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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, either as part of inflation targeting or in the form of forward guidance. We also summarize both actual central bank communication about future policy rates and empirical evidence on the effectiveness of these types of communication. We argue that there is a disconnect between the theory and practice of forward guidance, as theory assumes commitment on the part of 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; Forward guidance; Inflation targeting; Interest rate forecasts

1. Introduction

Nowadays, most central banks in advanced economies communicate about their future policy rates. However, the underlying rationale for this policy can differ across institutions. Whereas some central banks publish the path of future policy rates as part of their inflation targeting (IT) strategy, others communicate about future rates as a way to enhance the effectiveness of monetary policy by influencing private sector expectations. This second approach includes forward guidance in situations when policy rates are at or close to the effective lower bound (ELB).¹

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Under IT, some central banks not only publish inflation forecasts, but also interest rate forecasts. It has been 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 ELB. By committing to future levels of the policy rate, the central bank can address the ELB issue by promising monetary accommodation once the ELB is no longer a constraint (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 these differences and contrast theory 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. This name was chosen since the central bank acts as a (Delphic) oracle. The forecasts by the central bank could affect private sector expectations if the central bank is perceived to have superior forecasting ability or better knowledge about its own 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 thus ties itself to the mast in order to withstand the call of the sirens.

One contribution of our paper is to discuss a further distinction, which we label 'Aesopian forward guidance'. Within Delphic communication about future policy rates, we distinguish 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.²

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 forward guidance, where the central bank does not provide detailed quantitative information about the envisaged time frame; calendar-based forward guidance, where the central bank refers to a clearly specified time horizon; and threshold-based forward guidance, where the central bank links future rates to specific quantitative economic thresholds. Qualitative, calendar-based and threshold-based forward guidance are also referred to as open-ended, time-contingent and state-contingent forward guidance, respectively. 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 under the ELB (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. Here, a 'careful' forward guidance statement means a statement that is more cautious

Table 1. Classification of Communication about Future Policy Rates in Theory and Practice

Theory	Practice	Important characteristics
DELPHIC		
Publication of interest rate forecasts		
Mishkin (2004)	Reserve Bank of New Zealand	Discretion, time-consistent
Svensson (1997)	(since June 1997)	Conditional forecasts
Woodford (2013)	Norges Bank (since Nov. 2005)	
Eusepi and Preston (2007)	Riksbank (since Feb. 2007)	
Gosselin <i>et al.</i> (2008)		
Gersbach and Hahn (2011)		
Aesopian forward guidance		
–	Bank of England (Aug. 2013, Feb. 2014)	Discretion, time-consistent
	ECB (Jul. 2013)	Possible forms: open-ended; time
	Federal Reserve (Aug. 2003, Dec. 2008, Mar. 2009, Aug. 2011, Jan., Sep. & Dec. 2012, Dec. 2013, Mar. & Oct. 2014, Jan. & Mar. 2015)	contingent; state contingent (with or without thresholds)
	Bank of Japan (Apr. 1999, Oct. 2010, Feb. 2012, Jan. & Apr. 2013)	
	Bank of Canada (Apr. 2009)	
ODYSSEAN		
Publication of interest rate forecasts		
Rudebusch and Williams (2008)	–	Commitment, time-inconsistent
Ferrero and Secchi (2009)		
Laséen and Svensson (2011)		
Odyssean forward guidance		
Krugman (1998), Eggertsson and Woodford (2003), Werning (2011), Levin <i>et al.</i> (2010), Campbell <i>et al.</i> (2012), Carlstrom <i>et al.</i> (2012), Del Negro <i>et al.</i> (2012), English <i>et al.</i> (2013), Coenen and Warne (2013), Eggertsson and Mehrotra (2014), Da Costa (2014), De Graeve <i>et al.</i> (2014), Gavin <i>et al.</i> (2014), Haberis <i>et al.</i> (2014), Florez-Jimenez and Parra-Polania (2014), Kiley (2014), McKay <i>et al.</i> (2015), Harrison (2015), Boneva <i>et al.</i> (2015), Gersbach <i>et al.</i> (2015)	–	Commitment, time-inconsistent
		Possible forms: open-ended; time contingent; state contingent (with or without thresholds)

in being less explicit and less unequivocal, for example highlighting the conditionality and uncertainty of the guidance, and not providing a clear date or threshold when the policy rate would be changed. 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.

The main contributions of this paper are as follows. First, we examine the theory and practice of communication about future policy rates; second, we survey recent contributions; third, we introduce Aesopian forward guidance; and finally, we propose approaches for modelling Aesopian guidance. No consensus has yet arisen in the literature about the reasons for and effects of communication about future policy rates. There is therefore still fertile ground for continuing research.

Overall, we conclude 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 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.

2. Theory of Communication about Future Policy Rates

The transmission mechanism of changes in interest rate forecasts or changes in forward guidance to financial market prices and the macroeconomy is not yet fully 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.

