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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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Communication about future policy rates in theory and practice: A Survey *

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Abstract

We discuss the theoretical rationale for central bank communication about future policy rates as part of inflation targeting or of forward guidance. We also summarize actual central bank communication about future policy rates in major advanced countries as well as empirical evidence on the effectiveness of both types of communication. We argue that there is a disconnect between the theory and practice of forward guidance, with theory assuming commitment by the central bank, while in practice central banks generally do not commit. Future theoretical research on forward guidance should therefore take the absence of commitment by central banks into account.

Keywords: Central bank communication, interest rate forecasts, forward guidance, inflation targeting.

JEL classification: E52, E58.

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1. Introduction

Nowadays, most central banks in advanced economies communicate about their future policy rates. However, the underlying rationale for this policy is very different. Whereas some central banks publish the path of future policy rates as part of their inflation targeting (IT) strategy, others communicate about future policy rates as a way to enhance the effectiveness of monetary policy by influencing (interest and inflation) expectations, including when policy rates are at or close to the effective lower bound (forward guidance).

Under IT, central banks not only publish inflation forecasts, but also interest rate forecasts. Several economists have argued that the central bank's own projection of the policy interest rate path is "the only appropriate and logically consistent choice" (Mishkin, 2004, p. 9) and "provides the private sector with the best aggregate information for making individual decisions" (Svensson, 2006, p. 185). Several central banks, including the central banks of New Zealand, Norway and Sweden, follow this practice. These policy rate forecasts are conditional on current insights about future economic developments and do not imply commitment.

The Federal Reserve, the Bank of Japan, the ECB and the Bank of England have all provided forward guidance about future policy rates in various forms. Forward guidance has been argued to make monetary policy effective, even at the effective lower bound (ELB). If a central bank can commit to future values of the policy rate, it can work around the ELB constraint by promising monetary accommodation in the future once the ELB ceases to bind (Eggertsson and Woodford, 2003). In this framework, forward guidance implies a commitment to keep interest rates below levels implied by the central bank's reaction function once the ELB is no longer binding.

In the debate among academics and policymakers about the usefulness of communicating about future policy rates, the distinction between publishing future interest rates as part of an IT strategy and forward guidance is not always made (McDermott, 2014). An important aim of our survey is to discuss the theoretical differences and contrasting them with actual central bank communication practices.

Communication about future policy rates has been classified into "Delphic" and "Odyssean" communication by Campbell et al. (2012). They define Delphic communication as merely forecasting macroeconomic performance and likely monetary policy actions (the central bank acts as an oracle, like that of Delphi). These forecasts could, in turn, affect private sector expectations if the central bank is perceived to have superior forecasting ability or better knowledge about its own monetary policy intentions (Blinder et al., 2008). By contrast, under Odyssean communication the central bank commits itself to future monetary policy action (like Odysseus, the central bank ties itself to the mast in order to withstand the call of the sirens).

Within Delphic communication about future policy rates, we distinguish further between interest rate forecasts provided regularly as part of an inflation targeting framework, and forecasts provided (without commitment) of likely future monetary policy action and macroeconomic performance episodically under unusual circumstances, such as at the effective lower bound, which we refer to as “Aesopian forward guidance”. The analogy here is with fables by Aesop, where a particular situation is chosen and described, and insights are presented based on that situation. In the case of Aesopian forward guidance, the economic situation is chosen by the central bank.¹

Table 1 gives an overview of this classification of communication about future policy rates in theory and practice. The table highlights that currently Odyssean communication about future policy rates does not exist in practice. Central banks apply three broad forms of Aesopian forward guidance. As discussed in Filardo and Hoffman (2014), these three forms are qualitative (or open ended) forward guidance, where the central bank does not provide detailed quantitative information about the envisaged time frame; calendar-based (or time contingent) forward guidance, where the central bank refers to a clearly specified time horizon; and threshold-based (or state contingent) forward guidance, where the central bank links future rates to specific quantitative economic thresholds. Although different than forward guidance as advocated by Eggertsson and Woodford (2003), these types of guidance may be effective. As long-term rates are more relevant for economic decisions than the current level of the overnight rate, any action by the central bank that influences interest rate expectations could be a potential tool for monetary policy, even if current short-term rates cannot be reduced any further (Blinder et al., 2008).

In choosing a particular type of forward guidance, central banks face a trade-off between informing the private sector and avoiding the impression that they commit. There is a trade-off between unequivocal and careful statements. On the one hand, as also pointed out by Chehal and Trehan (2009), changes in economic conditions may make it necessary for the central bank to deviate from previously announced paths. In turn, these changes may surprise private sector participants and have negative consequences for central bank credibility, suggesting that careful statements may be preferable. On the other hand, careful statements may not have the same impact as unequivocal ones. One advantage of state-contingent forward guidance over open-ended and time-contingent forward guidance is that the former allows the public to distinguish whether changes in forward guidance are due to changes in expectations about the economic outlook or changes in monetary policy preferences, while the latter two do not allow such a distinction.

Overall, this survey will suggest that future theoretical research on forward guidance about policy rates should take account of the absence of commitment by central banks in providing forward guidance in practice. To arrive at this conclusion, we will first discuss the theoretical rationale for the publication of

¹ We thank Patrick Honohan for suggesting the term Aesopian guidance to one of us during a seminar.

future interest rates as part of an IT strategy, and for forward guidance about policy rates in Section 2. Next, in Section 3, we will summarize actual central bank policies in some major advanced countries. Following this summary, we will survey empirical evidence on the effectiveness of both types of communication in Section 4. Section 5 further discusses our main conclusions of this survey.

Table 1. Classification of communication about future policy rates in theory and practice

Type of communication	Theory	Practice	Important characteristics
DELPHIC			
<i>Interest rate forecasts published as part of inflation targeting</i>	Mishkin (2004) Svensson (1997) Woodford (2013)	Reserve Bank of New Zealand (since June 1997) Norges Bank (since November 2005) Riksbank (since February 2007)	Discretion, time-consistent Conditional forecasts
<i>Aesopian forward guidance</i>	–	Bank of England (August 2013, May 2014) ECB (July 2013) Federal Reserve (August 2003, December 2008, March 2009, August 2011, January 2012, September 2012, December 2012, December 2013, March 2014, October 2014, January 2015, March 2015) Bank of Japan (April 1999, April 2013) Bank of Canada (April 2009)	Discretion, time-consistent Possible forms: open-ended; time contingent; state contingent (with or without thresholds)
ODYSSEAN			
<i>Publication of interest rate forecasts</i>	Laséen and Svensson (2011)	–	Commitment, time-inconsistent
<i>Odyssean forward guidance</i>	Krugman (1998) Eggertsson and Woodford (2003) Werning (2011) Levin et al. (2010) Campbell et al. (2012) Carlstrom et al. (2012) Del Negro et al. (2012) English et al. (2013) Coenen and Warne (2013) Eggertsson and Mehrotra (2014) Da Costa (2014) De Graeve et al. (2014) Gavin et al. (2014) Haberis et al. (2014) Florez-Jimenez and Parra-Polania (2014) McKay et al. (2015)	–	Commitment, time-inconsistent Possible forms: open-ended; time contingent; state contingent (with or without thresholds)

