserve Bank of Australia (full sample), Reserve Bank of New Zealand, Norges Bank, Sveriges Riksbank, Bank of England (full sample), Federal Open Market Committee, and the European Central Bank (full sample) all had significant periods (or even their entire projections history) in which they used either a constant or a market-based policy rate assumption to generate their projections instead of an endogenous policy rate assumption. The results below show that the influence of central bank projections are still not (and no more) significantly different from zero.[10]

[8] Here, too, there is a range of terminology. Nakamura and Steinsson (2018) uses the term *information effects*, Cieslak and Schrimpf (2019) uses the term *non-monetary news*, and Jarociński and Karadi (2020) uses the term *central bank information shocks*. Campbell et al. (2012) and Andrade and Ferroni (2020) consider news on future macroeconomic conditions to be *Delphic shocks* and news on future monetary policy shocks to be *Odyssean shocks*.

[9] The slight difference in the forward guidance effect is attributable to sample composition. The central bank projections data are not available for all 32 years. Hence, the sample size is about 54% that of the sample size in Table 1 in the main paper. Like Hoesch et al. (2020), missing central bank projections are treated as missing data. Also, because the controls include private-sector forecasters' inflation and domestic growth revisions, this adjusts for relevant macroeconomic news and private signals.

[10] Also note that the interaction effects between forward guidance changes and central bank macroeconomic projections are also not significant.

Table 5: **Central Bank (CB) Information Effects (excluding projections that use an endogenous policy rate)**

	[1]	[2]
CB inflation revision (+25 bps)	0.18	-0.55
	(0.46)	(0.48)
CB GDP growth revision (+25 bps)	0.10	-0.01
	(0.06)	(0.04)
Indiv. inflation revision (+25 bps)		2.62***
		(0.47)
Indiv. GDP growth revision (+25 bps)		2.43***
		(0.45)
FG $\{-1, 0, 1\}$ change		4.48***
		(0.90)
Adjusted R^2	0.00	0.23
N	14719	14719

Dependent variables [1]-[2]: revisions to individuals' forecasts, 3-month T-bill rate in 12 months (bps). Regressions [1]-[2] include all controls from Equation 6. Standard errors clustered at the country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.4 Robustness: unanticipated forward guidance and interest rate disagreement

So far, we have not been able to disentangle the effects of anticipated forward guidance and unanticipated forward guidance. It is possible that the average forward guidance effect estimated above is understated because forward guidance announcements are systematically anticipated to some extent. If so, then it is important to determine the extent to which this effect could be understated. Accordingly, this section provides estimates of how a narrative forward guidance shock influences forecasters' rate expectations. First, financial news articles that covered the central bank decisions and the corresponding forward guidance were gathered from Factiva, a financial news database. The goal was to understand the extent to which each forward guidance change was anticipated. The main news sources were *The Financial Times*, Reuters, *The Wall Street Journal*, Dow Jones, and, occasionally, various domestic financial news providers. I analyzed over 600 articles corresponding to 238 changes in forward guidance from the eight central banks studied in this paper. There is at least one article for each forward guidance shift. The news articles very frequently drew on commentary from a sample of private-sector economists, forecasters, and analysts, making this approach especially appropriate given the survey data used in this paper.[11]

I categorized each change in forward guidance as either very unexpected, somewhat unexpected, or fully expected. The mutually exclusive categorizations take the form of binary indicator variables. The review of media articles strongly supports the hypothesis above that forward guidance, particularly a shift in forward guidance, is difficult to forecast. 43 forward guidance changes were categorized as very unexpected; 191 were categorized as somewhat unexpected, and only four were categorized as fully expected. Naturally, these latter two categorizations are subject to some selection bias because it is easier to

[11] The hyperlinks to all articles are included in the data set.

find archival news articles about very surprising events than it is to find articles about very unsurprising events. However, this is not problematic because we are interested in the average forward guidance effect of very unexpected changes.

Starting with the benchmark model (Equation 6), I interact a change in forward guidance ($\Delta\tilde{f}_{ct}$) with the binary indicator variable for very unexpected forward guidance changes. The hypothesis is that unexpected forward guidance changes lead forecasters to revise their interest rate forecasts in the intended direction by a larger amount compared to the baseline (fully expected or somewhat unexpected) average forward guidance effect. This would imply that the true average forward guidance effect could be larger than five basis points. When forward guidance announcements have been very unexpected, however, forecasters would not have had the opportunity to anticipate its effects on future interest rates and hence we would be able to observe the true—presumably larger—average forward guidance effect in those cases. The categorization of either very unexpected, somewhat unexpected, or fully expected was based on the reactions of journalists, analysts, and forecasters to forward guidance announcements as described in news articles.

One potential issue is that an unobserved variable, such as uncertainty, could be correlated with the use of unexpected forward guidance, confounding the analysis. Hence, I also consider a measurable variable related to uncertainty, forecaster disagreement, and its role in the formation of expectations in response to forward guidance. I start with the benchmark model (Equation 6) and then interact a change in forward guidance ($\Delta\tilde{f}_{ct}$) with the *first lag* of the standard deviation of the dependent variable, which is standardized.[12]

The results suggest that both unanticipated forward guidance and ex ante forecaster disagreement are important factors for interest rate expectations. First, Table 6 (columns [1]-[2], row (1)x(2)) indeed suggests that the influence of unexpected forward guidance is almost twice as large as average. Second, Table 6 (column [2], row (1)x(3)) shows that the higher the ex ante forecaster disagreement, the greater the influence of forward guidance. Hence, forecasters probably anticipate forward guidance to some extent, but the effect is not so large as to invalidate the estimated average forward guidance effect presented in this paper (five basis points). Further, ex ante forecaster disagreement is an important channel through which the magnitude of forecasters' responses to forward guidance is influenced. Because forecasters are more likely to be influenced by forward guidance the more they disagree, forward guidance may be particularly useful in such times. Column [3] shows that information effects are not even present in uncertain times, which also serves as an important robustness check for the results in subsection 5.2.[13]

Another potential issue is that these verbal reactions in news articles are based on market movements —perhaps even government yield curve movements immediately following the forward guidance announcement. If the forecasts in the sample data are partially based on these same market movements, then the interpretation of the estimates provided in this section would actually be that forecasters revise their interest rate forecasts to a greater extent when a forward guidance announcement led to large moves in government yields. However, this would tend to bias the results such that very unexpected forward guidance would appear to have an even larger effect than is truly the case. In turn, this would suggest that the average forward guidance effect estimates in the main paper are too low. As such, this is a

[12]The standard deviation of individual forecasts of the three-month Treasury bill in twelve months' time is calculated across a group of forecasts within a given country within a given month. The variable is then standardized to make the interpretation of the results easier. Before standardization, ex ante forecaster disagreement has a mean of 37 basis points and a standard deviation of 20 basis points.

[13]The estimated coefficient in row (3) x (7) in Table 6 is statistically significant but not economically significant.

Table 6: **Unanticipated forward guidance, interest rate forecast disagreement, and central bank information effects**

	[1]	[2]	[3]
(1) Forward guidance (FG) $\{-1, 0, 1\}$ change	4.50***	5.01***	6.61***
	(0.84)	(0.73)	(0.64)
(2) Very unexpected FG change $\{0, 1\}$	0.45	-0.20	
	(1.89)	(1.38)	
(3) Lagged interest rate disagreement ($\sigma\_t - 1$)		-2.57***	-0.91
		(0.28)	(0.70)
(4) Private inflation forecast revision (+25 bps)	3.37***	3.36***	2.01***
	(0.40)	(0.42)	(0.36)
(5) Private GDP growth forecast revision (+25 bps)	3.13***	3.13***	3.50***
	(0.23)	(0.22)	(0.36)
(6) Central bank inflation revision (+25 bps)			0.03
			(0.17)
(7) Central bank GDP growth revision (+25 bps)			-0.13
			(0.09)
(1) x (2)	4.37***	3.63***	
	(1.39)	(0.90)	
(1) x (3)		2.35***	3.31***
		(0.56)	(0.54)
(2) x (3)		-1.53	
		(2.13)	
(1) x (2) x (3)		1.17	
		(2.17)	
(3) x (4)			0.33*
			(0.18)
(3) x (5)			1.82***
			(0.31)
(3) x (6)			-0.18
			(0.28)
(3) x (7)			-0.13*
			(0.06)
Adjusted R^2	0.20	0.20	0.23
N	48911	48911	26359

Dependent variables [1]-[3]: revisions to individuals' forecasts, 3-month T-bill rate in 12 months (bps). Regressions include all controls from Equation 6. Standard errors clustered at the country level.

conservative approach to estimating the extent to which forward guidance anticipation is a problem for the benchmark estimates. In practice, this risk is low because, in the news articles, it is typically clear whether analysts and forecasters are discussing their surprise relative to their ex ante predictions or rather discussing the surprise of markets more generally.