In the definition of Campbell *et al.* (2012), Delphic guidance includes provision of information about the central bank's likely monetary policy actions in addition to macroeconomic forecasts, and therefore about its monetary policy reaction function. Revealing information about the monetary policy reaction function is therefore part of Delphic guidance, and within Delphic guidance also of Aesopian forward guidance. Revealing information about the reaction function is an important aspect and a key motivation for publishing policy rate forecasts and for forward guidance, since the one thing monetary policymakers would be expected to have more information about than the public is their own monetary policy preferences. By contrast, policymakers may not necessarily have superior information about the economic situation than the public.³ We now discuss the theory underlying both types of communication.

2.1 Publishing Interest Rate Forecasts: Theory

Inflation targeting and the systematic publication of policy rate forecasts are not necessarily related. Although communication is a central element, not all IT central banks publish their own policy rate

forecasts. Still, as argued below, there are good reasons why this group of central banks may decide to publish their own policy rate forecasts independent of the economic situation. And in this respect, there is a difference with non-IT central banks that do publish policy rate forecasts.

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, it also communicates about future policy rates. As Mishkin (2004) points out, a central bank that uses an IT approach has three choices concerning the path of the policy interest rate on which to base its forecasts. The central bank could use a constant interest rate assumption, use market forecasts of policy rates, or rely on its own projections. Using a constant rate is not optimal because future projected rate changes will be necessary to keep inflation on the target path. It is also problematic to use market forecasts, as these are based on expectations of monetary policy and therefore cause circularity. Mishkin (2004) argues that inflation forecasts based on constant interest rates or market forecasts are not truly transparent as the central bank knows that neither of these paths is what the monetary policy authority plans to do. Woodford (2013) follows a similar approach by arguing that IT requires the bank to model its own likely future conduct as part of the projection exercise. Using either constant rates or market rates will result in inconsistencies. A consistent approach 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 objective to lower inflation of an IT central bank may be more credible if policymakers also announce the policy rate path they expect will be needed to achieve the inflation objective (Kahn, 2007). But if private agents do not understand the conditional nature of policy rate forecasts, monetary policy decisions not in line with the announced policy intentions may undermine the credibility of the central bank (Mishkin, 2004).

The modelling of regular policy rate forecasts has allowed for deviations from rational expectations and the introduction of asymmetric information. As suggested below in Section 2.2, this would also be desirable for modelling Aesopian forward guidance.

Eusepi and Preston (2007) incorporate asymmetric information between the central bank and private agents about the monetary policy strategy. This approach allows them to study communication about the path of nominal rates. The authors assume monetary policy of an IT central bank under discretion, rather than under commitment. They assume that the central bank does not have full information about private sector expectations formation. Therefore, the central bank cannot manipulate agents’ beliefs to its advantage, in contrast to time-inconsistent policies under commitment. Eusepi and Preston find that in the absence of communication, the policy rule does not stabilize macroeconomic dynamics. However, by announcing the details of the policy rate setting, stability is restored. This communication allows households and firms to construct more accurate forecasts of future macroeconomic conditions, leading to greater macroeconomic stability. Gosselin *et al.* (2008) also incorporate asymmetric information between the central bank and the private sector, and rule out time-inconsistency effects, considering discretionary policy. They find that publication of a policy rate path fully aligns central bank and private sector expectations about the future inflation rate. The private sector trusts the central bank to eliminate future inflation and sets the long-term interest rate accordingly, leaving only unavoidable central bank forecast errors as a source of inflation volatility. Gersbach and Hahn (2011) also study discretionary policy under symmetric information, but assume that the central bank incurs a cost if it deviates from its interest rate projections. They find that in the presence of cost-push shocks, the publication of interest rate forecasts tends to improve welfare.

Rudebusch and Williams (2008) assume that the central bank has better information about its policy intentions (i.e., the parameters of the policy rule and the medium-term inflation target) than private agents. They allow for asymmetric information, uncertainty, and deviations from rational expectations in the form of adaptive learning. Their conclusion is that publication of policy rate forecasts can increase macroeconomic stability under imperfect information and learning. Ferrero and Secchi (2009) study the conditions for determinacy and stability under learning when a central bank publishes interest rate forecasts, allowing for deviations from rational expectations in the form of adaptive learning by private agents, and for asymmetric information between the central bank and private agents. The effect of interest rate forecast innovations may be modelled as the effect of announced shocks to future monetary policy provided under commitment by the central bank and perfectly anticipated by the public (Laséen and Svensson, 2011).⁴

There are still challenges in modelling communication in the form of regular policy rate forecasts. Some theoretical approaches assume that the central bank commits to future policy actions (Rudebusch and Williams, 2008; Ferrero and Secchi, 2009; Laséen and Svensson, 2011). This is not realistic, since in practice central banks publishing regular policy rate forecasts have not done so under commitment, as discussed in Section 3.1 below. For such modelling approaches, there is consequently some gap between theory and practice.

2.2 *Forward Guidance: Theory*

Unusual circumstances such as the ELB provide a motivation for the provision of Aesopian forward guidance (i.e. ad hoc/episodic and without commitment) so that the central bank can explain its (time-consistent) monetary policy reaction function under these unusual circumstances, without trying to affect private sector expectations by providing time-inconsistent commitment to future policy rates.