2. Theory of communication about future policy rates

So far, both the transmission mechanism of changes in interest rate forecasts published under IT and of changes in forward guidance to financial market prices and the macro-economy are not well understood. For example, there has been little analysis of impulse responses of an announced shock to future monetary policy (De Graeve et al., 2014). This contrasts with the transmission of current policy rate changes to market prices and macroeconomic variables, on which there is an extensive theoretical and empirical literature. This knowledge gap partly exists because the publication of interest rate forecasts under inflation targeting and of forward guidance is a relatively recent monetary policy tool, in contrast to the long-established traditional monetary policy tool of changes in the policy rate. We now discuss the theory underlying both types of communication.

2.1 Publishing interest rate forecasts under inflation targeting: theory

The distinctive feature of IT is a forward-looking decision-making process known as “inflation-forecast targeting” (Svensson, 1997). It means that the central bank uses its policy instruments in order to bring its inflation forecast in line with its inflation target. Not only does the central bank publish inflation forecasts, but it also communicates forecasts of its policy rate. As Mishkin (2004) points out, an inflation-targeting central bank has three choices concerning the path of the policy interest rate on which the inflation forecast could be based: 1) a constant interest rate path, 2) market forecasts of the future policy rates, or 3) a central bank projection of the policy interest rate path. The first option is not optimal because future projected changes in interest rates will be necessary to keep inflation on the appropriate target path. The second option is also problematic because markets forecasts are based on expectations of central bank policy and therefore cause circularity. Mishkin (2004) argues that inflation forecasts based on the constant interest rates or market forecasts are not truly transparent as the central bank knows that neither of these interest rate paths is what it plans to do. Also Woodford (2013) argues that inflation targeting requires the bank to model its own likely future conduct as part of the projection exercise. A constant interest rate assumption or the use of future interest rates as expected by the market necessarily result in inconsistencies. A consistent forecasting exercise must make assumptions that allow the evolution of the central bank’s policy instrument to be forecasted, along with the forecasts for inflation and other endogenous variables. Likewise, Svensson (2006, p. 176) argues: “... I believe that substantial progress can be made if central banks explicitly think in terms of entire instrument-rate plans and corresponding projections of target variables and develop a decision process in which the central bank explicitly chooses such an instrument plan.”

The effect of interest rate forecast innovations may be modeled as the effect of announced shocks to future monetary policy (Laséen and Svensson, 2011; De Graeve et al., 2014). However, the analysis in these papers assumes commitment by the central bank to the announced future monetary policy shocks, whereas in

practice inflation targeting central banks have not provided such commitment regarding their published interest rate forecasts, as discussed in Section 3.1 below.²

2.2 Forward guidance: theory

Keeping low for longer

The analysis of Odyssean forward guidance in the context of the ELB goes back to seminal contributions by Krugman (1998) and Eggertson and Woodford (2003).³ The important insight is the following. Even if short-term policy rates cannot at present be reduced any further, the central bank can still influence macroeconomic outcomes by steering future expectations of the policy rate. The central bank can reduce long-term interest rates by promising to keep the policy interest rate ‘lower for longer’, i.e. keep the future policy rates below levels consistent with its normal reaction function when the ELB is no longer binding. If it can do so credibly, long-term rates today (reflecting expected future short-term rates) will already be reduced. Through these long-term rates, the central bank can at present provide monetary accommodation, even though it cannot do so directly by reducing today's short-term policy rate. However, this is a time-inconsistent policy, since the costs of higher inflation arise only later, so that the central bank has an incentive to renege on its promise later. The effectiveness of this policy therefore depends on the central bank's ability to commit.

Levin et al. (2010) study the effects of forward guidance in the presence of different kinds of shocks at the effective lower bound, considering optimal monetary policy under commitment. They find that forward guidance alone, while leading to better outcomes than discretionary monetary policy, is not sufficient to keep output close to potential and inflation close to the long-run goal in the case of a large and persistent natural rate shock. This happens since forward guidance does not prevent a large negative output gap initially, and since a large increase in inflation is needed to reduce real interest rates sufficiently that an even steeper decline in output is avoided. They conclude that there could be a role for unconventional monetary policies as a complement to forward guidance. Eggertsson and Mehrotra (2014) find within an overlapping generations New Keynesian model that the effectiveness of forward guidance at the ELB can be limited if households and firms expect the policy rate to remain low indefinitely.

As in the case of interest rate forecasts published under inflation targeting, the

² The effect of interest rate forecast innovations may also be modeled as the effect of (modest) unannounced shocks to future monetary policy. Leeper and Zha (2003) paper consider a process for setting the money supply which switches between two regimes, and where the new rule is not observed by private agents; another possible interpretation of this setup suggested in Laséen and Svensson (2011) is that the new policy rule is announced by the central bank, but not believed by private agents (lack of credibility).

³ See also Werning (2011).

effect of forward guidance innovations may be modeled as the effect of announced future shocks to a monetary policy rule (Del Negro et al., 2012; De Graeve et al., 2014; Gavin et al., 2014). However, the analysis in these papers once again assumes commitment by the central bank, whereas in practice central banks have not provided such commitment regarding their forward guidance.

Moreover, in practice central banks even do not follow simple monetary policy rules. For example, in the case of the Federal Reserve, the central bank considers several different monetary policy rules, without committing to any, and considers other information (Calomiris, 2012). At the same time, it should be noted that the adoption of a monetary policy rule at the Federal Reserve has recently been under debate (Da Costa, 2014).

Effect on bond yields and forward guidance puzzle

Several theoretical studies find that forward guidance can lead to unrealistically large effects on bond yields and macroeconomic variables, which has been referred to as the “forward guidance puzzle” (Del Negro et al., 2012). Del Negro et al. (2012) find that standard medium-scale DSGE models, including the New York Fed model, tend to grossly overestimate the impact of forward guidance on macroeconomic variables. The New York Fed model considered by Del Negro et al. (2012) is broadly similar to the model used in Campbell et al. (2012). Likewise, Carlstrom et al. (2012) find that the Smets and Wouters (2007) model would predict explosive inflation and output if the policy rate were held at the effective lower bound between eight and nine quarters.