Why might forward guidance not be as easy to anticipate as central bank policy rate decisions? In other words, why isn't the gap between the average forward guidance effect and the very unexpected forward guidance effect not larger? First, a private forecaster cannot anticipate the precise wording that a central bank committee will agree on, nor can he or she be privy to the ongoing private conversations of a central bank's monetary policy committee (e.g. the Governing Council, Monetary Policy Committee, or FOMC). And the precise wording of forward guidance is central to its interpretation. Far more importantly, how much of the anticipated signal, $\Delta\tilde{f}_{ct}$, is embedded in $r^h_{ic,t-1}$, the interest rate forecast that took place one month earlier? If $r^h_{ic,t-1}$ (last month's interest rate forecast) does not incorporate any anticipated forward guidance for $\tilde{f}_{ct}$ (the state of forward guidance this month), then the (*ceteris paribus*) relationship between Δr^h_{ict} and $\Delta\tilde{f}_{ct}$ should reflect an unconfounded measure of individual forecasters' average revision in response to a forward guidance change. Why *would* $r^h_{ic,t-1}$ reflect some aspect of anticipated forward guidance for period t?

One possibility is that the month leading up to the forecast made at period $t-1$ did not include a central bank policy rate decision and corresponding press release; the month leading up to the forecast made at period t *does* include a decision and press release; and, forecaster i anticipates that the central bank will change its forward guidance at that time. As such, forecaster i then modifies $r^h_{ic,t-1}$ to incorporate this future forward guidance change. Recall that $r^h_{ic,t-1}$ reflects a policy rate forecast at either a three-month ($h = 3$) or a twelve-month ($h = 12$) horizon. So, in either case ($h = 3, h = 12$), the $t-1$ forecast pertains to a date that follows the aforementioned policy rate decision in month t by at least a month. Hence, in this scenario, Δr^h_{ict} would not respond to $\Delta\tilde{f}_{ct}$ in a manner that would fully reflect forecaster i's expectation of the influence of forward guidance on future interest rates. To incorporate anticipated forward guidance changes in the manner described above, however, would reflect a high degree of certainty about precisely how the central bank intends to draft its policy communication.

Further, the nature of $\tilde{f}_{ct}$ makes it far more difficult to forecast than the level of the policy rate at some time in the near future. $\tilde{f}_{ct}$ incorporates a panoply of factors: an agglomeration of private views (those of the monetary policy committee), some of which may reflect known preferences (Hansen et al. (2014), Hansen et al. (2018), Bordo and Istrefi (2018)), precise choice of language (Jain and Sutherland (2020)), both intended and perceived tone (Hubert and Labondance (2020)), historical communication to that point (Woodford (2013)), sentiment, and narrative (Shiller (2017)). Obviously, this is a complex variable to forecast. Admittedly, Governing Council or Monetary Policy Committee speeches—especially by the governor or chair—may provide some minor insight into upcoming forward guidance (Ehrmann and Fratzscher (2007), Hansen and McMahon (2016)). Ultimately, however, no one can forecast future forward guidance—not even the governor or chair—because forward guidance is drafted collectively by a group of people within a committee in the days immediately before the policy rate decision. To assume that monetary policy committees not only systematically signal their policy rate decision but also signal upcoming forward guidance would be to presuppose that decisions on and communications of monetary policy are agreed in advance of monetary policy committee meetings (Svensson (2010)).

4.5 Robustness: generalized method of moments

In this section, I consider the possibility that forward guidance is not strictly exogenous. To obtain valid estimates under this assumption, I use the Arellano-Bond (Arellano and Bond (1991)) and Arellano-Bover/Blundell–Bond (Arellano and Bover 1995; Blundell and Bond 1998) (dynamic) panel estimators. These estimators make a number of assumptions (Roodman (2006)). First, they assume small T, large N panel data sets. In this paper, we have a large T, large N data set. Second, they assume a linear functional relationship. In this paper, I do the same. Third, they assume that the model includes a lagged dependent variable. In column [1], I use a static model to maintain comparability with the benchmark econometric model and estimates in the main paper (Sutherland (2020)). In column [2], I use a dynamic model. The results are not sensitive to the inclusion of a lagged dependent variable.

Table 7: **GMM estimation of the benchmark equation**

	[1]	[2]	[3]
Forward guidance $\{-1, 0, 1\}$ change (+1)	3.92***	4.17***	4.97***
	(0.93)	(0.75)	(1.10)
Private inflation forecast revision (+25 bps)	2.94***	2.88***	3.00***
	(0.44)	(0.45)	(0.45)
Private domestic output forecast revision (+25 bps)	2.80***	2.62***	2.51***
	(0.23)	(0.25)	(0.34)
Quantitative easing $\{-1, 0, 1\}$ change (+1)	-3.98***	-4.04***	-3.76**
	(1.07)	(1.03)	(1.29)
Policy rate (PR) change (+25 bps)	3.56***	3.22***	3.52***
	(0.70)	(0.61)	(1.10)
Effective lower bound (ELB)	3.72	1.85	16.18***
	(2.90)	(3.10)	(5.17)
Lagged dependent variable		-0.14***	
		(0.01)	
N	48911	44312	48911

Dependent variable: revision to individuals' forecasts of the policy rate level twelve months from now.
Clustered standard errors (at the country level) are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Fourth, they assume that the independent variables are not strictly exogenous. Thus far, we have assumed something close to strict exogeneity, but we relax that assumption in this section in line with the last two assumptions above. Fifth, they assume time-invariant individual heterogeneity. Sixth, they assume that this individual heterogeneity is orthogonal to the matrix of instruments. Seventh, they assume within-unit heteroskedasticity and autocorrelation.

The baseline specification ([1]) comes from Equation 6. To use this estimator, I take a stance on the exogeneity of each regressor in order to construct an instrument matrix, which is constructed using vectors of lagged regressors. Here, forward guidance and quantitative easing are no longer treated as strictly exogenous. Of course, where used, the lagged dependent variable is considered to be endogenous. All other regressors are treated as strictly exogenous, which is more consistent with the approach taken thus far. All models are estimated using one-step system generalized method of moments (GMM). I use standard errors that are robust to heteroskedasticity and arbitrary patterns of autocorrelation within individuals and cluster on country as all countries are used in this panel.

To avoid overfitting endogenous variables, I collapse the instruments. I use five lags of the instruments that are treated as not strictly exogenous. The instrument matrix uses first differences and the results are robust to the use of orthogonal deviations as well (Arellano and Bover (1995)). The instrument count for the estimates in columns [1] and [2] are 378 and 382 respectively. This high instrument count risks over-fitting variables that are not strictly exogenous by failing to expunge their endogenous components. The instrument count is driven mostly by the inclusion of monthly time dummy variables. In column [3], I report the results when time dummy variables are not used, in which case the instrument count is 15. The table below shows the estimates. The conclusion is that, when forward guidance is no longer treated as strictly exogenous, the estimates are very similar to those obtained using a standard fixed effects estimator.

4.6 Robustness: omitted variable bias analysis

One significant shortcoming of the econometric approach taken in this paper is that we are unable to account for forecasters' revisions to their inflation and domestic growth forecasts at horizons beyond about 12 months. Of course, this is an intentional modelling decision intended to avoid simultaneity bias, but also reflects a restriction of data availability because the only inflation and growth forecast available are for the current year and the next year. Indeed, this is also one of the downsides of using survey data as we can only use the forecasts and the corresponding forecast horizons made available by the data provider. Hence, it would be useful, to the extent possible, to consider how significant such omitted variable bias might be for the estimates provided in this paper. Of course, we are severely limited in our ability to do so, but one useful exercise is to consider the effects of: (i) including as much inflation and domestic growth information as possible, that is, the longest forecast horizons available; (ii) omitting even the available inflation and growth forecast data that we do have. We are interested in the extent to which doing so biases the estimate of the effect of a change in forward guidance.

Column [1] of Table 8 uses Equation 6 uses all available information. Subsequent columns use less and less information. Column [1] includes both the current-year and next-year inflation and growth forecasts instead of the interpolated 12-month-ahead inflation and growth forecasts used in the paper and repeated again in column [2] for reference. To reiterate, the latter approach is used in the paper in order to provide macroeconomic forecasts with a consistent forecast horizon month to month and also to avoid introducing some simultaneity bias. The former approach results in macroeconomic forecasts with horizons that vary depending on the calendar month. Nonetheless, using both the current-year and next-year forecasts is useful for our purposes here because, in the case of the earlier calendar months at least, we are including inflation and growth forecasts that extend as far as two years into the future.