Nimark (2014) models signals that are more likely to be available after unusual realizations of a latent variable, that is, in unusual economic circumstances, so that realizations of shocks matter for the type of signals that are available. He finds that conditional private sector expectations always respond more strongly to such a signal than to standard signals. This finding is consistent with private agents paying more attention to ad hoc (Aesopian) forward guidance provided by the central bank in unusual economic circumstances than to communication about policy rates provided on a regular basis in normal economic circumstances. Woodford (2005) suggests that ad hoc forward guidance about the policy rate may be most useful under special circumstances, such as those faced by the Federal Reserve in 2003, while other ways of guiding expectations may be more appropriate under more normal conditions.

2.2.1 *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).⁵ 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', that is, keep the future policy rates below levels consistent with its normal reaction function when the ELB is no longer binding. If the monetary policy authority can do so credibly, long-term rates (reflecting expected future short-term rates) will be reduced already in the current period. Through these long-term rates, the central bank can provide monetary policy accommodation, even though it can no longer do so directly by reducing today's short-term policy rate. However, this policy is time-inconsistent, since the costs of higher inflation arise only later, so that the central bank has an incentive to renege on its promise in the future. 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, although leading to better outcomes than discretionary 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. The intuition is that 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. The mechanism underpinning this result is based on deleveraging in the presence of households that are both borrowers and savers at different stages in their lives, rather than with a representative saver as in standard models of deleveraging. As in standard models, a deleveraging shock leads to a reduction in spending by borrowers at the existing rate of interest, and the real interest rate then falls so that the level of aggregate spending is unchanged. In contrast to standard models with a representative saver where the economy only experiences a brief transition with a negative interest rate during the deleveraging phase, the economy in this model settles down at a new steady state with a permanently lower real rate of interest. The effect of forward guidance in models assuming commitment relies on affecting expectations after the ELB shock has ended; since the shock in this model is permanent, manipulating these expectations has only limited effects.

Within a New Keynesian framework, Gersbach *et al.* (2015) model renewable forward guidance contracts, as a partial commitment device that can improve economic performance at the ELB. They study the case when the government commits to always offering a forward guidance contract in downturns and no contract in normal times, and the case when the government decides in each period whether to offer the forward guidance contract or not.

As in the case of interest rate forecasts published under inflation targeting, the effect of forward guidance innovations may be modelled as the effect of announced future shocks to a monetary policy rule with commitment, as discussed in Section 2.1 (Del Negro *et al.*, 2012; De Graeve *et al.*, 2014; Gavin *et al.*, 2014). It is worth noting that in practice central banks 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).

Several papers model Odyssean forward guidance as temporary deviations from the policymakers' monetary policy rule, which are unanticipated by private agents, and which private agents do not expect to be implemented again in the future (Del Negro *et al.*, 2012; Coenen and Warne, 2013; Haberis *et al.*, 2014; Boneva *et al.*, 2015). As Boneva *et al.* (2015) point out, the assumption that the deviations are unanticipated is not consistent with the otherwise rational expectations nature of the models, and therefore the models are subject to the problems of policy evaluation identified in Cooley *et al.* (1984) and Sims (1982). These problems are that if the parameters of a policy rule are subject to change, private agents should recognize this under rational expectations and have a probability distribution over the parameters of the policy rule, rather than assuming them to be constant. But policy evaluation assumes that private agents behave as if they know which policy rule is in force and are certain that the policy rule will be maintained into the indefinite future. However, under rational expectations private agents should attach a high probability to the current policy regime prevailing into the indefinite future only if the policy regime changes considered are indeed very rare. Boneva *et al.* (2015) model forward guidance as a fully credible state-contingent commitment, which is a temporary deviation from optimal discretionary policy. They point out that the modelling of forward guidance as a time-inconsistent credible commitment is at odds with their modelling of the baseline policy as time-consistent. These authors plan to address the problems

of the assumptions of forward guidance being unanticipated and not expected to be implemented again by modelling forward guidance at the ELB in a regime switching framework in future work.

2.2.2 *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). Similarly, 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. The explosive behaviour is a manifestation of the familiar problem induced by an interest rate peg: if the policy rate does not respond to endogenous variables in a DSGE model, but is fixed, then the model solution can become unstable.

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 (Coenen and Warne, 2013; De Graeve *et al.*, 2014). Another explanation is based on global solutions of a non-linear 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. Kiley (2014) presents a model within which imperfect information can reduce the effects of forward guidance (provided under credible commitment) in New Keynesian models, which provides another possible solution to the forward guidance puzzle.

Harrison (2015) argues that imposing paths for the policy rate using anticipated monetary policy shocks could represent a sufficiently large deviation from past monetary policy behaviour that the results from a single regime rational expectations model become unreliable (for the reasons highlighted by Leeper and Zha, 2003). He suggests that in rational expectations models, forward guidance should only be modelled using ‘modest policy interventions’ in the sense of Leeper and Zha (2003), which do not lead to a revision in private sector beliefs about the monetary policy regime. He points out a problem of the approach of modelling Odyssean forward guidance in papers such as Del Negro *et al.* (2012) exhibiting the forward guidance puzzle, which could be partly responsible for this puzzle, namely that the experiments considered do not constitute modest policy interventions, but lead private agents to believe that there has been a change in the monetary policy regime which is not accounted for in the model.

