The Macroeconomic Effects of Forward Communication∗

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Abstract

This paper provides an empirical assessment of the effectiveness of forward guidance over different horizons, shedding new light on the strength of the “forward guidance puzzle”. Our identification strategy allows us to disentangle the change in future interest rates stemming from deviations from the systematic part of monetary policy (“target” and “forward guidance” shocks) and changes in future interest rates that are due to unanticipated revisions in the Central Bank’s economic outlook (“information” shocks). This allows us to make a qualitative assessment of the power of forward guidance. We investigate to what extent the horizon of guidance matters for its macroeconomic effects, and find that the more forward the shock is, the weaker is its impact on output and inflation. We thus conclude that the effect of a forward guidance shock is not only exaggerated in standard New Keynesian models, its slope is also reversed.

Keywords: [monetary policy, forward guidance, interest rates]

JEL classification codes: E43; E44; E52; E58; G12

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1 Introduction

In New Keynesian models, promises regarding future policy rates potentially have very strong effects on output and inflation – even in the very short run - through the expectations channel. The size of the effect of forward guidance crucially depends on the degree of forward-looking behavior. McKay et al. (2015) observe that, in a standard New Keynesian model, a promise to lower interest rates by 1 percentage point 5 years into the future has an effect on inflation that is 18 times higher than the effect of changing the interest rate by the same amount today. This does not seem very plausible. Likewise, Calstrom et al. (2015) show that keeping rates below the natural rate of interest for two years leads to unstable dynamics for inflation and output in the Smets and Wouters (2007) model, a finding termed the “forward guidance puzzle” in a paper by DelNegro et al. (2015). More muted responses to monetary policy promises far into the future can be achieved by introducing myopic agents in an otherwise standard policy model (Gabaix, 2017). Ultimately, how strong the effects of signaling the path of future policy rates really are remains an empirical question. This paper provides an answer to that question.

The aim of this paper is to investigate the empirical strength of the forward guidance puzzle, i.e. the puzzling theoretical prediction that forward guidance is more effective the further into the future it relates to. In order to do this, we need to come as close as possible to a forward guidance shock as the one identified in a standard New Keynesian model. There are several challenges in empirically identifying such a shock. First of all, we need to make sure that we abstract from the systematic component of (communication about future) monetary policy: central banks adjust their current policy rate, or guidance of future policy rates, in response to changing prospects for economic fundamentals. One way to account for this is to utilize data on market rates on monetary policy announcements dates. After all, under full information, movements in market rates within a narrow window around the time of the policy announcement should merely reflect policy surprises. The second challenge comes from the fact that these announcements may also reveal information about the central bank’s assessment of the economic outlook.\footnote{Earlier work has shown that it is crucial to account for this effect when evaluating the macroeconomic effects of policy surprises extracted from financial data. Campbell et al. (2012) use high-frequency data to estimate the effects of forward guidance in the post-crisis period and find that a negative forward guidance shock (i.e. a signal of lower future policy rates) leads to an decrease in expected output and inflation – the opposite of what theory would suggest. One possible explanation put forward by the authors is that signals of lower policy rates to come might be interpreted by market participants as...}
use the identification approach suggested by Jarocinski and Karadi (2018) to differentiate between surprises related to policy updates and surprises related to the central bank releasing private information about its economic outlook. The approach combines high frequency responses in interest rates and stock prices with sign restrictions in a VAR. However, Jarocinski and Karadi (2018) do not distinguish between a “target” shock and a “forward guidance” shock, which is crucial for our analysis. We therefore incorporate the assumptions from Gürkaynak et al. (2005) by adding an additional zero-restriction to our VAR: forward guidance shocks should not move the current short-term rate, but only longer maturity interest rates. Finally, we approximate the effect of forward guidance shocks of different horizons by utilizing forward rates of different maturities. This allows us to evaluate the slope of the forward guidance effect, thus ultimately being able to shed light on whether forward guidance is indeed more effective the further into the future it relates to.

The empirical analysis is based on data for Sweden, a country that publishes conditional forecasts of future policy rates along with projections of other key macro variables. This means its central bank has a history with forward guidance that goes beyond forward guidance in zero-lower-bound periods, allowing us to make more general statements about the effectiveness of such policies.