The estimated effect of a change in forward guidance using the benchmark econometric approach (that shown in the main paper and column [2]) is 5.33 basis points. When we include all of the available inflation and growth forecast information, the estimate drops very slightly to 5.23 basis points (column [1]). Starting again with the benchmark econometric approach but then omitting the domestic growth forecasts at the 12-month horizon, the estimate of a change in forward guidance drops vary slightly to 5.29 basis points (column [3]). Starting again with the benchmark econometric approach but then omitting the inflation forecasts at the 12-month forecast horizon, the estimate of a change in forward guidance increases very slightly to 5.64 basis points (column [4]). Omitting both forecasts results in an estimate of 5.61 basis points (column [5]).

For these forecast horizons at least, it seems that the more domestic growth and especially inflation forecast information that is included, the lower the forward guidance coefficient estimate, although these differences are considerably smaller than even one standard error. Were this trend to continue out the growth and inflation forecast term structure, we might conclude that the benchmark forward guidance estimate is biased upward slightly. Of course, however, we cannot make such a simplistic assumption and these estimates are intended to provide some insight into the magnitude of the potential bias. For the horizons considered here at least, the bias appears to be quite small.

Table 8: **Benchmark Model with Different Macroeconomic Controls**

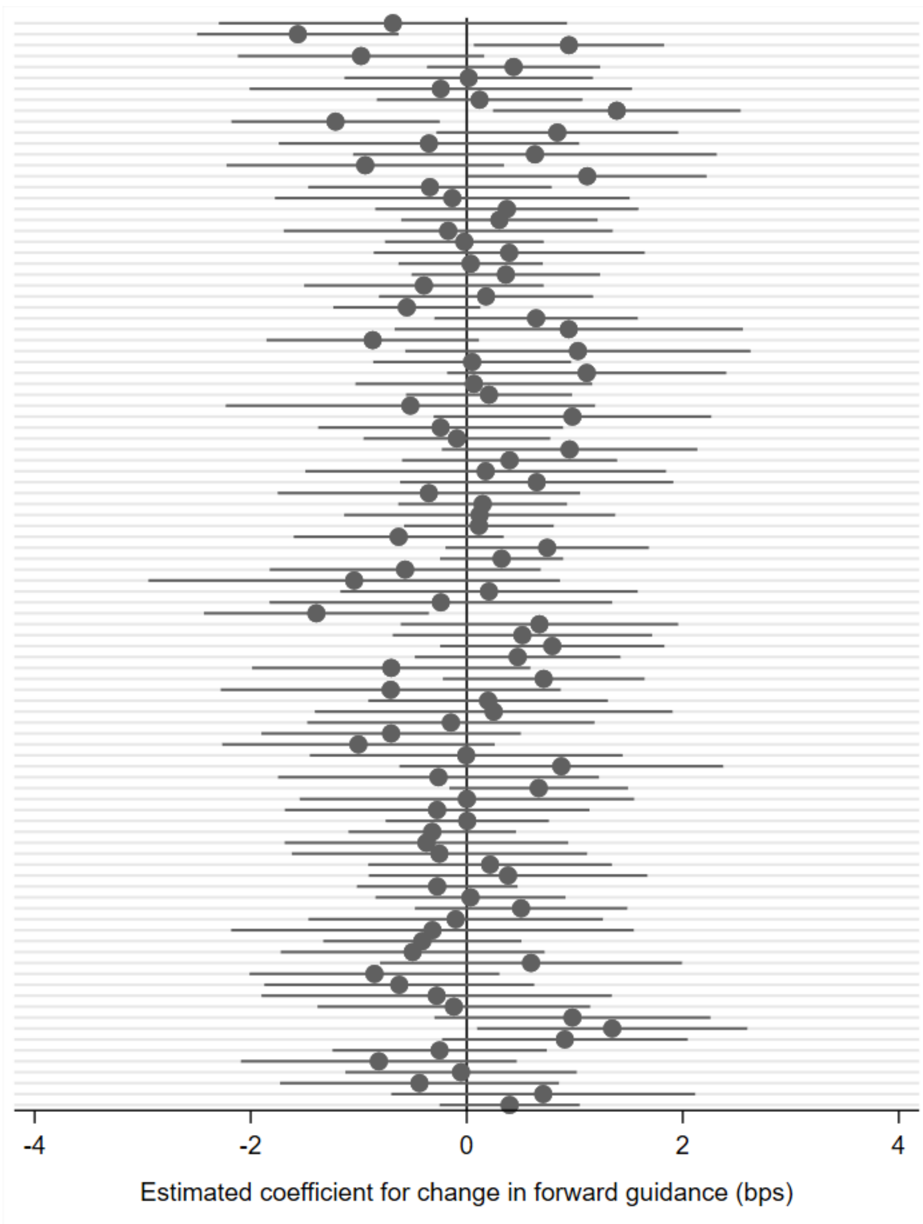
	[1]	[2]	[3]	[4]	[5]
FG $\{-1, 0, 1\}$ change	5.23***	5.33***	5.29***	5.64***	5.61***
	(0.97)	(1.06)	(1.09)	(1.00)	(1.03)
Current-year π rev. (+25 bps)	1.50***				
	(0.32)				
Next-year π rev. (+25 bps)	0.73***				
	(0.08)				
Current-year GDP g rev. (+25 bps)	1.98***				
	(0.20)				
Next-year GDP g rev. (+25 bps)	0.50***				
	(0.05)				
12-month π rev. (+25 bps)		3.37***	3.55***		
		(0.40)	(0.40)		
12-month GDP g rev. (+25 bps)		3.13***		3.27***	
		(0.23)		(0.23)	
CB rate change (+25 bps)	6.85***	6.93***	6.91***	7.14***	7.13***
	(0.79)	(0.77)	(0.75)	(0.80)	(0.78)
QE $\{-1, 0, 1\}$ change (+1)	-2.46**	-2.49**	-2.11**	-2.36**	-1.96**
	(0.88)	(0.87)	(0.70)	(0.95)	(0.76)
Adjusted R^2	0.20	0.20	0.19	0.19	0.18
N	48911	48911	48911	48911	48911

Dependent variables [1]-[5]: revisions to individuals' forecasts of the 3-month T-bill rate in 12 months (bps). Regressions [1]-[5] include all other controls from Equation 6. Standard errors clustered at the country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.7 Robustness: placebo interventions

In this section, I follow the lead of Bertrand et al. (2004) who generate placebo interventions (state-level laws in their case) and replace $\Delta\tilde{f}_{ct}$ in Equation 6 with a placebo forward guidance intervention to test whether any bias exists that would give us a false positive for the forward guidance effect observed in our results. Each placebo is randomly drawn from $\{-1, 0, 1\}$. The random draws are structured so that the proportions of each member of the set are the same in the placebo data as the actual forward guidance data. Approximately 95% of the data take the value 0, approximately 3% take the value -1, and approximately 2% take the value $+1$. The figure below shows 100 estimates of the average forward guidance effect and their corresponding 95% confidence intervals, which confirm the absence of bias.