Several solutions have been proposed to the forward guidance puzzle. One possible explanation is that the puzzle is not a problem of the DSGE models themselves, but rather of the way in which forward guidance is implemented within such models. If guidance is provided conditional on the future state of the economy, the forward guidance puzzle can be avoided (De Graeve et al., 2014; Coenen and Warne, 2013). Another explanation is based on global solutions of a nonlinear DSGE model. Failing to include the ELB constraint causes the model to substantially overstate the expansionary effect of forward guidance, while including it can provide an explanation for the forward guidance puzzle (Gavin et al., 2014). A further solution proposed by McKay et al. (2015) is to abandon the assumption of complete markets, and instead assume that agents face uninsurable income risk and borrowing constraints. Then a precautionary savings motive reduces the macroeconomic effects of forward guidance. Another solution to the forward guidance puzzle is to assume that commitment to the forward guidance is imperfectly credible, as discussed below.

Forward guidance at the effective lower bound may lead to either an increase or decrease in nominal bond yields in different DSGE models (De Graeve et al., 2014). Within the New York Fed DSGE model (Del Negro et al. 2012), a stimulating policy action through forward guidance induces a decline in the nominal long-term bond yield, whereas within the models of Smets and Wouters (2007) it induces an increase in the nominal long-term bond yield (De Graeve et al., 2014). The effect within DSGE models can depend on whether an exogenous or endogenous transmission channel dominates in the model (De Graeve et al.,

2014). The exogenous shock in the short-term interest rate leads to a reduction in the long-term nominal yield, which can be partly or more than offset by an endogenous reaction of the short-term interest rate to the inflation and output effects generated by the exogenous shock. The effect can also depend on how private agents interpret the forward guidance, for example, whether private agents consider the commitment by the central bank as credible.

By contrast, the more robust result from such structural models is that forward guidance at the effective lower bound leads to a reduction in *real* bond yields (De Graeve et al., 2014). The reaction of the long-term real bond yield captures the equilibrium effect on output of the forward guidance shock taking into account the endogenous response of inflation and monetary policy.

Thresholds and escape clauses

Three recent papers (English et al., 2013; Coenen and Warne, 2013; and Florez-Jimenez and Parra-Polania, 2014) study forward guidance augmented with thresholds or escape clauses, once again assuming commitment by the central bank. Odyssean forward guidance with thresholds at the effective lower bound may be modeled as a commitment to a simple monetary policy rule, augmented by thresholds, assuming that the central bank credibly commits itself not to depart from the effective lower bound, despite the prescriptions of its simple policy rule, at least until a threshold condition is satisfied, for example, in terms of the unemployment rate or the projection for inflation (English et al., 2013). Such guidance can significantly improve economic outcomes compared to a simple monetary policy rule, moving the economy closer to the outcome of fully optimal policy under commitment (English et al., 2013). In a related paper, Coenen and Warne (2013) consider a New-Keynesian model at the ELB. They find that forward guidance using a time-based conditional commitment to keep interest rates low for longer can be successful in mitigating downside risks to price stability, but that the provision of time-based forward guidance may give rise to upside risks over the medium term if extended too far into the future. Time-based forward guidance complemented with a threshold condition concerning tolerable future inflation can provide insurance against these upside risks. The effect of escape clauses in a model with forward guidance under commitment has been studied by Florez-Jimenez and Parra-Polania (2014). Such a clause can improve welfare, since it allows the central bank to avoid cases in which the cost of reduced flexibility is too high, but only provided the shock is not too large. If the shock is very large, these authors find that the optimal response is to make an unconditional promise and further reduce the promised rate.

Heterogeneity and imperfect credibility

The beliefs of private agents and the interpretation of forward guidance by private agents can affect the impact of forward guidance. Wiederholt (2014) considers dispersed information of households at the effective lower bound within a DSGE model. The consequences of heterogeneous and sticky inflation expectations within this model are fourfold. First, the deflationary spiral in bad states of the world is less severe than under perfect information. Second,

communication about the current state of the economy affects consumption. Third, the direction in which this effect works is dependent on whether or not the effective lower bound binds. Finally, a commitment to increase future inflation can reduce current consumption.

The issue of imperfect credibility of forward guidance has also been considered (Bodenstein et al., 2012; Haberis et al., 2014). Bodenstein et al. (2012) study optimal future policy rate announcements in Sweden and in the United States within a New-Keynesian model. They assume optimal policy under commitment, where the commitment to earlier plans is revoked with a known and fixed probability. They conclude within this setup that the credibility of the Federal Reserve and Sveriges Riksbank has been low in the wake of the 2008 global financial crisis. Haberis et al. (2014) model forward guidance as a commitment to a transient interest rate peg within a New-Keynesian model. They show that if the peg is imperfectly credible, its macroeconomic effects are significantly dampened, providing a solution to the forward guidance puzzle.

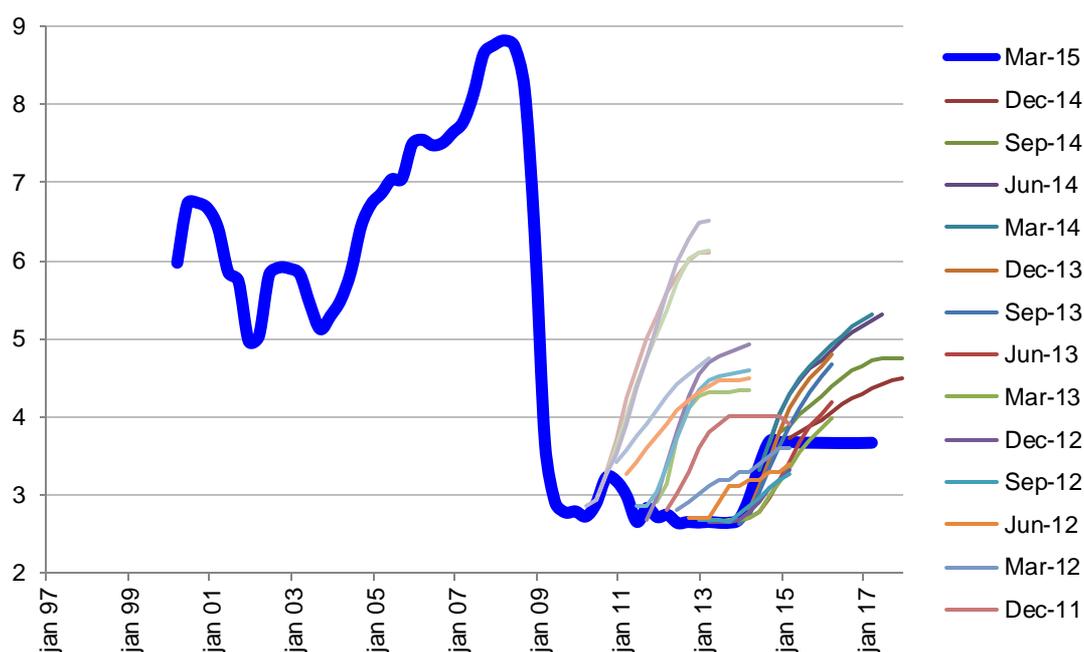
3. Practice of communication about future policy rates