Our results confirm the findings of Jarocinski and Karadi (2018) that an information shock is followed by an increase in activity and inflation. Moreover, we find that it leads to an appreciation of the exchange rate. These findings are consistent with the interpretation that market participants update their views on current and future demand conditions based on the central bank’s assessment of the economic outlook. The impulse responses are very different following ‘traditional’ monetary policy and forward guidance shocks. Both shocks indicate that a monetary policy contraction (either now or in the future) will lead to a currency appreciation and a drop in output and (after some time) inflation. Guidance about future policy intentions induces larger impulse responses than current rate surprises. Most importantly though, the macroeconomic effects of a forward guidance revealed information about the future state of the economy. As also illustrated by Jarocinski and Karadi (2018) and Andrade and Ferroni (2018), failing to properly account for this problem could potentially lead to biased inference regarding the effects of monetary policy shocks.

The central bank of Norway also publishes such interest rate projections. We show some results for Norway too, but because a much lower number of financial instruments is available, we cannot assess the effectiveness of forward guidance over as many periods into the future as for Sweden. This is an important drawback of the Norwegian data.
shock decrease with the horizon of the guidance. Hence, our results are inconsistent with theoretical predictions from standard New Keynesian models. The results are robust to various VAR specifications.

There is now a large number of empirical works that investigate the effects of forward guidance on yields and other asset prices. Borio and Zabai (2016) provide an extensive survey of this literature and an overview of the quantitative effects. The overall impression is that these measures have been successful in moving asset prices. However, the majority of these studies focus exclusively on the various post-crisis variants of forward guidance as practiced by central banks in the US, UK, Euro area and Japan. It has also been difficult to distinguish between the effects of forward guidance and asset purchasing programs.

Although forward guidance seems to be effective in moving medium- to long-term interest rates at high frequencies, the empirical evidence on its effectiveness in moving key macroeconomic variables is still relatively scarce. Some exceptions are Andrade and Ferroni (2018), Smith and Becker (2015) and Bundick and Smith (2018). Andrade and Ferroni (2018) find that the ECB was successful in stimulating the economy when it was surprising the market with signals of future policy accommodation. Smith and Becker (2015) find that forward guidance, identified using a timing restriction, yields quantitatively similar effects on US employment and inflation as conventional policy shocks. Bundick and Smith (2018) find no disconnect between the empirical effects of forward guidance shocks and the predictions from a standard theoretical model. Even though they do not control for the information effect, they still find very strong economic effects of forward guidance. However, they only look at the effect of a 12-month ahead forward guidance shock, and are therefore not able to empirically evaluate the slope of the effects for varying horizons. In terms of assessing the macroeconomic effects of forward guidance over varying horizons, the paper that comes closest to ours is D’Amico and King (2016), who add survey forecasts to an otherwise standard VAR for the US. They use a mixture of sign and zero restrictions to identify the economic effects of news about future monetary policy (their equivalence of forward guidance shocks). They find quite sizable effects of forward guidance, and the effects increase with the horizon – in line with the

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3Borio and Zabai (2016) also summarize the literature on the macroeconomic effects of unconventional monetary policy, but the studies mentioned all evaluate balance sheet policies (such as asset purchases) rather than forward guidance. These studies all find positive effects on output and inflation, although the effects vary quantitatively.
predictions from standard New Keynesian models.

The rest of this paper is set up as follows. Sections 2 and 3 elaborate on our methodology and data, respectively. Section 4 presents the results, and Section 5 concludes.

2 Methodology

In this section, we present the empirical approach and identifying assumptions used to estimate the effect of the three policy surprises. The basic set-up is based upon Jarocinski and Karadi (2018), and extended in order to trace out the effectiveness of forward guidance for several horizons.

We assess the dynamic impact of the three shocks (conventional monetary policy shock, forward guidance shock, and information shocks) by following and extending the approach suggested by Jarocinski and Karadi (2018). This involves extending a fairly standard open-economy monthly VAR with variables reflecting high-frequency movements in various financial variables around monetary policy announcements, while imposing a combination of sign and zero restrictions. Jarocinski and Karadi (2018) utilize the high-frequency co-movements of both interest rates and stock prices in order to disentangle monetary policy shocks from information shocks. Theory dictates a negative relation between stock prices and monetary policy shocks: a monetary tightening will reduce the value of expected future pay-offs by both increasing the discount rate and potentially reducing future revenues due to an economic slowdown. However, when the central bank tightens monetary policy because its outlook on the future is better than expected, this can be considered a positive information shock. Positive information about the economy increases expected future revenues, and hence has a positive effect on stock prices. The correlation between stock prices and interest rate changes is therefore informative for the type of shock that drives the interest rate changes.