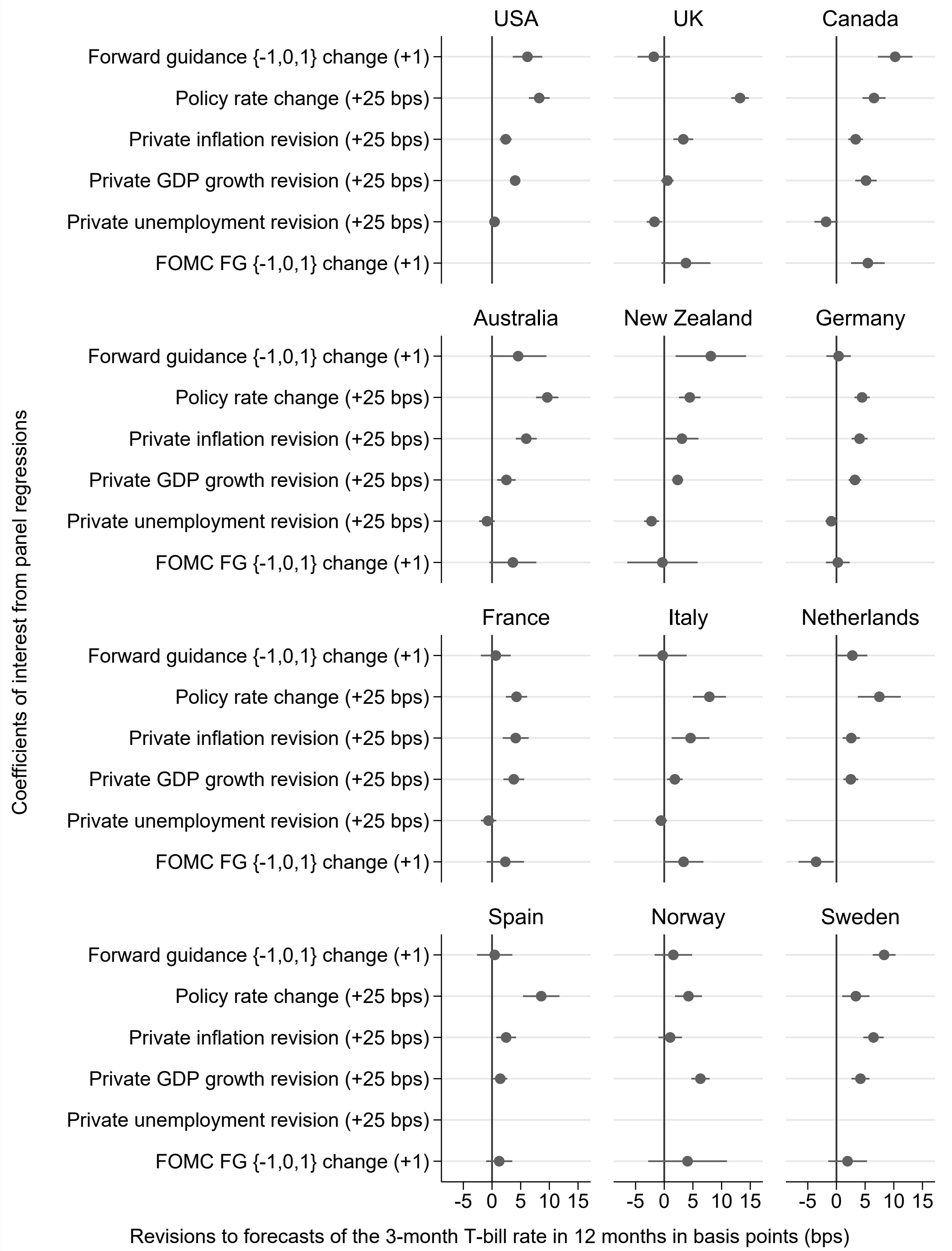
Figure 12: **Simulations using randomly generated placebo variables for a change in forward guidance**



5 Additional results

5.1 Country-specific estimates

Figure 13: **Central bank policy decisions' effect on one-year policy rate forecasts by country**



In this section, I estimate Equation 6 for each country and provide the results in Figure 13. I include private-sector forecasters' revisions to their unemployment outlooks, Δu_{ict}^{h}. These forecasts are not available, however, for the Netherlands, Norway, Spain, and Sweden. I also must adjust α_t to avoid collinearity issues with $\Delta \tilde{f}_{ct}$. Accordingly, I use yearly fixed effects instead of monthly fixed effects for the country-by-country regressions.

Overall, Figure 13 shows that forward guidance by the Bank of Canada, Federal Reserve, Reserve Bank of Australia, 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, Euro Zone, or Norway. What explains the discrepancy? One simple explanation is that both the Bank of England and the European Central Bank were comparatively late adopters of forward guidance (each launched its inaugural forward guidance statements on, by coincidence, the same day in 2013). Most 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)). As such, its communication may simply be more predictable on average. I now review the results country by country and discuss how each compares with the forward guidance literature for that country.

The results for New Zealand are consistent with the literature. Empirical studies of the Reserve Bank of New Zealand (RBNZ) have found that RBNZ monetary policy surprises (Drew et al. (2007)) and RBNZ interest rate forecasts (Moessner and Nelson (2008), Andersson and Hofmann (2009)) influence the short end of the yield curve. Ferrero and Secchi (2009) document reductions in short-term money market volatility following the introduction of forward guidance. Svensson (2015) shows that the policy rate path projections published by the Reserve Bank of New Zealand have been fairly well aligned with market-implied policy rate paths and that the RBNZ has often appeared to have been successful at influencing market rates. RBNZ forward guidance has also contributed to improved short-term interest rate forecast accuracy and reductions in corresponding forecast disagreement (Kool and Thornton (2015), Jain and Sutherland (2020)).

The results for Norway are less consistent with the literature. Using the methodology from Gürkaynak et al. (2005), Brubakk et al. (2017) show that the publication of the policy rate path in Norway influences market-implied policy rate expectations in the manner intended by the Norges Bank. By contrast, Figure 13 shows that this is not the case for private-sector forecasts. This discrepancy should not be attributable to the choice of sample period. Brubakk et al. (2017) restrict the sample data to 2001 onwards as this was when the Norges Bank began inflation targeting. When I take the same approach, the results are very similar. One possible source of the discrepancy is that Brubakk et al. (2017) investigate the influence of the *policy rate path publication*, whereas in this paper, I measure and estimate the effects of all forward guidance—both verbal and quantitative.

The estimates for the Sveriges Riksbank suggest that forward guidance in Sweden has been very influential on average. In this case, the results correspond well to those from Brubakk et al. (2017). The Riksbank is among the central banks that have used forward guidance the most. These results may have been stronger had it not been for some challenging instances of forward guidance during the sample period, such as the April 2009 decision and the period from 2011 onwards. Andersson et al. (2006) study the period before the Riksbank started using forward guidance in 2004. The authors use data from 1996 to 2003 to consider the relative contributions of repo rate changes, inflation reports, speeches, and minutes to changes in the term structure of interest rates. They find that repo rate changes were the dominant driver of short-term rates. They also find that inflation reports and speeches influence interest rates and conclude that communication is an important tool for the Riksbank.

Svensson (2010) argues that early evidence suggested that the publication of a repo rate path successfully influenced market expectations of the path of monetary policy, but that following the April 2009 policy rate decision, the repo rate path lost some credibility. Svensson (2015) explains that the repo rate paths published by the Riksbank in 2011 and beyond were much higher than that implicitly forecasted by the markets because the Executive Board was attempting to lean against the wind and later to normalize monetary policy. He takes this as a sign that Executive Board forward guidance lacked credibility for a significant period of time. Nonetheless, Brubakk et al. (2017) show that, from 2001 to 2016, forward guidance in Sweden influenced market-implied policy rate expectations in the manner intended by the Riksbank. Similarly, the estimates provided here show that Riksbank forward guidance moved private-sector policy rate forecasts in the intended direction on average.

The results in Figure 13 suggest that, on average, forward guidance has probably been the most influential in Canada. The particularly sizable result in Canada could be partially attributable to the success of the Bank of Canada's so-called conditional commitment. Woodford (2013) showed that, following the commitment made by the Bank of Canada in April 2009, which he appropriately describes as unprecedented, market yields along the interest-rate curve fell instantly. He notes that interest-rate contracts with maturities beyond the period mentioned in the conditional commitment (about one year) actually fell by more than those falling within the period covered by the conditional commitment. Woodford (2013) suggests that either rate expectations at longer maturities actually fell more than those at shorter maturities or that uncertainty related to the future path of monetary policy fell thereby lowering term premia. Chang and Feunou (2013) shows that both the implied and realized volatility of interest rate option prices declined following the Bank of Canada's commitment. This tends to favour the uncertainty interpretation, but of course, both aspects could be a factor. We can also see in Figure 13 that there are clear spillover effects from Federal Reserve (FOMC) forward guidance to Canadian interest rate expectations, but not to other countries' rate expectations. Jones et al. (2022) estimate that a large expansionary FOMC forward guidance shock decreases Canadian output by about 0.2% to 0.4%.

Turning to Europe, Brand et al. (2010) find that ECB monetary policy communication can lead to significant revisions of interest rate expectations over the term structure. Similar to Altavilla et al. (2019), they find that this effect is hump-shaped across the term structure. More closely related to this study, Hubert and Labondance (2018) estimate the effect of ECB forward guidance on the term structure of interest rates. They find that "The peak effect is on the longest maturities, forward guidance announcements decreasing OIS rates by around 4 and 5 basis points at the three- and five-year horizons." (p. 203). Similar to the methodology used in this paper and related to Hubert (2016), the authors take care to control for the information embedded in the Eurosystem macroeconomic projections released by the ECB around the same time that forward guidance is released. "Interestingly, the effect of forward guidance announcements is unchanged when controlling for ECB projections and SPF forecasts, suggesting that the effect at work may be mainly Odyssean." (Hubert and Labondance (2018), p. 208). Coenen et al. (2017) analyse forward guidance at the effective lower bound in Canada, the Czech Republic, Germany, Italy, Japan, Norway, Sweden, the UK, and the US and document a number of findings. The authors find that certain types of forward guidance attenuate the link between macroeconomic news and bond yields (similar to Swanson and Williams (2014a)) and reduce disagreement about short-term interest rates (as in Jain and Sutherland (2020)), particularly state-contingent and long-horizon, time-contingent forward guidance.