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. In contrast, 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 in DSGE models can depend on whether an exogenous or endogenous transmission channel dominates (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.

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. Hanson and Stein (2015) argue that in standard New Keynesian models with nominal price rigidities, changes in the monetary policy stance should not affect forward real rates at horizons longer than that over which nominal prizes can readjust, which plausibly includes horizons above around 10 years. If forward real rates are affected at such longer horizons, this reaction likely reflects changes in term premia, which could be generated by demand effects due to yield-oriented investors who care about current portfolio yield and not just expected holding-period returns.

2.2.3 *Thresholds and Escape Clauses*

Several recent papers study forward guidance augmented with thresholds or escape clauses, once again assuming commitment by the central bank (Coenen and Warne, 2013; English *et al.*, 2013; Florez-Jimenez and Parra-Polania, 2014; Boneva *et al.*, 2015). A threshold could mean something different for a central bank that already has an explicit inflation target than for a central bank without such a target. Odyssean forward guidance with thresholds at the effective lower bound may be modelled 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. Boneva *et al.* (2015) analyse threshold-based forward guidance using global solution methods. Relative to Florez-Jimenez and Parra-Polania (2014), Boneva *et al.* (2015) examine threshold-based forward guidance defined on endogenous variables (rather than exogenous shocks) and use the (more standard) infinite horizon variant of the simple New Keynesian model.

2.2.4 *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 is binding. Finally, a commitment to increase future inflation can reduce current consumption.

Andrade *et al.* (2015) present a model in which there is heterogeneity in the extent to which private agents believe that forward guidance is Odyssean or Delphic, while it is assumed that the forward guidance provided by the central bank is Odyssean. The macroeconomic effects of a forward guidance announcement therefore depend on the relative weights of these groups in the population. An announcement of a lower policy rate is interpreted as bad news about the state of the economy by agents with Delphic beliefs. As a result, when there are more agents of this type in the economy, the stimulus of a lower for longer policy is reduced. Andrade *et al.* (2015) present evidence from the US Survey of Professional Forecasters that forward guidance lowered disagreement about future short-term interest rates to historically low levels while it hardly affected disagreement about future inflation and future consumption, and interpret this evidence within their model of heterogeneous beliefs.

Most of the aforementioned studies assume that forward guidance policies are regarded as fully credible. The issue of imperfect credibility of forward guidance has been considered by Bodenstein *et al.* (2012) and Haberis *et al.* (2014). Bodenstein *et al.* (2012) study optimal future policy rate announcements in Sweden and in the USA 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.

2.2.5 Suggestions for Modelling Aesopian Forward Guidance

Faust (2015, p. 10) highlights that in full-information rational expectations equilibrium, Delphic communication about the monetary policy reaction function has no effects, since the public is assumed to know this reaction function. Since Delphic communication about the monetary policy reaction function has no effects in full information rational expectations equilibrium, one therefore needs to introduce deviations from full information rational expectations in order to give a role to and study the effects of Delphic forward guidance. These further modelling efforts include incorporating asymmetric information, and studying discretionary monetary policy in the presence of asymmetric information and uncertainty. In particular, models should incorporate asymmetric information between the central bank and the private sector about the monetary policy reaction function in order to model a clarification of the reaction function as a motivation for forward guidance.

Promising approaches to model Aesopian forward guidance are Markov regime switching models which allow incorporating uncertainty, asymmetric information and learning, and which could be solved under discretionary policy. Svensson and Williams (2008a) provide an overview of papers studying Markov switching models allowing for uncertainty and learning, including their own work on such models solved for optimal policy under commitment with symmetric information and learning (both adaptive and Bayesian) (Svensson and Williams, 2007a,b,2008b).⁶ Moreover, the ELB could be incorporated into such models in order to Aesopian study forward guidance at the ELB.

Markov regime switching models are challenging to solve, and more progress could usefully be made in research on such models, especially by including asymmetric information of the central bank and private agents, and by deviating from rational expectations. A challenge with considering deviations from rational expectations is that the problem becomes multidimensional in that there is a wide range of possible assumptions which can be made, and there is no good means of choosing among the assumptions. One example is replacing rational expectations by adaptive learning, for which there are many different specifications that lead to different results.

Our suggestion of using Markov regime switching models to model Aesopian forward guidance is consistent with the suggestion by Boneva *et al.* (2015) to address the problems of the assumptions of

forward guidance being unanticipated and not expected to be implemented again in the future as discussed above.

Moreover, Aesopian forward guidance at the ELB could be modelled by allowing for the ELB in existing models of Delphic regular policy rate forecasts incorporating asymmetric information about monetary policy preferences and learning, such as that of Eusepi and Preston (2007). Moreover, such models of Delphic regular policy rate forecasts could be adapted by restricting the policy rate forecasts to be episodic. Furthermore, models of regular policy rate forecasts allowing for asymmetric information and learning solved under commitment, such as Rudebusch and Williams (2008), could be solved under discretion instead, and the ELB could be incorporated within them.