Because we are interested in splitting the monetary policy shock further into a target and forward guidance shock, we extend the sign restricted exo-VAR from Jarocinski and Karadi (2018) with a zero restriction on the impact of forward guidance. The rationale for this restriction comes from Gürkaynak et al. (2005). They argue that whereas a target surprise can potentially impact interest rates of all maturities, forward guidance can impact interest rates of all maturities but the very short one. How short this maturity
should be depends on the central bank and how often it has the opportunity to change interest rates. For most central banks, there is at least one month between rate meetings, and thus a commonly used maturity for the shortest end of the yield curve in this setting is a one-month interest rate.

For the identification scheme, we use a combination of sign and zero restrictions, following an approach similar to Arias et al. (2018). The model is estimated using a Bayesian approach with a flat prior. The prior is described in appendix XX

The baseline VAR can be expressed as follows:

\[ y_t = \alpha_y + \sum_{k=1}^{K} \beta_{y,k} y_{t-k} + \sum_{k=1}^{K} \beta_{m,k} m_{t-k} + \gamma_m \varepsilon_t^m + u_t^y \]  \hspace{1cm} (1)

where \( m_t \) denotes a vector of changes in \( N_m \) financial instruments around a policy announcement in month \( t \) and \( y_t \) is a vector of \( N_y \) macro economic variables. The vector of reduced-form residuals are given by \( u_t^y \). Changes in financial instruments on announcement days, \( m_t \), are assumed to be iid, so that \( m_t = u_t^m, u_t^m \sim N[0, \Sigma^m] \).

In order to trace out the effect of the policy shocks into the baseline VAR-model we need to transform the reduced form residuals from \( u_t^m \) into structural policy shocks. The mapping between the reduced form residuals and the structural shocks can be expressed as:

\[ u_t^m = Z_m \varepsilon_t^m \]

where \( Z_m \) is a matrix of structural parameters and \( \varepsilon_t^m \) represents the structural policy shocks. We impose zero and sign restrictions on the impact matrix \( Z_m \) following Arias et al. (2018). The restrictions follow from our identifying assumptions about the three types of shocks, and are summarized in the table below:

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\[ ^4 \text{In principle, a central bank has the possibility to change the interest rate at any time, but under normal circumstances will only do so at scheduled announcement dates – at least for the length of our sample.} \]

\[ ^5 \text{To generate a monthly series based on the event-based series for policy surprises we proceed in two steps. First we generate a daily series of cumulated surprises the last 31 days. The monthly series is the average of the 31-day cumulated daily series. This is the same procedure as in Gertler and Karadi (2015).} \]
Table 1: Identifying restrictions

<table>
<thead>
<tr>
<th>Shock</th>
<th>Monetary policy (current)</th>
<th>Monetary policy (forward)</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short rate</td>
<td>+</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Longer rate</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Stock market</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Notes: Restrictions imposed on the impact effects of the three structural shocks of interest. The short interest rate refers to an instrument that matures before the next interest rate meeting, typically a one-month interest rate.

Since the restrictions imposed are not sufficient to uniquely identify the structural shocks of interest, we have what is often called set identification, i.e. there will be a set of admissible parameter vectors that jointly fulfill both the zero and sign restrictions. As Jarocinski and Karadi (2018) describe, the prior on the rotations is uniform in the subspace where the sign restrictions are satisfied. In particular, we calculate the lower triangular Choleski decomposition of $\Sigma^m (C)$ and post-multiply it by a 3x3 orthogonal matrix, $Q$, taken from QR decomposition of a randomly drawn matrix, and rotated such that $CQ$ satisfy the zero restrictions.\(^6\) We store the draws where $CQ$ satisfies both the sign and zero restrictions.

We repeat this procedure until we have 10,000 rotations where both the zero and sign restrictions are satisfied. Each draw of the structural parameters will yield a unique time series for the structural policy shocks ($\varepsilon^m_t$). For each rotation we draw model parameters from the posterior. The above procedure, with the QR decomposition of a randomly drawn matrix, implies a uniform prior on the space of rotations $Q^*$ (Rubio-Ramirez et al., 2010). When computing uncertainty bounds we take all the draws into account weighting them according to the uniform prior on rotations.

\(^6\)2x2 in Jarocinski and Karadi (2018), as they only distinguish between a monetary policy shock an an information shock.
3 Data

The empirical analysis is based on data for Sweden, a country that publishes conditional forecasts of future policy rates along with projections of other key macro variables. This means its central bank has a history with forward guidance that goes beyond forward guidance in zero-lower-bound periods, allowing us to make more general statements about the effectiveness of such policies. The central bank of Norway also publishes such interest rate projections. We show some results for Norway too, but because a much lower number of financial instruments is available, we cannot assess the effectiveness of forward guidance over as many periods into the future as for Sweden. This is an important drawback of the Norwegian data.