The results for the United Kingdom are similar to those of the Eurosystem countries. Although private-sector forecasts of the policy rate did not appear to shift down with dovish forward guidance and up with hawkish forward guidance in either the United Kingdom or the Eurosystem countries, this is perhaps to be expected under the circumstances. The Bank of England and European Central Bank have only utilized forward guidance in recent years during periods when the policy rate was at or near the effective lower bound. As such, it may be unrealistic to think that forward guidance could materially shift 12-month policy rate forecasts. Kaminska and Mumtaz (2022) make similar arguments (pp. 10-11, pp. 17-18) in a study of Bank of England monetary policy. Nonetheless, they show that their signalling factor (likely forward guidance) was very important, especially around 2016 to 2019 (pp. 22-23). Crucially, Kaminska and Mumtaz (2022) also incorporates two-year gilt yields (in addition to one-year yields), which, judging by the results of similar high-frequency event studies of Europe and the US (Altavilla et al. (2019), Swanson (2021) respectively), is perhaps a more useful gauge of forward guidance efficacy during effective lower bound periods.

The results for the Bank of England and the European Central Bank reported in Figure 13 should not be taken as evidence of ineffective forward guidance, but should instead be interpreted through the lens of the effective lower bound. The prima facie evidence from Figure 1 (main paper) for the United Kingdom and Eurosystem countries suggests that forward guidance had the intended effects and that we would not really expect those effects to show up in this particular empirical test. Here, the results from Swanson and Williams (2014b) may be more appropriate, who found that United Kingdom government bond yields were substantially constrained by the effective lower bound in 2009 and 2012, but were actually quite responsive to news in 2010 to 2011. The paper also found that German government bond yields were unconstrained by the effective lower bound until 2012. It would be very informative to repeat this analysis for the United Kingdom and the Eurosystem countries covered in this study for the period from 2013 to 2018 when the Bank of England and European Central Bank have been at or near the effective lower bound and have used forward guidance of numerous types on several occasions.

Figure 13 suggests that FOMC forward guidance moved private-sector forecasters' expectations for the level of the policy rate in twelve months' time in the intended direction by about five basis points on average. FOMC forward guidance began in 2003 and was used frequently thereafter. The FOMC has heavily favoured time-contingent forward guidance, but of course, used state-contingent forward guidance from December 2012 to March 2014. Woodford (2013) observes that the introduction of a specific date into FOMC forward guidance has been found to be particularly influential. This is well aligned with the empirical literature on Federal Reserve forward guidance—both with papers that use high-frequency market interest rate data (e.g. Gürkaynak et al. (2005), Swanson (2021)) and those that use private-sector forecast or expectations (e.g. Campbell et al. (2012)). Svensson (2015) also shows that the policy rate path projections published by the FOMC have been generally well aligned with market-implied policy rate paths, but discusses a discrepancy that began in 2014. From 2014 onwards, markets consistently expected future policy rates to be lower than those forecasted by the FOMC. This gap persisted for a number of years but the two paths gradually converged over time.

5.2 Central bank information effects

The benchmark results with the central bank projections included (explained in the main paper) are displayed in column [2] of Table 9. The other columns repeat the analysis but using both type of interest-rate forecasts at both forecast horizons (see table notes for details). Columns [1], [3], and [4] use forecasts of the three-month treasury bill rate at the *three-month horizon* and the ten-year government bond yield at both horizons respectively as the dependent variables. Column [2] uses the forecast of the three-month treasury bill rate at the *twelve-month horizon* as the dependent variable (as in the benchmark results in the main paper).

$$\Delta r^h_{ict} = \beta \Delta \tilde{f}_{ct} + \gamma \Delta \tilde{q}_{ct} + \phi \Delta \tilde{p}_{ct} + \varphi \tilde{e}_{ct} + \psi_1 \Delta \tilde{\pi}^h_{ct} + \psi_2 \Delta \tilde{g}^h_{ct} + \delta_1 \Delta \pi^h_{ict} + \delta_2 \Delta g^h_{ict} + \alpha_i + \alpha_t + \epsilon_{ict} \quad [7]$$

Table 9: **Interest Rate Expectations and Central Bank Information Effects**

	[1]	[2]	[3]	[4]
(1) Forward guidance (FG) $\{-1, 0, 1\}$ change	4.15***	5.55***	3.24***	2.72***
	(1.28)	(0.86)	(0.80)	(0.85)
(2) Individual inflation revision (+25 bps)	1.32***	2.17***	1.24***	1.29***
	(0.29)	(0.36)	(0.33)	(0.27)
(3) Individual GDP growth revision (+25 bps)	1.47***	3.15***	1.25***	1.70***
	(0.21)	(0.40)	(0.25)	(0.34)
(4) Central bank inflation revision (+25 bps)	-0.08	0.03	0.27*	0.15
	(0.23)	(0.19)	(0.14)	(0.12)
(5) Central bank GDP growth revision (+25 bps)	-0.05	-0.03	0.04	-0.01
	(0.04)	(0.07)	(0.07)	(0.08)
Adjusted R^2	0.38	0.22	0.30	0.20
N	26332	26359	25325	25252

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).
Standard errors clustered at the country level. Regressions include all controls from Equation 6.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: **3M T-Bill Rate Expectations and Central Bank (CB) Information Effects (3M)**

	[1]	[2]	[3]	[4]	[5]	[6]
CB π revision (+25 bps)	0.76**	-0.08	0.04	-0.05	0.15	0.15
	(0.30)	(0.23)	(0.52)	(0.27)	(0.13)	(0.16)
CB GDP g rev. (+25 bps)	0.11	-0.05	0.67*	-0.34	-0.03	-0.04
	(0.07)	(0.04)	(0.31)	(0.20)	(0.03)	(0.06)
Indiv. π rev. (+25 bps)		1.32***	2.78***	0.88	0.81***	1.26***
		(0.29)	(0.36)	(0.52)	(0.19)	(0.32)
Indiv. GDP g rev. (+25 bps)		1.47***	3.42***	1.65***	0.57***	1.29***
		(0.21)	(0.74)	(0.35)	(0.12)	(0.21)
FG $\{-1, 0, 1\}$ change		4.15***	4.29*	4.22*	2.92***	
		(1.28)	(2.05)	(1.92)	(0.86)	
adj. R^2	0.00	0.38	0.36	0.42	0.23	0.18
N	26332	26332	7692	9483	9157	18892

Standard errors in parentheses
Dependent variables [1]-[6]: revisions to individuals' forecasts, 3-month T-bill rate in 3 months (bps).
Columns [1]-[2]: full sample; column [3]: 1990-2006; column [4]: 2007-2014; column [5]: 2015-2021.
Column [6]: subsample, periods with no policy rate change, no FG change, and no QE change.
Regressions [2]-[6] include all controls from Equation 6. Standard errors clustered at the country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: **3M T-Bill rate expectations and central bank (CB) information effects (12M)**

	[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; column [3]: 1990-2006; column [4]: 2007-2014; column [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 6. Standard errors clustered at the country level.

Table 12: **Ten-Year Bond Yield Expectations and Central Bank (CB) Information Effects (3M)**

	[1]	[2]	[3]	[4]	[5]	[6]
CB π revision (+25 bps)	0.37**	0.27*	0.21	0.20	0.35	0.22
	(0.14)	(0.14)	(0.47)	(0.28)	(0.25)	(0.18)
CB GDP g rev. (+25 bps)	0.11*	0.04	0.05	0.35**	-0.05	0.06
	(0.05)	(0.07)	(0.40)	(0.11)	(0.06)	(0.07)
Indiv. π rev. (+25 bps)		1.24***	1.89***	1.05*	0.92**	1.62***
		(0.33)	(0.35)	(0.56)	(0.30)	(0.32)
Indiv. GDP g rev. (+25 bps)		1.25***	2.62***	1.33**	0.62*	1.13***
		(0.25)	(0.58)	(0.42)	(0.28)	(0.32)
FG $\{-1, 0, 1\}$ change		3.24***	1.05	3.40**	4.08**	
		(0.80)	(1.28)	(1.06)	(1.38)	
Adjusted R^2	0.00	0.30	0.31	0.32	0.25	0.27
N	25325	25325	7382	9241	8702	18131

Dependent variables [1]-[6]: revisions to individuals' forecasts, 10-year bond yield in 3 months (bps).
Columns [1]-[2]: full sample; column [3]: 1990-2006; column [4]: 2007-2014; column [5]: 2015-2020.
Column [6]: subsample, periods with no policy rate change, no FG change, and no QE change.
Regressions [2]-[6] include all controls from Equation 6. Standard errors clustered at the country level.