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.

Also 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, that is, 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 A1 summarizes forward guidance by five major central banks. Policymakers have emphasized the motivation of revealing information about the monetary policy reaction function in providing forward guidance in the wake of the financial crisis, as the following quotes demonstrate. According to ECB

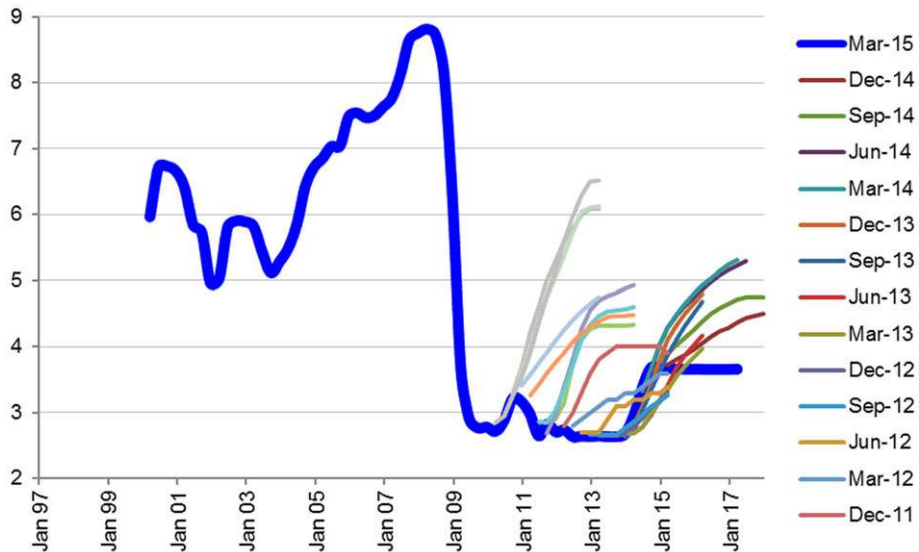


Figure 1. New Zealand 90-Day Interest Rate and RBNZ Forecasts (in Percent).

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.

President Draghi (2014), clarifying the monetary policy reaction function is particularly important in unusual/crisis situations, in particular at the ELB: ‘faced with the effective lower bound and different contingencies, we had to explain our future policy intentions and clarify our more complex reaction function’, and ‘the different contingencies in crisis conditions and the policy measures associated with them are unfamiliar to the public. This makes understanding our reaction function more complex’. ECB Governing Council member Coeuré (2013) mentioned that ‘The main challenge of such [Odyssean] guidance is its inherent inconsistency over time and thus lack of credibility.[...] This is a possible explanation why, in practice, central banks have refrained from using forward guidance in a way that implies a major change in strategy. Therefore, central banks’ forward guidance has rather aimed at providing greater clarity on the reaction function and the assessment of future economic conditions’.

Former Bank of England Deputy Governor for monetary policy Bean (2013) describes the threshold-based forward guidance introduced by the Bank of England’s MPC in August 2013 as follows: ‘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)’. Current Bank of England Deputy Governor for monetary policy Broadbent (2013) is explicit about the nature of the reaction function change that was being communicated in August 2013: ‘When there is no uncertainty about supply growth – when the only thing giving rise to unpredicted changes in output are shocks to “aggregate demand” – setting monetary policy is reasonably straightforward. [...] I think it’s not a bad description of those halcyon, pre-crisis days known as the “Great Stability”. [...] But as you become less confident about future supply, the unemployment data become more informative. This, in my view, is a key rationale for conditioning policy on the rate of unemployment, as we have in our policy announcement in August’.

Citing evidence from statements by FOMC chairs, Faust (2015) argues that ‘what remains is the rather mundane possibility that the central banks were attempting to explain their evolving understanding of a

broadly time consistent reaction function. In particular, they were explaining that this reaction function would dictate significantly more accommodation than the public seemed to be expecting'. In the unusual situation of the effective lower bound, the monetary policy reaction function is likely to differ from that in normal times (Yellen, 2015). At the ELB, the public is likely not to have known the (time-consistent) monetary policy reaction function, especially in view of unconventional monetary policy measures, including in the form of asset purchases; indeed, there was not even a consensus among professional economists about the appropriate reaction function at the ELB (Faust, 2015). Then Federal Reserve chair Bernanke (2013) mentioned that forward guidance was specifically related to the ELB, and that away from the ELB in a more normal monetary environment 'that kind of guidance won't be necessary anymore, because as was the case prior to the crisis, the markets can just look at the behaviour of the Fed and essentially extrapolate that behaviour to understand what the Fed is likely to do as the economy evolves'.