3.1 Publishing interest rate forecasts: practice

The Reserve Bank of New Zealand (RBNZ) was the first central bank to publish interest rate projections on a regular basis. Since June 1997, the projections of the 90-day interest rate are reported in the RBNZ's quarterly Monetary Policy Statement (MPS). Each MPS offers a comprehensive analysis of the state of the economy and contains projections for several key economic time series. For instance, according to the MPS of March 2014 "The Bank's assessment is that the OCR [Official Cash Rate] will need to rise by about 2 percentage points over the next two years for inflation to settle around target. That assessment is conditional on the economic outlook, and will be re-assessed over time as new data are released and events unfold."

The evolution of the RBNZ's published 90-day interest rate forecasts shows substantial revisions to the forecasts, and deviations of the actual interest rate from the forecasts (see Figure 1). Consistent with the Delphic nature of the forecasts, the actual path of the short-term interest rate often deviates from the projected path. For the period between 2010 and 2015, the 90-day interest rate realizations were mostly below the projected paths.

Figure 1: New Zealand 90-day interest rate and RBNZ forecasts (in percent)



Source: RBNZ website. The figure shows the New Zealand 90-day interest rate and compares these with quarterly RBNZ forecasts published between March 2010 and March 2015.

In addition to the RBNZ, the central banks of Norway and Sweden have published policy rate forecasts as part of their inflation targeting strategy. Norges Bank has done so since 2005, and Sveriges Riksbank since 2007. Like the Reserve Bank of New Zealand, Norges Bank and the Riksbank have emphasized that their published interest rate paths are forecasts, not promises, i.e. they emphasized the Delphic nature of their communication about interest rates. The evolution of the interest rate forecasts published by Norges Bank and Sveriges Riksbank also show substantial revisions to the forecasts, and deviations of the actual policy rate from the forecasts, consistent with a Delphic nature of their forecasts (McDermott, 2014; Vikoren, 2014).

Not all inflation-targeting central banks publish the interest rate forecasts of their monetary policy decision makers. The Czech National Bank and the Central Bank of Iceland, for instance, publish staff policy rate forecasts. As they are staff forecasts, rather than forecasts by policymakers, they play a different role in the monetary policy decision-making process. As such, these do not constitute forward guidance about policy rates by policymakers. The Central Bank of Iceland first published staff policy rate forecasts in March 2007 (Central Bank of Iceland, 2007). The Czech National Bank first published staff forecasts in 2008 (Czech National Bank, 2008).

3.2 Forward guidance: practice

Table 2 summarizes forward guidance by five major central banks. The Bank of Japan (BoJ) was a pioneer in using forward guidance. It introduced forward guidance about policy rates in a press conference by its governor on 13 April 1999 (Shirai, 2013). A word-by-word translation of the relevant sentences is as follows⁴:

"[...] I think that until the time we can expect to dispel our concern of deflation, we will continue the current policy measures that provides enough liquidities to keep the overnight call rate effectively zero, while taking account of market functionality. I think I can say that this is a view agreed by many Board members at the time of Monetary Policy Meeting last Friday."

Okina and Shiratsuka (2004) have referred to this forward guidance as a commitment, namely as "Governor's announcement of the commitment to zero interest rate until deflationary concerns are dispelled" (see Table 1 of Okina and Shiratsuka, 2004). However, in our view this forward guidance is of Delphic rather than Odyssean nature, since the wording does not indicate a clear commitment. First, the guidance was provided in a press conference by the governor, rather than by the Policy Board of the Bank of Japan. Describing it, Shirai (2013) writes that "He [the governor] indicated that he thinks", which does not present a clear commitment. And the literal translation above includes "I think" in both of the governor's sentences, and "until the time we can expect to dispel our concern of deflation", which is not a commitment based on an objective criterion but reflects subjective judgment. Moreover, the term "deflationary concerns" was not defined, so that the Bank of Japan could not be held accountable against this criterion. Furthermore, a monetary policy statement by the Bank of Japan from 1999 mentions that monetary policy by the Bank of Japan is never determined in advance, which is also evidence against a commitment:

"What should be clear is that the conduct of monetary policy is exclusively decided by majority vote at the Monetary Policy Meeting, a regular meeting of the Policy Board. It is never the case that our policy is determined in advance or in consultation with outside bodies." (Bank of Japan, 1999)

The introduction of 'Quantitative and Qualitative Monetary Easing' by the Bank of Japan in April 2013 (Bank of Japan, 2013) has been classified as forward guidance about policy rates at the effective lower bound by Bank of England (2013a). However, the Bank of Japan's statement does not explicitly refer to forward guidance about policy rates, but only to "quantitative and qualitative monetary easing" (Bank of Japan, 2013), which may be interpreted as including low policy rates, but this is not made clear,

⁴ These sentences in Governor Hayami's press conference are only available in Japanese. We thank Toshitaka Sekine for help with translating them.

“The Bank will continue with the quantitative and qualitative monetary easing, aiming to achieve the price stability target of 2 per cent, as long as it is necessary for maintaining that target in a stable manner. It will examine both upside and downside risks to economic activity and prices, and make adjustments as appropriate.” (Bank of Japan, 2013)

Moreover, the statement mentions that appropriate adjustments will be made to the policy. This forward guidance can therefore also be classified as Delphic, rather than Odyssean, since it does not present a clear promise about future policy rates.