Table 13: **Ten-Year Bond Yield Expectations and Central Bank (CB) Information Effects (12M)**

	[1]	[2]	[3]	[4]	[5]	[6]
CB π revision (+25 bps)	0.35**	0.15	0.46	-0.15	0.30	0.25
	(0.15)	(0.12)	(0.42)	(0.19)	(0.31)	(0.20)
CB GDP g rev. (+25 bps)	0.03	-0.01	-0.11	0.23	-0.06	-0.01
	(0.06)	(0.08)	(0.20)	(0.17)	(0.08)	(0.09)
Indiv. π rev. (+25 bps)		1.29***	1.99**	1.16**	0.77**	1.48***
		(0.27)	(0.54)	(0.35)	(0.32)	(0.32)
Indiv. GDP g rev. (+25 bps)		1.70***	2.75***	2.26***	0.84**	1.58***
		(0.34)	(0.55)	(0.59)	(0.28)	(0.44)
FG $\{-1, 0, 1\}$ change		2.72***	1.03	2.98*	3.28**	
		(0.85)	(1.05)	(1.38)	(1.20)	
Adjusted R^2	0.00	0.20	0.19	0.22	0.20	0.18
N	25252	25252	7369	9218	8665	18078

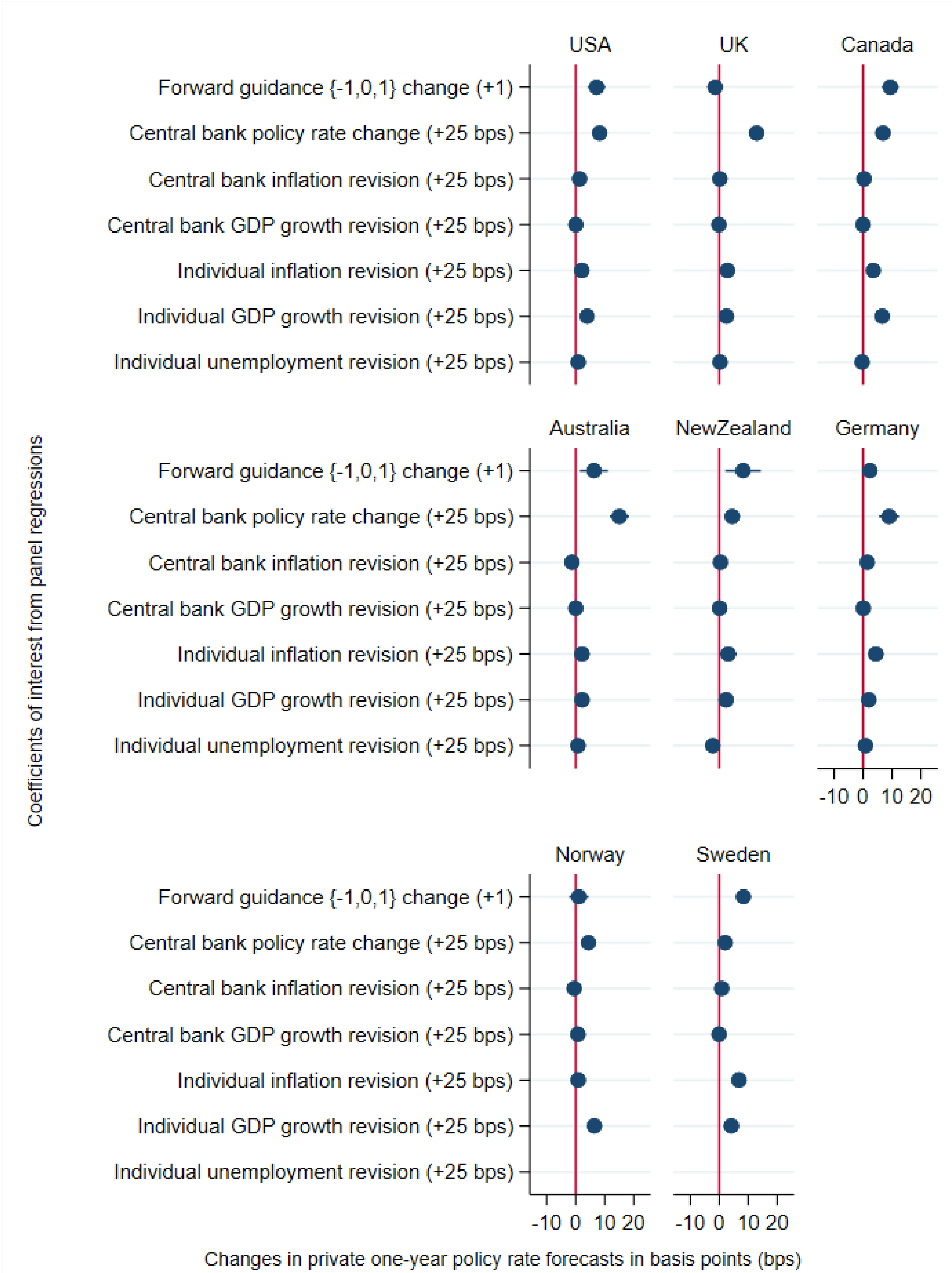
Dependent variables [1]-[6]: revisions to individuals' forecasts, 10-year bond yield in 12 months (bps).
Columns [1]-[2]: full sample; column [3]: 1990-2006; column [4]: 2007-2014; column [5]: 2015-2020.
Column [6]: subsample, periods with no policy rate change, no FG change, and no QE change.
Regressions [2]-[6] include all controls from Equation 6. Standard errors clustered at the country level.

Table 14: **Interest Rate Expectations at and away from the Effective Lower Bound**

	[1]	[2]	[3]	[4]	[5]	[6]
CB π revision (+25 bps)	0.03	0.12	0.23*	0.15	0.24	0.09
	(0.19)	(0.24)	(0.13)	(0.12)	(0.21)	(0.29)
CB GDP g rev. (+25 bps)	-0.03	0.16	-0.04	-0.01	0.26	-0.04
	(0.07)	(0.17)	(0.04)	(0.08)	(0.20)	(0.08)
Indiv. π rev. (+25 bps)	2.17***	2.82***	1.07***	1.29***	1.50***	0.77
	(0.36)	(0.42)	(0.19)	(0.27)	(0.22)	(0.66)
Indiv. GDP g rev. (+25 bps)	3.15***	5.46***	0.61***	1.70***	2.52***	0.73**
	(0.40)	(0.78)	(0.13)	(0.34)	(0.55)	(0.27)
FG $\{-1, 0, 1\}$ change	5.55***	7.26***	0.11	2.72***	1.99*	3.92***
	(0.86)	(1.25)	(0.81)	(0.85)	(1.00)	(1.01)
CB rate change (+25 bps)	6.65***	6.04***	10.89***	1.56**	1.26**	4.39**
	(0.80)	(0.66)	(1.66)	(0.61)	(0.49)	(1.98)
QE $\{-1, 0, 1\}$ change (+1)	-2.22**	-9.00***	2.89***	2.61***	0.75	3.85**
	(0.81)	(2.25)	(0.80)	(0.78)	(1.15)	(1.42)
Adjusted R^2	0.22	0.26	0.09	0.20	0.21	0.19
N	26359	17801	8558	25252	17119	8133

Dependent variable [1]: revisions to 3-month T-Bill forecasts over the next 12 months (bps), full sample.
Dependent variable [2]: revisions to 3-month T-Bill forecasts over the next 12 months (bps), away from ELB.
Dependent variable [3]: revisions to 3-month T-Bill forecasts over the next 12 months (bps), at the ELB.
Dependent variable [4]: revisions to 10-year T-Bond forecasts over the next 12 months (bps), full sample.
Dependent variable [5]: revisions to 10-year T-Bond forecasts over the next 12 months (bps), away from ELB.
Dependent variable [6]: revisions to 10-year T-Bond forecasts over the next 12 months (bps), at the ELB.
Regressions [1]-[6] include controls from Equation 6. Standard errors clustered at the country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 14: **Central bank policy decisions' and central bank macroeconomic projections' effect on private-sector one-year policy rate forecasts by country**



5.3 Central bank information effects (private-sector inflation and growth forecasts)

In this section, I consider how central bank inflation and growth projections influence private-sector inflation and growth forecasts. This should help us to understand the extent to which private-sector forecasters incorporate the central bank's inflation and growth projections, which are released first, into their own inflation and growth expectations, which are formed afterwards.