Threshold-based or state-dependent forward guidance can be provided under commitment. Some papers modelling Odyssean forward guidance allow for commitment to state-contingent responses (e.g. Eggertson and Woodford, 2003). But in practice central banks did not provide such a commitment to state-contingent responses. Then Bank of England MPC member David Miles emphasized that the Bank of England's forward guidance did not involve an unconditional commitment: 'It was absolutely not an unconditional commitment. What we said was that we would not raise interest rates at least until unemployment fell to 7%, provided the inflation outlook remained benign And neither did we commit to raise interest rates when unemployment fell to 7% (which it subsequently did fairly quickly)'. (Miles, 2014, p. 3). Former and current chairs of the Federal Reserve, Bernanke (2012) and Yellen (2014), both rejected the idea of intentional overshoots of inflation (Faust, 2015), which is part of the Odyssean forward guidance at the ELB of Eggertson and Woodford (2003). Faust, who worked as Special Advisor to the Board of the Federal Reserve, judges that the Federal Reserve and other central banks did not provide Odyssean forward guidance: 'Thus, I think the historical record is pretty clear that central banks did not attempt Odyssean guidance'. (Faust, 2015, p.11).

3.2.1 *Bank of Japan*

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 follows⁷:

[. . .] 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 the '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 BoJ introduced state-contingent forward guidance in October 2010, which was subsequently modified. 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,

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.

3.2.2 *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 started to use 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 A1). Subsequent modifications of the forward guidance are shown in Table A1.

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 FOMC, these projections do not necessarily coincide with those 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.

3.2.3 *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)

3.2.4 *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, an unexpectedly strong decline in unemployment forced the BoE already in February 2014 to change its guidance. A statement on 'Monetary Policy as the economy recovers' in the February 2014 Inflation Report included 'Despite the sharp fall in unemployment, there remains scope to absorb spare capacity further before raising Bank Rate' (Bank of England, 2014a, p. 8). 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)

Moreover, consistent with a Delphic nature of the BoE's forward guidance, the minutes of the August 2014 MPC meeting state:

The actual path for monetary policy, even after the first rise in Bank Rate, would, however, remain dependent on economic conditions. In other words, the Committee's guidance on the likely pace and extent of interest rate rises was an expectation, not a promise. (Bank of England, 2014b, p. 9)

3.2.5 *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).

Similarly, the ECB (2014) 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. Indeed, Issing (2014, p. 8), former member of the ECB's Governing Council, stated that 'A central bank should . . . under no circumstances make any unconditional commitments to its future policy'.

4. Empirical Evidence of Communication about Future Policy Rates

4.1 *Publishing Interest Rate Forecasts: Evidence*

4.1.1 *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) report 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.

4.1.2 *Conditionality of Forecasts*

The RBNZ, Norges Bank and the Riksbank have emphasized that their published interest rate paths are forecasts, not promises. Therefore, we argue that these forecasts should be thought of as Delphic in nature. For example, the RBNZ's (2014) 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'. Similarly, 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 understand the conditional nature of the 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.* (2016) report 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.

4.1.3 *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 (Bergstrom and Karagedikli, 2013; Kool and Thornton, 2014). 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) 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.

Svensson (2015) studies the extent to which the market anticipates the central banks' policy rate path, as well as the extent to which market expectations line up with central bank policy rate paths after the publication. For the Reserve Bank of New Zealand, the Riksbank and the Federal Reserve (in the latter case the policy rate path of FOMC participants since 2012, not of the FOMC decision-making committee). He finds that in many cases the market has anticipated the Reserve Bank of New Zealand's policy rate path quite well, and market expectations have lined up well with the path after publication. For the Riksbank, he finds more mixed evidence. He finds that the US experience includes cases where the market has anticipated the FOMC path quite well and market expectations have lined up well with the path after

publication. More recently, the market path lies significantly below the FOMC path. Svensson (2015) discusses these results for different states of the economy. During the global financial crisis, in February 2009, the market anticipated a big downward shift in the policy rate path by the Riksbank quite well, and after publication the market expectations of the future policy rate lined up quite well with the published policy rate path. In contrast, in September 2011, the Riksbank published a high and increasing policy rate path that was disregarded by the market. Market expectations before and after publication instead indicated a fall in the policy rate, expectations that predicted the actual outcome of the policy rate very well. He suggests that this can be understood with reference to the aggressive leaning against the wind and policy tightening that the Riksbank initiated in June/July 2010, because of concerns about household debt.

4.2 *Forward Guidance: Evidence*

4.2.1 *Effects of Aesopian Forward Guidance*

A number of studies have considered the effects of Aesopian forward guidance, that is, conditional forecasts made under special circumstances, on financial market prices. Table A2 summarizes these and other studies on the effects of forward guidance.⁸

4.2.1.1 *The USA.* Some empirical studies find that FOMC Aesopian forward guidance has been effective, that is, led to lower medium and long-term nominal interest rates. 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 guidance still holds when controlling for the effect of asset purchase announcements that coincided with some of the forward guidance announcements. Smith and Becker (2015) employ a VAR model including federal funds futures and macroeconomic variables using monthly data. They find that the effects of a forward guidance shock on the expected federal funds rate 12 months ahead are significant for the first 20 months after the guidance is provided. They also find that forward guidance shocks that imply a lower expected path of the federal funds rate decrease the slope of the expected funds rate curve, consistent with the findings of Moessner (2013). They also find that the peak effects on employment and prices due to a typical forward guidance announcement are similar to those due to a typical change in the effective federal funds rate before the ELB.