Table 2. Forward guidance by five central banks

Central bank	Type of guidance	Date	Statement
<i>Bank of Canada</i>	Time contingent	April 2009	Conditional “on the outlook for inflation, the target overnight rate can be expected to remain at its current level until the end of the second quarter of 2010”.
<i>Bank of England</i>	State contingent (with threshold)	August 2013	MPC “agreed its intention not to raise Bank Rate from its current level of 0.5% at least until ... the unemployment rate has fallen to a 'threshold' of 7% ...”
	State contingent (without threshold)	May 2014	“all members agreed that, in the absence of other inflationary pressures, it would be necessary to see more evidence of slack reducing before an increase in Bank Rate would be warranted.”
<i>Bank of Japan</i>	Open ended	April 1999	Having lowered the policy rate to 0.15% in February 1999, the governor of the BoJ indicated in April 1999 that he thinks the BoJ would maintain it at that rate until “deflationary concerns” were “dispelled”.
	Time contingent	April 2013	BoJ states that it would continue with its program of “qualitative and quantitative easing, aiming to achieve the price stability target of 2 percent, as long as it is necessary for maintaining that target in a stable manner.”
<i>ECB</i>	Open ended	July 2013	“Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time.”
		June 2014	“the key ECB interest rates will remain at present levels for an extended period of time in view of the current outlook for inflation.”
<i>Federal Reserve</i>	Open ended	August 2003	FOMC stated that it believed that “policy accommodation’ could ‘be maintained for a considerable period.”
		December 2008	“[t]he Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time.”
		March 2009	“for some time” was replaced by “for an extended period”
	Time contingent	August 2011	Exceptionally low rates expected to last “at least through mid-2013”
		January 2012	“at least through late 2014”
		September 2012	“at least through mid-2015”
	State contingent	December 2012	Exceptionally low level of the federal funds rate would “be appropriate at least as long as the

	(with threshold)		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."
		December 2013	Exceptionally low level of the federal funds rate would "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 now anticipates ... that it likely will be appropriate to maintain the current target range for the federal funds rate well past the time that the unemployment rate declines below 6-1/2 percent, especially if projected inflation continues to run below the Committee's 2 percent longer-run goal."
	State contingent (without threshold)/open-ended	March 2014	"The Committee continues to anticipate ... that it likely will be appropriate to maintain the current target range for the federal funds rate for a considerable time after the asset purchase program ends, especially if projected inflation continues to run below the Committee's 2 percent longer-run goal, and provided that longer-term inflation expectations remain well anchored. The Committee currently anticipates that, even after employment and inflation are near mandate-consistent levels, economic conditions may, for some time, warrant keeping the target federal funds rate below levels the Committee views as normal in the longer run."
		October 2014	Addition of: "However, if incoming information indicates faster progress toward the Committee's employment and inflation objectives than the Committee now expects, then increases in the target range for the federal funds rate are likely to occur sooner than currently anticipated. Conversely, if progress proves slower than expected, then increases in the target range are likely to occur later than currently anticipated."
		January 2015	"the Committee judges that it can be patient in beginning to normalize the stance of monetary policy."
		March 2015	"the Committee judges that an increase in the target range for the federal funds rate remains unlikely at the April FOMC meeting. The Committee anticipates that it will be appropriate to raise the target range for the federal funds rate when it has seen further improvement in the labor market and is reasonably confident that inflation will move back to its 2 percent objective over the medium term."

Source: Den Haan (2013); (update of) Bank of England (2013a)

Federal Reserve

The FOMC has used explicit forward policy rate guidance as an unconventional monetary policy tool at the effective lower bound of the policy rate. On 16

December 2008 the FOMC introduced open-ended forward guidance that the federal funds rate would remain at exceptionally low levels “for some time”, which was altered to “for an extended period” on 18 March 2009. This phrasing was changed to time-contingent forward guidance by altering it to “at least through mid-2013” on 9 August 2011, to “at least through late 2014” on 25 January 2012, and to “at least through mid-2015” on 13 September 2012. The time-contingent guidance was subsequently changed to state-contingent guidance of “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” on 12 December 2012. This forward guidance was modified further in December 2013 and March 2014, when it was also linked to the end of the asset purchase program (see Table 2). Subsequent modifications of the forward guidance are shown in Table 2.

The Federal Reserve Board also started regularly publishing target federal funds rate projections by Federal Reserve Board members and Federal Reserve Bank presidents in January 2012, but without assigning individual projections by name. Since this group contains non-voting members and is larger than the decision-making body of the FOMC, these projections do not necessarily coincide with the projections of the FOMC.

The classification of forward guidance in practice into Delphic and Odyssean forward guidance has not been uncontroversial. For the FOMC’s forward guidance at the effective lower bound in the wake of the global financial crisis, there is a wide range of views on whether it implies a commitment or not. Some think that it implies no commitment (Calomiris, 2012), while others think that it might imply some implicit or explicit commitment (Campbell et al., 2012). In his discussion of the work by Campbell et al. (2012), Calomiris (2012, p. 56-57) expresses his view as follows:

“As a close follower of the Federal Reserve and its policy pronouncements, I reacted with something of a shock to the claim that it has been using forward guidance to make successful commitments to markets in recent years. [...] A commitment requires clarity about what is being promised; otherwise it is hard to see how there could be any accountability for violating it. [...] Forward guidance simply entails no commitment, as defined either by macroeconomic theory or by common English usage.”

Woodford (2012) also argues that the Federal Reserve has provided forward guidance in a Delphic rather than an Odyssean form. Woodford (2012, p. 38) states that:

“While the FOMC’s forward guidance has often been interpreted as making a commitment [...] in fact its communication about future policy [...] has taken only the form of *predictions* about the future path of the funds rate, given what can be known at present.”

Bank of Canada

The forward guidance that was introduced by the Bank of Canada in 2009 was also phrased in terms of an expectation. Therefore, it can also be classified as being Delphic in nature,

“Conditional on the outlook for inflation, the target overnight rate can be expected to remain at its current level until the end of the second quarter of 2010 in order to achieve the inflation target.” (Bank of Canada, 2009)

even though it is referred to as a “commitment” in the same monetary policy statement,

“To reinforce its conditional commitment to maintain the overnight rate at 1/4 per cent, the Bank will roll over a portion of its existing stock of one- and three-month term Purchase and Resale Agreements (PRAs) into six- and twelve-month terms [...]” (Bank of Canada, 2009)

Bank of England

When the MPC of the Bank of England (BoE) announced its forward guidance based on a threshold for unemployment on 7 August 2013, it announced that the guidance

“would cease to hold if any of the following three ‘knockouts’ were breached.” (Bank of England, 2013b)

These three knockouts were defined in terms of the difference between CPI inflation and the 2% target, the anchoring of inflation expectations, and potential threats to financial stability. However, instead of any of these knockouts, the unexpectedly strong decline in unemployment to even below the threshold forced the BoE already in May 2014 to change its guidance. Despite increased levels of economic activity, the MPC was still worried about the slack in the economy. According to the minutes of the MPC meeting in May 2014 the “central view of most Committee members was that the margin of spare capacity remained in the region of 1% – 1½% of GDP, although it had probably narrowed a little since February. There was considerable uncertainty around that central estimate, however, and a range of views on the Committee.” Still, “all members agreed that, in the absence of other inflationary pressures, it would be necessary to see more evidence of slack reducing before an increase in Bank Rate would be warranted.”