In doing so, we can also analyse the correlation between policy rate changes, forward guidance, and quantitative easing with the private-sector inflation and growth forecasts. Overall, for these monetary policy variables, the correlation is broadly positive when significant as we might expect. In other words, for example, all else equal, we would expect that in periods in which the central bank policy rate is increased or the central bank makes a hawkish change to its forward guidance, these are also periods that coincide with higher inflation and growth over the next twelve months since monetary policy operates with a lag.

On the other hand, we probably should not expect this relationship to be terribly strong because of the forward-looking nature of monetary policy decisions. Indeed, although all of the quantitative easing coefficient estimates are positive, none is significant. It is also noteworthy that the only statistically significant positive correlations are those between forward guidance changes and inflation forecast revisions as well as central bank policy rate changes and inflation forecast revisions rather than growth forecast revisions.

Finally, I rerun these regressions for the mutually exclusive sub-samples *away from the effective lower bound* (columns [2] and [5]) and *at the effective lower bound* (columns [3] and [6]). It is reasonable to hypothesize that these correlations would be substantially different in these two different states of the world, which indeed appears to be the case.

In the main paper, the reference below is provided, which refers to the equations and tables directly below.

> I am also unable to find evidence that central bank macroeconomic projection revisions influence private-sector macroeconomic projection revisions (online appendix).

Columns [1]-[3]:

$$\Delta\pi_{ict}^{h} = \beta\Delta\tilde{f}_{ct} + \gamma\Delta\tilde{q}_{ct} + \phi\Delta\tilde{p}_{ct} + \varphi\tilde{e}_{ct} + \psi_1\Delta\tilde{\pi}_{ct}^{h} + \psi_2\Delta\tilde{g}_{ct}^{h} + \delta\Delta g_{ict}^{h} + \alpha_i + \alpha_t + \epsilon_{ict} \quad [8]$$

Columns [4]-[6]:

$$\Delta g_{ict}^{h} = \beta\Delta\tilde{f}_{ct} + \gamma\Delta\tilde{q}_{ct} + \phi\Delta\tilde{p}_{ct} + \varphi\tilde{e}_{ct} + \psi_1\Delta\tilde{\pi}_{ct}^{h} + \psi_2\Delta\tilde{g}_{ct}^{h} + \delta\Delta\pi_{ict}^{h} + \alpha_i + \alpha_t + \epsilon_{ict} \quad [9]$$

Table 15: **Private-Sector Forecaster Inflation and Growth Expectations**

	[1]	[2]	[3]	[4]	[5]	[6]
Indiv. GDP g rev. (+25 bps)	1.36***	1.69***	0.96***			
	(0.22)	(0.32)	(0.26)			
Indiv. π rev. (+25 bps)				2.24***	2.03***	2.60**
				(0.46)	(0.52)	(0.98)
CB π revision (+25 bps)	0.66	0.74	0.70	-0.58*	-0.57*	-0.51
	(0.37)	(0.48)	(0.45)	(0.28)	(0.28)	(0.80)
CB GDP g rev. (+25 bps)	0.04	0.04	-0.05	0.29	0.09	0.36
	(0.11)	(0.29)	(0.09)	(0.31)	(0.13)	(0.45)
FG $\{-1, 0, 1\}$ change	1.76**	2.10**	-0.11	-0.64	0.14	-1.00
	(0.69)	(0.71)	(1.43)	(1.38)	(1.28)	(2.04)
CB rate change (+25 bps)	1.67***	1.45**	0.13	1.40	0.80	5.19
	(0.38)	(0.46)	(1.88)	(1.11)	(0.88)	(9.57)
QE $\{-1, 0, 1\}$ change (+1)	0.91	3.92	0.24	3.89	2.45	6.60
	(1.63)	(3.47)	(1.10)	(2.44)	(2.94)	(4.59)
Adjusted R^2	0.23	0.23	0.29	0.54	0.36	0.64
N	26359	17801	8558	26359	17801	8558

Dependent variable [1]: revisions to individual π forecasts over the next 12 months (bps), full sample.
Dependent variable [2]: revisions to individual π forecasts over the next 12 months (bps), away from ELB.
Dependent variable [3]: revisions to individual π forecasts over the next 12 months (bps), at the ELB.
Dependent variable [4]: revisions to individual growth forecasts over the next 12 months (bps), full sample.
Dependent variable [5]: revisions to individual growth forecasts over the next 12 months (bps), away from ELB.
Dependent variable [6]: revisions to individual growth forecasts over the next 12 months (bps), at the ELB.
Regressions [1]-[6] include the controls from Equation 6. Standard errors clustered at the country level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.4 Unanticipated forward guidance and interest rate disagreement

The benchmark results with the unexpected forward guidance term, lagged interest-rate disagreement, and the corresponding interaction terms (as in the main paper) are displayed in column [2] of Table 16. The other columns repeat the analysis but using both type of interest-rate forecasts at both forecast horizons (see table notes for details). Columns [1], [3], and [4] use forecasts of the three-month treasury bill rate at the *three-month horizon* and the ten-year government bond yield at both horizons respectively as the dependent variables. Column [2] uses the forecast of the three-month treasury bill rate at the *twelve-month horizon* as the dependent variable (as in the benchmark results in the main paper).

Table 16: **Unanticipated forward guidance, interest rate forecast disagreement, and the transmission of forward guidance**

	[1]	[2]	[3]	[4]
(1) Forward guidance (FG) $\{-1, 0, 1\}$ change	1.92	4.71***	2.43**	2.22*
	(1.80)	(0.86)	(0.98)	(1.15)
(2) Very unexpected FG change $\{0, 1\}$	1.51	-0.30	-0.14	1.60
	(2.33)	(1.35)	(2.56)	(2.13)
(3) Lagged interest rate disagreement (σ)	-1.60**	-2.27***	0.18	-0.69*
	(0.58)	(0.44)	(0.36)	(0.33)
(1) x (2)	5.65***	4.13***	0.18	1.72*
	(0.98)	(1.10)	(1.28)	(0.89)
(1) x (3)	-1.93	2.95***	1.65	0.54
	(1.54)	(0.74)	(1.62)	(1.32)
(2) x (3)	-0.58	-2.10	0.43	3.75**
	(4.97)	(2.25)	(2.46)	(1.69)
(1) x (2) x (3)	3.44	0.92	-2.16	0.47
	(3.27)	(2.27)	(1.94)	(1.47)
Adjusted R^2	0.36	0.22	0.29	0.19
N	43564	42973	43369	42687

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).
Standard errors clustered at the country level. Regressions include both firm and month fixed effects.
Control variables (Equation 6) suppressed for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

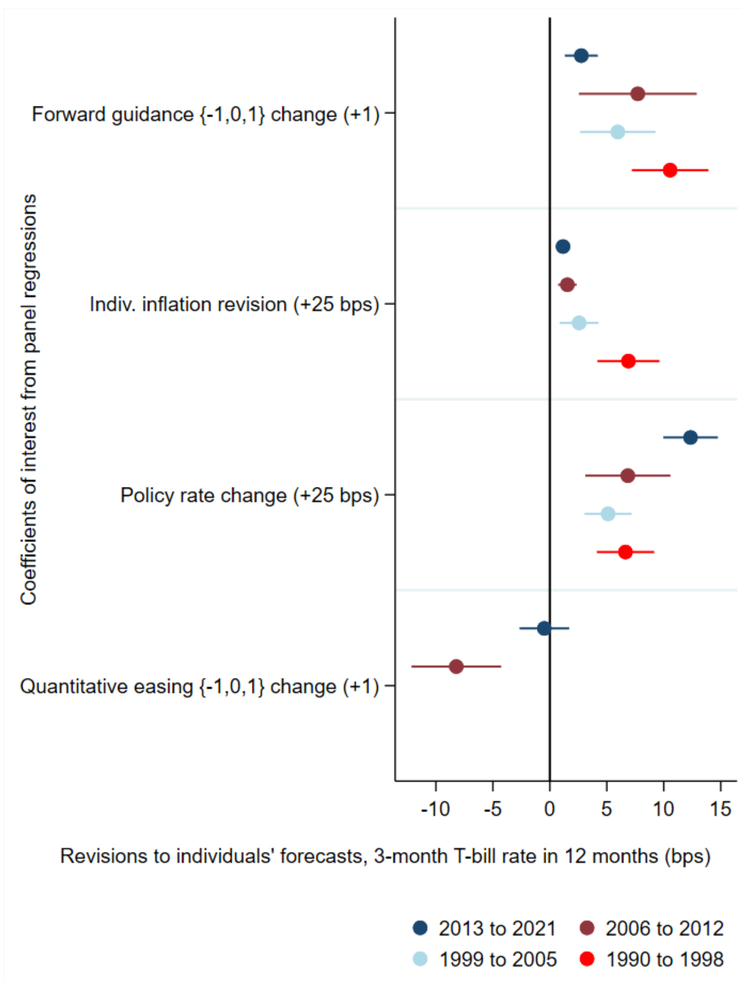
5.5 Note on Benchmark results (ten-year bond yield at the twelve-month forecast horizon)