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 3–7 years ahead. Sinha (2015) examines the effects of FOMC forward guidance on higher moments of the risk-neutral probability densities derived from options on US Treasury yields in 2012 and 2013, and reports that FOMC forward guidance affected these higher moments.

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 2–5 years ahead.

Some studies examine the effect of FOMC forward guidance on other asset prices. 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 derived from equity index options. Consistent with

these results, Hattori *et al.* (2016) find that unconventional monetary policy announcements substantially reduced option-implied equity market and interest rate tail risks, with most of the impact due to forward guidance rather than asset purchase announcements. They perform event study regressions using daily data derived from equity index options and interest rate swaptions. 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.

Some recent studies go beyond forward guidance about future policy rates. For instance, Campbell *et al.* (2012) also include general communication about monetary policy and the economic outlook. Following Gürkaynak *et al.* (2005), they find that forward guidance significantly affects US Treasury yields since 2007. Swanson (2015) finds that forward guidance has relatively small effects on the longest-maturity Treasury yields and essentially no effect on corporate bond yields, while large-scale asset purchases (LSAPs) have large effects on those yields but essentially no effect on short-term US Treasuries. Both types of policies have significant effects on medium-term Treasury yields, stock prices, and exchange rates. Hanson and Stein (2015) perform event study regressions using changes in the 2-year nominal yield on FOMC announcement days as a proxy for changes in expectations regarding the path of the federal funds rate, for all FOMC announcement dates from 1999 to February 2012 (excluding five dates between 2009 and 2011 with significant news about LSAPs), that is, including but not restricted to dates when explicit forward guidance was provided. These authors find that a 100-basis point increase in the 2-year nominal yield on FOMC announcement days is associated with a 65-, 42- and 30-basis point increase in the 5-year, 10-year and 20-year forward real rate, respectively. As discussed above in Section 2.2, they argue that the effect on very long-term (around 10 years and greater) forward real rates likely reflect changes in term premia.

Hansen and McMahon (2015) use a FAVAR model to study effects of FOMC forward guidance on financial and macroeconomic variables, using tools from computational linguistics to quantify the forward guidance, defined more widely and not restricted to explicit forward guidance but including more general communication about monetary policy, as in Campbell *et al.* (2012). They find that shocks to forward guidance are more important than the FOMC communication of current economic conditions in terms of their effects on market and real variables, but neither communication has strong effects on real economic variables.

Greenwood *et al.* (2015) consider the theoretical effects of forward guidance about short rates versus forward guidance about quantitative easing programs within a no-arbitrage model of the yield curve, interpreting shocks to the expected path of future short rates and future bond supply as policy announcements that provide forward guidance on these variables. Forward guidance on short rates in their model works through the expectations hypothesis. They use this model to analyse the evidence on the effects of quantitative easing announcements in the USA. They find that this evidence is hard to square with changing expectations about short rates, but is more consistent with changing expectations about bond supply.

Engen *et al.* (2015) conclude that post-crisis private-sector forecasters pushed their expected time for the onset of tightening of US monetary policy progressively further into the future, presumably in response to the Federal Reserve's quantitative easing and forward guidance for the policy rate, which they consider jointly.

4.2.1.2 Other Countries. 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 2009 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.

For the euro area, the ECB (2014) states that its forward guidance introduced in July 2013 led to a lasting reduction in market uncertainty about the path of future short-term interest rates. Also, the ECB finds that it has reduced 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 A1) 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.

4.2.2 *Evidence on Delphic versus Odyssean Nature*

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 report that pre-crisis forward guidance by the FOMC significantly increased the sensitivity of 1-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 (2014a) study the effect of the ELB on medium- and longer-term interest rates in the USA. They find that the sensitivity to macroeconomic news of yields with maturities greater than 1 year was high from 2008 to 2010, but fell close to zero from late 2011. They argue that the latter finding may be partly due to the FOMC's forward guidance. Swanson and Williams (2014b) perform a similar analysis for the UK and the euro area, but do not consider the effect of forward guidance by the Bank of England and ECB, since the guidance was introduced only in August 2013 after the end of their sample period in December 2012. Raskin (2013) also studies changes in the sensitivity of US 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 6 months to 3 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.

4.2.3 *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 USA, 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 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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Notes

1. Recent experiences suggest that the lower bound on interest rates can be below zero. We therefore prefer using the term Effective Lower Bound rather than Zero Lower Bound.
2. We thank Patrick Honohan for suggesting the term Aesopian guidance to one of us during a seminar.
3. Romer and Romer (2000) demonstrate that the Federal Reserve's Greenbook forecasts outperform private forecasts. El Shagi et al. (2014) confirm the superiority of Greenbook forecasts for inflation and output using an extended sample (1968–2006). However, the relative forecast performance is not robust in the presence of large macroeconomic shocks such as the Great Moderation and oil price shocks.
4. 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) 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).

5. See also Werning (2011).
6. For other surveys on learning, see Evans and Honkapohja (2009b).
7. These sentences in Governor Hayami's press conference are only available in Japanese. We thank Toshitaka Sekine for help with translating them.
8. 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.