When it introduced forward guidance in August 2013, the Bank of England’s forecast of the unemployment rate differed substantially from some private sector forecasts. Moreover, the Bank of England had received some criticism for its forecasting ability in the recent past:

“The MPC’s recent forecast performance has been noticeably worse than prior to the crisis, and marginally worse than that of outside forecasters.

The forecast errors of the MPC have been characterized by persistent over-prediction of output growth and persistent under-prediction of CPI inflation” (Stockton, 2012).

Members of the Bank of England’s Monetary Policy Committee at the time of the introduction of forward guidance by the Bank of England have argued for a Delphic, rather than Odyssean, nature of the Bank of England’s forward guidance (den Haan, 2013):

“[i]t [forward guidance] is not an attempt to inject additional stimulus by pre-committing to a 'lower for longer' policy with the aim of pushing inflation above target for a period; raising inflation expectations and reducing real interest rates [...].” (Dale and Talbot, 2013)

“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.” (Bean, 2013)

European Central Bank

The forward guidance by the ECB is open-ended. While after earlier Governing Council meetings it was stated that monetary policy would be accommodative “for as long as necessary”, in July 2013 the ECB announced that:

“The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time. This expectation is based on the overall subdued outlook for inflation extending into the medium term, given the broad-based weakness in the real economy and subdued monetary dynamics.” (Draghi, 2013).

Likewise, in June 2014 the ECB stated: “Concerning our forward guidance, the key ECB interest rates will remain at present levels for an extended period of time in view of the current outlook for inflation.” Forward guidance about policy rates by the ECB contained no commitment but was phrased in terms of an expectation, and can therefore also be classified as being Delphic guidance.

4. Empirical evidence of communication about future policy rates

4.1 Publishing interest rate forecasts: evidence

Effects of interest rate forecasts published as part of inflation targeting

Several studies report evidence for an effect of published forecasts as part of IT on market interest rates in New Zealand - the first country that introduced this policy strategy (Moessner and Nelson, 2008; Andersson and Hofmann, 2010; Detmers and Nautz, 2012; 2014). Moessner and Nelson (2008) find that the surprises in the RBNZ forecasts have a significant influence on financial-market interest rates at horizons of two to six quarters ahead, with coefficients of around 0.2. Their conclusion is based on the reaction of futures rates at various horizons on the day of publication of the interest rate forecast to the surprise in the forecast. Considering a more recent sample period including the global financial crisis, Detmers and Nautz (2012) confirm for the pre-crisis period that the RBNZ's interest rate projections were an efficient tool for guiding market expectations for short-term horizons. However, they find for the post-crisis period that the role of interest rate projections for futures rates has decreased significantly. Investigating the time-varying and state-dependent effects of interest rate projections on market expectations and uncertainty using an EGARCH model, Detmers and Nautz (2014) find a stabilizing effect of new central bank announcements of their interest rate projections. Andersson and Hofmann (2010) find weak evidence for New Zealand that the publication of an interest rate path could enhance the central bank's leverage over medium-term interest rates.

By contrast, according to Woodford (2012), the Riksbank's time-contingent forward guidance was not so successful, as market participants' expectations were often not in line with projected policy rates. Goodhart and Rochet (2011)'s empirical evidence suggests that Swedish money market rates at longer horizons do not react to the surprise component in the official policy rate path. This finding would indicate that the projected repo path at longer horizons adjusts to market rates, rather than the other way round.

Conditionality of forecasts

The RBNZ, Norges Bank and the Riksbank have emphasized that their published interest rate paths are forecasts, not promises, i.e. these forecasts are Delphic in nature. For example, the RBNZ's Monetary Policy Statement of March 2014 states that "The Bank's assessment is that the OCR will need to rise by about 2 percentage points over the next two years for inflation to settle around target. That assessment is conditional on the economic outlook, and will be re-assessed over time as new data are released and events unfold." Likewise, Norges Bank's Monetary Policy Report of September 2014 (p. 17) states that "The projections for the key policy rate, inflation, capacity utilisation and other variables are based on Norges Bank's assessment of the economic situation and of the functioning of the economy and monetary policy. There is uncertainty surrounding the projections. Monetary policy can respond to changes in the economic outlook and if relationships between the interest rate, inflation and the

real economy differ from those assumed. Hence, there is uncertainty about future interest rate developments. The uncertainty surrounding Norges Bank's projections is illustrated using fan charts [...]. The width of the fans reflects historical uncertainty."

Several papers find evidence for a Delphic interpretation by market participants of interest rate forecasts published under inflation targeting. In other words, there are indications that market participants understood the conditional nature of these forecasts. If market participants interpreted the publication of interest rate forecasts as Odyssean communication, changing economic circumstances would not affect their expectations about future policy rates. Under those conditions, market interest rates would not react to macroeconomic news. A reduction in the sensitivity of market interest rates to domestic economic news with the introduction of the publication of interest rate forecasts would therefore provide evidence that financial market participants interpret the forecast as conditional. Moessner et al. (2014) find that the sensitivity of interest rate swaps to Swedish macroeconomic news was not significantly affected by the Riksbank's introduction of the publication of interest rate forecasts, suggesting that the conditionality of the communication was understood by market participants and that it was not interpreted as Odyssean. Similarly, Moessner and Nelson (2008) find no evidence that market participants systematically overweight interest rate forecasts published by the Reserve Bank of New Zealand or that they do not appreciate the uncertainty and conditionality of it.

For New Zealand and Norway, Mirkov and Natvik (2013) find that policymakers appear to be constrained by their most recently announced interest rate forecasts in setting the current policy rate. They derive a simple policy rule for a central bank that perceives deviations from its previously announced forecasts to be costly, and study whether previously announced interest rate paths affect the current policy rate. They view their results as consistent with the central banks valuing the ex-post accuracy of their forecasts.

Predictability

There are also indications that the publication of interest rate forecasts may improve the forecasting performance by private agents, although overall the evidence remains mixed and improvements mainly relate to short-term horizons. For New Zealand, there is some weak evidence that the publication of interest rate forecasts as part of inflation targeting helped to improve market participants' ability to forecast short-term yields, but not long-term yields (Kool and Thornton, 2014; Bergstrom and Karagedikli, 2013). For New Zealand, it has also been studied how the effect of published interest rate forecasts on the forecasting performance of private agents depends on whether they interpret them as Delphic or Odyssean communication. Using a small Bayesian VAR model, Bergstrom and Karagedikli (2013) find that if the communication is interpreted as Delphic, the forecasting performance of private agents for short-term interest rates is improved at short horizons. The forecasting performance for other macroeconomic variables is neither improved nor worsened. If the communication is interpreted as Odyssean, the forecasting performance of market participants for short-term interest rates is again improved at short

horizons, but the forecasting performance for macroeconomic variables is worsened. For Sweden, the evidence is mixed. Beechey and Österholm (2014) report that the forecast accuracy of survey-based and market-based private sector policy-rate expectations one quarter ahead has improved modestly since the Riksbank started publishing its own policy-rate forecasts, while Kool and Thornton (2014) find no evidence of improved unconditional forecast accuracy. Andersson and Hofmann (2010) conclude that monetary policy surprises became smaller after Norges Bank started to publish policy rate forecasts in November 2005, but that this result could also be due to low volatility in the global economy and financial markets during the latter period, which they take to end in June 2007 before the global financial crisis.