In Table 2 in the main paper, I repeat the analysis from the benchmark results in the main paper, but I use the ten-year bond yield at the twelve-month forecast horizon instead of the three-month T-bill rate at the twelve-month forecast horizon as the dependent variable. Other empirical studies have also found that forward guidance influences short-term market interest rates more than bond yields (e.g. Moessner and Nelson (2008), Gagnon et al. (2011), Hubert and Labondance (2018), Altavilla et al. (2019), Andrade and Ferroni (2020)). Andersson et al. (2006) (p. 1816) summarizes well why a number of factors could explain the weaker influence of forward guidance on longer-term interest rates. "First, it is hardly meaningful to indicate policy intentions more than a few years ahead since future monetary policy depends on future economic conditions, which become very hard to predict as the forecast horizon increases. Second, the controllability of interest rates declines with maturity since movements in long-term interest rates to a large extent reflect exogenous factors such as global interest rate trends and fluctuating term premia. It is therefore an open empirical issue to determine to what extent monetary policy signaling can affect medium- and long-term interest rates."

5.6 Subsample analysis of interest rate expectations

When we segregate our sample data into four periods, we see that forward guidance was particularly influential in both the years leading up to the global financial crisis and the years spanning the crisis. Perhaps most interestingly, forward guidance is estimated to have been much less influential in recent years. Following the analysis for the Bank of England and the European Central Bank and the benchmark results from the main paper, this is probably attributable to policy rates at or near the effective lower bound. Similarly, Detmers and Nautz (2012) find that the influence of Reserve Bank of New Zealand policy rate projections waned in the post-crisis period.

Figure 15: **Central bank policy decisions' effect on private-sector interest rate forecasts in different periods** (sub-sample analysis for the periods 1990 to 1998; 1999 to 2005; 2006 to 2012; 2013 to 2021)



It is also not surprising that policy rate changes became more influential over time as central banks approached the effective lower bound and policy rate changes themselves became fewer and farther between. One interesting result is that the relationship between individual forecasters' revisions to their policy rate forecasts and the revisions to their inflation forecasts was strongest in the 1990s. This earlier period in the sample data coincides with a period of higher and more volatile inflation and one in which central banks had not yet established a long track record of successful inflation targeting. That the sensitivity has been much lower in recent years may reflect lower and more stable inflation, anchored inflation expectations, and central banks' reduced needed to respond aggressively to inflation shocks.

The tables below repeat the analysis from Table 3 in the main paper, which considers how forward guidance affected interest rate expectations in different periods, but replaces the dependent variable with the other interest rate forecast revisions. When we use the 3-month T-bill rate in 3 months as a dependent variable instead (Table 17), the trend is similar but less pronounced as might be expected given that the forecast horizon is only three months. However, when we use the 10-year bond yield in 3 months and 12 months as a dependent variables instead (Table 18, Table 19), the trend is quite different. Instead, the influence of forward guidance in earlier years was minimal and the influence in more recent years has been relatively significant at around three basis points on average. Again, this is likely a corollary of far more frequent periods at the effective lower bound and flatter yield curves in more recent years. At the effective lower bound, the ability of forward guidance to influence short-term interest rate forecast revisions is minimal, but it can certainly influence longer-dated bond yields given the expectation hypothesis.

Table 17: **Forward Guidance and Rate Expectations by Period (3-month T-bill rate in 3 months)**

	[1]	[2]	[3]	[4]
Forward guidance (FG) $\{-1, 0, 1\}$ change	3.64**	6.36**	3.90	2.53***
	(1.61)	(2.19)	(2.58)	(0.69)
adj. R^2	0.28	0.37	0.42	0.20
N	12358	12293	11569	12624

[1]: 1990 to 1998; [2]: 1999 to 2005; [3]: 2006 to 2012; [4] 2013 to 2021.

Dependent variable: revisions to individuals' forecasts, 3-month T-bill rate in 3 months (bps).

Regressions include all controls from Equation 6. Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 18: **Forward Guidance and Rate Expectations by Period (10-year bond yield in 3 months)**

	[1]	[2]	[3]	[4]
Forward guidance (FG) $\{-1, 0, 1\}$ change	-5.40	1.74	3.32**	3.83***
	(3.80)	(1.54)	(1.39)	(1.00)
adj. R^2	0.30	0.33	0.27	0.23
N	11996	11998	11226	11997

[1]: 1990 to 1998; [2]: 1999 to 2005; [3]: 2006 to 2012; [4] 2013 to 2021.

Dependent variable: revisions to individuals' forecasts, 10-year bond yield in 3 months (bps).

Regressions include all controls from Equation 6. Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 19: **Forward Guidance and Rate Expectations by Period (10-year bond yield in 12 months)**

	[1]	[2]	[3]	[4]
Forward guidance (FG) $\{-1, 0, 1\}$ change	-2.64	2.42	3.51*	2.92***
	(1.93)	(1.63)	(1.73)	(0.94)
adj. R^2	0.19	0.18	0.18	0.18
N	11982	11987	11196	11957

[1]: 1990 to 1998; [2]: 1999 to 2005; [3]: 2006 to 2012; [4] 2013 to 2021.

Dependent variable: revisions to individuals' forecasts, 10-year bond yield in 12 months (bps).

Regressions include all controls from Equation 6. Standard errors clustered at the country level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Summary Statistics

Table 20: **Summary statistics: central bank policy changes and private-sector forecast revisions**

	Mean	SD	Count	Min	Max
Forward guidance $\{-1, 0, 1\}$ change	-0.02	0.23	48911	-1	1
Forward guidance $\{0, 1\}$	0.37	0.48	48911	0	1
Forward guidance with commitment $\{0, 1\}$	0.01	0.10	48911	0	1
Time-contingent forward guidance $\{0, 1\}$	0.11	0.31	48911	0	1
State-contingent forward guidance $\{0, 1\}$	0.09	0.28	48911	0	1
Qualitative forward guidance $\{0, 1\}$	0.25	0.43	48911	0	1
Quantitative easing $\{-1, 0, 1\}$ change	-0.02	0.16	48911	-1	1
Effective lower bound $\{0, 1\}$	0.20	0.40	48911	0	1
Central bank policy rate projection $\{0, 1\}$	0.15	0.35	48911	0	1
Policy rate change (basis points (bps))	-2.33	21.75	48911	-175	300
Private T-bill forecast revision, 12-month horizon (bps)	-2.38	32.95	48911	-360	340
Private inflation forecast revision, pseudo-12 mo horizon (bps)	-0.70	23.21	48911	-473	257
Private growth forecast revision, pseudo 12-mo horizon (bps)	0.68	33.92	48911	-761	534
Private T-bill forecast revision, 3-month horizon (bps)	-2.60	28.64	47069	-300	300
Private bond yield forecast revision, 3-month horizon (bps)	-2.22	29.14	47069	-300	300
Private bond yield forecast revision, 12-month horizon (bps)	-2.12	29.34	47069	-350	300
Private unemployment forecast rev., 12-mo horizon (bps)	-0.72	25.61	38928	-719	680
CB inflation projection rev., pseudo 12-mo horizon (bps)	-0.09	35.21	26359	-346	223
CB growth projection rev., pseudo 12-mo horizon (bps)	0.22	98.86	26359	-1673	1619
CB policy rate projection rev., 12-mo horizon (bps)	-1.22	42.67	7043	-390	430
CB policy rate projection rev., 24-mo horizon (bps)	-0.97	29.24	7043	-410	150
Very unexpected forward guidance change $\{0, 1\}$	0.01	0.11	48911	0	1
First lag, SD, T-bill forecast revision, 12-mo horizon	36.38	19.76	48911	2	146

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