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Appendix

Table A1. 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% . . . '.
		February 2014	'Despite the sharp fall in unemployment, there remains scope to absorb spare capacity further before raising Bank Rate'.
	State contingent (without threshold)	February 2016	'The MPC judges it more likely than not that Bank Rate will need to increase over the forecast period to ensure inflation remains likely to return to the target in a sustainable fashion. All members agree that, given the likely persistence of the headwinds weighing on the economy, when Bank Rate does begin to rise, it is expected to do so more gradually and to a lower level than in recent cycles. This guidance is an expectation, not a promise. The actual path Bank Rate will follow over the next few years will depend on the economic circumstances'.
<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'.
	State contingent	October 2010	The Bank will maintain the virtually zero interest rate policy until it judges, based on the 'understanding of medium- to long-term price stability', that price stability is in sight, on condition that no problem will be identified in examining risk factors, including the accumulation of financial imbalances.
		February 2012	For the time being, the Bank will pursue the powerful easing by conducting its virtually zero interest rate policy and by implementing the Asset Purchase Program, with the aim of achieving the goal of 1 percent in terms of the year-on-year rate of increase in the CPI. The Bank will continue pursuing the powerful easing until it judges that the 1 percent goal is in sight on the condition that the Bank does not identify any significant risk, including the accumulation of financial imbalances, from the viewpoint of ensuring sustainable economic growth.
		January 2013	The Bank will pursue aggressive monetary easing, aiming to achieve the 2 percent target, through a virtually zero interest rate policy and purchases of financial assets, as long as the Bank judges it appropriate to continue with each policy measure respectively.
		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'.

(Continued)

Table A1. *Continued*

Central bank	Type of guidance	Date	Statement
		January 2016	BoJ states that it would continue with its program of “‘QQE with a Negative Interest Rate” 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 (with threshold)	December 2012	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’.
		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’.

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Table A1. *Continued*

Central bank	Type of guidance	Date	Statement
		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'.

Sources: Den Haan (2013); (update of) Bank of England (2013a); Filardo and Hofmann (2014).

Table A2. 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 to 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 to 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 to 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 to 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, that is, to a flattening of the yield curve.
Moessner (2015a)	Federal Reserve	June 2004 to 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.

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Table A2. *Continued*

Study	Central bank	Period	Method	Conclusion
Moessner (2014)	Federal Reserve	June 2004 to 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 to 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 to 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 3–7 years ahead.
Gürkaynak <i>et al.</i> (2005)	Federal Reserve	January 1990 to December 2004	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.
Campbell <i>et al.</i> (2012)	Federal Reserve	February 1990 to 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.

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Table A2. Continued

Study	Central bank	Period	Method	Conclusion
Moessner and Nelson (2008)	Federal Reserve	June 1998 to August 2007/ March 1994 to July 2007	Studies changes in sensitivity of interest rates/implicit 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 to 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 options.	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 6 months to 3 years ahead to economic surprises.
Swanson and Williams (2014a,b)	Federal Reserve	January 1990 to 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 1 year was high from 2008 to 2010, but fell close to zero from late 2011, which may be partly due to the FOMC's FG, in addition to the ELB.
Swanson (2015)	Federal Reserve	January 2009 to June 2015	Regressions of daily changes in asset prices on two derived factors, interpreted as forward guidance and LSAP factors.	Forward guidance has relatively small effects on the longest maturity Treasury yields and essentially no effect on corporate bond yields. It has significant effects on medium-term Treasury yields, stock prices, and exchange rates.
Smith and Becker (2015)	Federal Reserve	December 2008 to December 2014	VAR model including federal funds futures and macroeconomic variables using monthly data.	Effects of a forward guidance shock on the expected federal funds rate 12 months ahead are significant for the first 20 months; forward guidance shocks that imply a lower expected path of the federal funds rate decrease the slope of the expected funds rate curve.

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Table A2. Continued

Study	Central bank	Period	Method	Conclusion
Sinha (2015)	Federal Reserve	January 2012 to December 2013	Uses event study regressions to examine the effects of FOMC forward guidance on higher moments of the risk-neutral probability densities derived from options on US Treasury yields.	The author finds that FOMC forward guidance affected higher moments of the risk-neutral probability densities derived from options on US Treasury yields.
Hansen and McMahon (2015)	Federal Reserve	January 1998 to December 2014	FAVAR model to study effects of FOMC forward guidance quantified using tools from computational linguistics on market prices.	Shocks to forward guidance are more important than the FOMC communication of current economic conditions in terms of their effects on market and real variables, but neither communication has strong effects on real economic variables.
Hanson and Stein (2015)	Federal Reserve	January 1999 to February 2012	Event study regressions using changes in the 2-year nominal yield on FOMC announcement days as a proxy for changes in expectations regarding the path of the federal funds rate.	A 100-basis point increase in the 2-year nominal yield on an FOMC announcement day is associated with a 42-basis point increase in the 10-year forward real rate.
Hattori <i>et al.</i> (2016)	Federal Reserve	January 2008 to May 2014	Event study regressions using daily data derived from equity index options and interest rate swaptions.	Unconventional monetary policy announcements substantially reduced option-implied equity market and interest rate tail risks. Most of the impact was due to forward guidance rather than asset purchase announcements.