In this section, we describe our dataset, which consists of two parts: asset price changes around monetary policy announcements, obtained from intra-day data and aggregated up to monthly series, and monthly data on macroeconomic variables. The former will enter the VAR as exogenous variables, whereas the macroeconomic variables will be endogenous variables in the VAR. Our sample covers the period from 2000 to 2018.

3.1 High frequency data

In order to extract monetary policy surprises from interest rates, we use intra-day changes in interest rates on announcement days. We also extract intra-day changes in equity indices. All intra-day data is obtained from the Thomson Reuters tick history (TRTH) database. We follow the literature (Gürkaynak et al., 2005; Gertler and Karadi, 2015; Jarocinski and Karadi, 2018, among others), and extract monetary policy surprises for a 30-minute window around the announcement, i.e. we take the change in the one-month interest rate from 10 minutes before until 20 minutes after the announcement. We choose to use day-long windows for the longer maturity interest rates, as we expect that most forward guidance will come from the published report (including interest rate projections) and the press conference, which follows half an hour after the announcement. Whereas US and European money markets are characterized by high trading volumes and liquidity, the Swedish and Norwegian markets are much smaller and trading occurs less frequent. We therefore allow for slower information processing in these markets by sing
day-long event windows.\footnote{Brubakk et al. (2017) evaluate several event windows and find that a short window is sufficient to measure the monetary policy surprise, but that this would not capture the full response to communication.}

We use forward rate agreements (FRAs) to measure interest rate changes over several horizons. These rates reflect market participants’ expectations of the three-month money market rate on a specific date in the future, plus a potential forward premium. More precisely, the first FRA (hereafter FRA1) reflects the expected three-month money market rate from the first upcoming IMM-date, FRA2 for the second upcoming IMM-date, etc.\footnote{The IMM-dates are the third Wednesday in March, June, September and December.} Note that the FRAs do not capture the prevailing interest rate. For Sweden, we have data available for FRA contracts up to 12 quarters (IMM-dates) ahead. For Norway, we only have a sufficient number of data points for FRAs 1 to 4. In order to calculate expectations further out on the yield curve, we rely on swap rates reflecting the expected average rate over the contract period.

As in Brubakk et al. (2017), we use constructed one-month rates in order to measure the monetary policy surprise. Ideally, we would like to use a one-month OIS/futures contract to extract unexpected changes in the key policy rate. However, although Sweden has an OIS-market now, it did not have one during the first few years of our sample. Norway does not have an OIS or interest rate futures market at all. We therefore construct a synthetic one-month interest rate instrument by using forward exchange rates (USDNOK and USDSEK) in combination with covered interest parity (CIP):

\[ \frac{F_t}{S_t} = \frac{1 + r_t^{us}}{1 + r_t^{loc}} \quad (2) \]

We use data on \( F_t \) (the one-month forward USDSEK and USDNOK exchange rates), \( S_t \) (the spot USDSEK and USDNOK exchange rates), and \( r_t^{us} \) (the one-month US interest rate), and can extract \( r_t^{loc} \) (the one-month Swedish or Norwegian interest rate) based on the above parity condition.

For Sweden, our measure of stock prices is based on the headline index, OMXSBGI (OMX Stockholm Index). In Norway, the headline index is heavily influenced by movements in oil prices. We therefore use a sub-index that has historically shown to co-move more with the domestic business cycle, rather than with international developments, as it mostly consists of consumer goods producers (OSE25GI – OSE Consumer Discretionary
GI Index). Intra-day data on these equity indices is available from 2005 for Sweden and 2001 for Norway. We use daily changes for our benchmark estimation, for which data is available for our full sample from 2000 to 2018. We perform robustness checks using intra-day (rather than daily) data on stock prices.

3.2 Monthly data

We include five low frequency variables in the VAR: the key policy rate, a one year money market rate, core inflation, an activity factor, and the nominal exchange rate. As a measure of core inflation we use CPI with fixed interest rate (CPIF) excluding energy in Sweden, and CPI adjusted for energy and taxes (CPI-ATE) for Norway, the core inflation measures used by respectively Sveriges Riksbank and Norges Bank. To obtain a monthly series on activity, we follow the methodology described in ?: we extract the principal component of a data set consisting of three frequently used monthly economic activity indicators (industrial production, retail sales and unemployment), and label this the ‘activity factor’. The one year money market rate is calculated as the average of the first four FRA-contracts. For the exchange rates we use trade weighed indices, the TCW-index for Sweden and the I44 for Norway. For these indices, an increase in value indicates a weakening of the domestic currency.