Central banks publishing policy rate paths as part of their IT framework have provided such forecasts over horizons of up to several years ahead. But doubts have been expressed whether making forecasts of future interest rates beyond the near-term horizon is sensible, because of the difficulty of making correct predictions at longer horizons due to uncertainty about future developments (Goodhart and Lim, 2011). Consequently, such guidance at longer horizons might contain mainly noise. Goodhart and Lim (2011) perform regressions in order to assess whether the forecasts can predict the level and changes of actual interest rate outturns a certain number of quarters ahead. They reach the striking conclusion that forecasts of short-term interest rates made for New Zealand by the Reserve Bank of New Zealand have been excellent for the immediate forthcoming quarter, reasonable for the next quarter, but essentially useless thereafter.

4.2 Forward guidance: evidence

Effects of Aesopian forward guidance

A number of studies have considered the effect of Aesopian forward guidance, i.e. conditional forecasts made under special circumstances, on financial market prices. Appendix Table A1 summarizes these and other studies on the effects of forward guidance.⁵

Some empirical studies, mainly for the United States, find that Aesopian forward guidance has been effective. Moessner (2013) reports that explicit FOMC forward guidance at the ELB led to a significant reduction in medium-term nominal interest rates, using event study regressions with daily data on interest rate futures, and controlling for the effect of macroeconomic news. The effect of

⁵ We only consider studies on forward guidance and do not consider studies on quantitative easing and other forms of unconventional monetary policies. There is some evidence that the effectiveness of these other forms of unconventional monetary policies is affected by forward guidance. For instance, Curdia and Ferrero (2013) suggest that forward policy rate guidance is essential for quantitative easing to be effective, and that communication about the beginning of federal funds rate increases will have stronger effects on bond yields than communication about the end of asset purchases.

guidance still holds when controlling for the effect of asset purchase announcements that coincided with some of the forward guidance announcements. Consistent with the more robust prediction from theoretical models that forward guidance at the ELB leads to a reduction in long-term real bond yields (De Graeve et al., 2014), Moessner (2015a) reports that FOMC forward guidance at the ELB led to a reduction in real US Treasury yields at horizons of 2 to 5 years ahead. Using an event study methodology and controlling for the effect of macroeconomic news, Moessner (2014) finds that the FOMC's forward guidance at the ELB led to an increase in US equity prices and a decrease in several risk indicators, including uncertainty about future interest rates measured by an implied volatility index for US government bonds, and US equity index risk reversals. Moessner (2015b) studies international spillovers from US forward guidance, and presents evidence from event study regressions suggesting that forward guidance by the FOMC at the ELB led to higher equity prices in a number of advanced and emerging economies, with equity indices of economies with lower sovereign ratings rising by more, consistent with the risk-taking channel of monetary policy. Moessner (2015c) presents evidence from event study regressions that open-ended and time-contingent forward guidance announcements led to a significant reduction in forward US Treasury yields at a wide range of horizons, with the largest reduction occurring at the 5-year ahead horizon; by contrast, forward guidance announcements containing state-contingency led to a significant increase in forward US Treasury yields for horizons of 3 to 7 years ahead.

The effect of FOMC forward guidance more generally, including explicit forward guidance announcements, but also including more general communication about monetary policy and the economic outlook, has been analyzed in Campbell et al. (2012). Their paper uses the method of Gürkaynak et al. (2005) of decomposing news in FOMC statements into news about the target and the path of monetary policy. They find that forward guidance has significantly affected US Treasury yields since 2007, confirming the results of Gürkaynak et al. (2005) for an earlier sample period that the Federal Reserve's monetary policy statements affected interest rates mainly via their impact on expectations of future monetary policy.

There is evidence, though only weak, that the Bank of Canada's forward guidance has affected interest rate expectations. Considering movements in interest rate futures, Chehal and Trehan (2009) find little evidence suggesting that the introduction of the Bank of Canada's forward guidance in April 1999 significantly affected interest rate expectations in Canada. In contrast, He (2010) finds some evidence to suggest that the guidance reduced market interest rates, notably short-term rates, relative to what their historical relationship with inflation and unemployment based on VAR analysis would imply. Without providing econometric evidence, ECB (2014) states that the ECB's forward guidance introduced in July 2013 led to a lasting reduction in market uncertainty about the path of future short-term interest rates, and to a reduction in the sensitivity of money market forward interest rates to macroeconomic data releases, so that it has become more consistent with historical averages.

For Japan, Okina and Shiratsuka (2004) find that the forward guidance provided by the governor of the BoJ in April 1999 (see Table 2) was effective in stabilizing

market expectations for the path of short-term interest rates, reducing longer term interest rates and flattening the yield curve, but that it did not manage to reverse deflationary expectations. They estimate a forward-rate curve for Japanese interest rates, using Tokyo interbank offered rates, and yen swap rates up to a maturity of 12 years. From this forward curve they derive indicators of the shape of the yield curve, and do a case-study analysis of the short-term impact of the introduction of forward guidance.

Evidence on Delphic versus Odyssean nature and interpretation of Aesopian forward guidance

Moessner and Nelson (2008) consider the Aesopian forward guidance of the FOMC prior to the global financial crisis. They find no evidence that market participants systematically over-weighted the forward guidance or that they did not appreciate the uncertainty and conditionality of it. They study changes in the sensitivity of interest rates and implied volatilities to macroeconomic news, using daily data. The authors find that pre-crisis forward guidance by the FOMC significantly increased the sensitivity of one-year ahead Eurodollar futures interest rates and of the implied volatility of 5-year US Treasury notes to macroeconomic news. These findings are consistent with a Delphic interpretation of this guidance by market participants.

Other papers also studied possible effects of forward guidance on the sensitivity of asset prices to macroeconomic news. Swanson and Williams (2014) study the effect of the ELB on medium- and longer-term interest rates in the United States. They find that the sensitivity to macroeconomic news of yields with maturities greater than one year was high from 2008-10, but fell close to zero from late 2011. They argue that the latter finding may be partly due to the FOMC's forward guidance. Raskin (2013) also studies changes in the sensitivity of short-term interest rate expectations to economic news, but using probability distributions of interest rate expectations derived from interest rate options. The author finds that the introduction of the FOMC's time-contingent forward guidance in August 2011 led to a significant reduction in the sensitivity of the risk-neutral percentiles six months to three years ahead to economic surprises.

Campbell et al. (2012) conclude that their empirical results suggest that market participants may have interpreted the FOMC's forward guidance (in its more general, rather than just explicit form, e.g. including communication about the macroeconomic outlook in policy statements) as being partly Odyssean in nature. Woodford (2012), however, suggests that the empirical results of Campbell et al. (2012) cast some doubt on this conclusion, and that they are also consistent with a Delphic interpretation of the FOMC's forward guidance on the part of market participants. Moessner (2015a) finds that US long-term breakeven inflation rates were barely affected by the FOMC's forward guidance, suggesting that inflation expectations have remained well-anchored, which is consistent with a Delphic nature and interpretation of the FOMC's forward guidance. Finally, Femia et al. (2013) conclude that market participants interpreted the FOMC's policy rate guidance as conveying important information about the Committee's policy reaction function. They distinguish between whether market participants interpreted forward guidance as implying greater

pessimism about economic developments or the central bank following a more accommodative policy reaction function, by considering responses from the Survey of Primary Dealers of the Federal Reserve Bank of New York, which asked dealers about the economic conditions that were expected at the time of lift off from the ELB.

Predictability

Central banks providing forward guidance have also provided such guidance over horizons of up to several years ahead, so doubts expressed whether making forecasts of future interest rates beyond the near-term horizon is sensible due to uncertainty about future developments are also relevant for forward guidance (Goodhart and Lim, 2011). At the same time, there is still little evidence on the effect of forward guidance on the forecast performance for interest rates by private agents. For the United States, Kool and Thornton (2014) find no evidence that the publication of forward guidance helped to improve market participants' ability to forecast short-term or longer-term yields.

5. Conclusion

This survey discussed the theoretical rationale for central bank communication about future policy rates in the form of the publication of interest rate forecasts as part of inflation targeting and in the form of forward guidance. We also summarized actual central bank policies for communication about future policy rates in major advanced countries. Moreover, we surveyed the empirical evidence on the effectiveness of both types of communication. We argued that there is a disconnect between the theory and practice of forward guidance, with theory assuming commitment on the part of the central bank, while in practice central banks do not provide commitment. We suggest that in order to provide more useful insights for policy, future theoretical research on forward guidance should take account of the absence of commitment by central banks in providing forward guidance in practice.

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Appendix Table A1: Summary of empirical research on market reactions to forward guidance

Study:	Central bank:	Period:	Method:	Conclusion:
Okina and Shiratsuka (2004)	Bank of Japan	March 1998 – February 2003	Case-study analysis of the short-term impact of the introduction of FG, using indicators for the shape of the yield curve derived from estimated forward-rate curve	Forward guidance (FG) was effective in stabilizing market expectations for the path of short-term interest rates, reducing longer term interest rates and flattening the yield curve, but did not manage to reverse deflationary expectations.
Chehal and Trehan (2009)	Bank of Canada	January 2009 – September 2009	Analysis of daily US and Canadian expected policy rates.	FG affected interest rates initially, but the effect does not appear to have persisted.
He (2010)	Bank of Canada	January 1991 – March 2010	VAR of monthly interest rates, unemployment and inflation. Predictions of VAR estimated on data until FG (April 2009) are compared to actual data to examine whether model parameters have changed.	Canadian 1-year treasury bill rates and 1-year forward 3-month rates have generally been lower than their model-implied values since April 2009. Canadian longer-term interest rates are also lower than their model-implied values, though their difference diminishes as the maturities become longer.
Moessner (2013)	Federal Reserve	June 2004 – February 2013	Event study methodology using daily data examining impact of FG announcements on near- to medium-term interest rate futures implied by Eurodollar contracts	FG announcements significantly reduced implied interest rates at horizons of 1–5 years ahead, with the largest effect at the intermediate horizon of 3 years. This effect was not just due to associated asset purchase announcements. FG led to a significant reduction in the term spread, i.e. to a flattening of the yield curve.
Moessner (2015a)	Federal Reserve	June 2004 – February 2013	Event study methodology using daily data examining impact of FG announcements on real interest rates and breakeven US Treasury yield curves.	FG announcements led to a significant reduction in real yields 2–5 years ahead. By contrast, long-term breakeven inflation rates were barely affected, suggesting that inflation expectations have remained well-anchored.

Moessner (2014)	Federal Reserve	June 2004 – February 2013	Event study methodology using daily data examining impact of FG announcements on equity prices and several risk indicators.	Significant increase in equity prices and reduction in credit spreads and risk indicators such as volatility index for US government bonds and US equity index risk reversals.
Moessner (2015b)	Federal Reserve	June 2004 – February 2013	Event study methodology using daily data examining international spillovers from FG announcements on equity prices in advanced and emerging economies	Significant increase in equity prices in a number of advanced and emerging economies, with those of economies with lower sovereign ratings rising by more, consistent with the risk-taking channel of monetary policy.
Moessner (2015c)	Federal Reserve	June 2004 – June 2014	Event study methodology using daily data examining impact of FG announcements on US government bond yield curves	Open-ended and time-contingent FG announcements led to a significant reduction in forward US Treasury yields at a wide range of horizons, with the largest reduction occurring at the 5- year ahead horizon. By contrast, FG announcements containing state-contingency led to a significant increase in forward US Treasury yields for horizons of 3 to 7 years ahead.
Campbell et al. (2012)	Federal Reserve	February 1990 – June 2007	Regressions of daily changes in asset prices on two derived factors, a target factor and path factor)	Significant effect of path factor on US government bond yields and corporate bond yields.
Moessner and Nelson (2008)	Federal Reserve	June 1998 – August 2007/ March 1994 – July 2007.	Studies changes in sensitivity of interest rates/implied volatilities to macroeconomic news	Pre-crisis FG significantly increased sensitivity of interest rates and implied volatilities to macroeconomic news.
Raskin (2013)	Federal Reserve	January 2007 – December 2012	Studies changes in the sensitivity of short-term interest rate expectations to economic news, using probability distributions of interest rate expectations derived from interest rate	The introduction of the FOMC's time-contingent FG in August 2011 led to a significant reduction in the sensitivity of the risk-neutral percentiles six months to three years ahead to economic surprises.

			options.	
Swanson and Williams (2014)	Federal Reserve	January 1990 – December 2012	Study effect of the ELB on sensitivity of interest rates to macroeconomic news using daily data.	Sensitivity to macroeconomic news of yields with maturities greater than one year was high from 2008-10, but fell close to zero from late 2011, which may be partly due to the FOMC's FG, in addition to the ELB.

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