4 Analysis and results

In this section, we report the impulse responses of three shocks identified using a mixture of sign and zero restrictions. Our starting point is an estimated reduced form VAR with 6 lags. For the baseline specification we use monthly data on the policy rate, a one-year money market rate, core inflation, the activity factor and the nominal exchange rate, as discussed in the data section. The high frequency identification is based on changes in the one-month rate, the FRA3-contract and stock prices on the announcement day.
Notes: This figure shows the impulse responses from estimating our baseline VAR for Sweden, with five endogenous variables and three identified shocks: a current rate shock, a forward guidance shock, and an information shock. Sample is 2010-2018. The dotted lines show XXX confidence bands.
Figure 2: Norway IRFs

Notes: This figure shows the impulse responses from estimating our baseline VAR for Norway, with five endogenous variables and three identified shocks: a current rate shock, a forward guidance shock, and an information shock. Sample is 2010-2018. The dotted lines show XXX confidence bands.
4.1 Impulse responses

4.1.1 Sweden

In Figure 1, we show the impulse responses for the three identified shocks based on Swedish data. Tracing out the responses from a shock to the current policy rate, we note that a surprise tightening leads to an appreciation of the exchange rate and a slowdown in economic activity. Inflation increases somewhat on impact, but the mean-adjusted rate turns negative after roughly three months. A conventional monetary policy shock does not seem to have a very strong effect on the longer rates. At the same time, a surprise signal of a future tightening, i.e. a forward guidance shock, seems to be more effective than a conventional policy shock. A positive forward guidance shock is followed by a slowdown in activity, an appreciation of the currency and drop in the inflation rate. In contrast to a conventional tightening, there are no signs of a price puzzle. Hence, in summary, a positive forward guidance shock leads to a textbook contraction of the economy.

The impulse responses from an information shock can be found in the third column in Figure 1. A positive information shock is followed by an increase in both the current rate and the one-year rate. Presumably as a result the exchange rate appreciates. However, both activity and inflation increases, despite tighter financial conditions. This is exactly the responses one would expect in the face of a demand shock. However, the information shock is not a demand shock in the standard sense. Rather, it results from a revision of agents expectations of the economic prospects. One interpretation is that the information shock reflects new assessments or news communicated by the central bank on announcement days which are internalized by market participants.

It is worth emphasizing that we impose no restrictions on the responses in any of the monthly variables.

4.1.2 Norway

The results for Norway are shown in Figure 2. Qualitatively, the results are similar to those for Sweden. A surprise increase in the key policy rate lifts the one-year rate and leads to a slowdown in activity and a strengthening of the exchange rate. However, the inflation rate increases in the short run before falling below its sample mean. Hence,
there is an element of a price puzzle on impact, which has also been found in previous studies on the effect of monetary policy shocks. A positive forward guidance shock, i.e. an anticipated increase in future policy rates unrelated to the economic outlook, looks qualitatively similar to a shock to the current rate. However, the appreciation of the currency is stronger and longer-lasting. Furthermore there seems to be less of a price puzzle. Inflation picks up temporarily on impact, but drops back rather quickly. The quantitative effects on activity are quite similar to the ones obtained from a conventional monetary policy shock.

A positive information shock is accompanied by an increase in both the current rate and the one-year rate. Unlike the case of an unanticipated monetary policy shock, however, a positive information shock is accompanied by a pick-up in activity and increased inflation pressure, as would be expected. The responses are quite similar to those for Sweden.

4.2 A forward guidance puzzle?

Ultimately, we are interested in the power of a forward guidance shock aimed at different horizons. Does promising a lower rate 8 quarters from now have a stronger effect on output and inflation than promising a lower rate 2 quarters from now?

In order to investigate this we identify forward guidance shocks for different parts of the yield curve, by using announcement-day surprises based on all available FRAs, and estimate the corresponding impulse responses. So, compared to the baseline specification, we replace the announcement-day surprise in FRA 3 with the announcement-day surprise in FRA 4, then estimate the impulse responses for that VAR. We then replace it with the announcement-day surprise in FRA 5, then estimate the impulse responses for that VAR, etcetera. We can then compare the impulse responses for our variables of interest, inflation and activity, for the different forward guidance shocks, to evaluate whether the macroeconomic consequences of the forward guidance shock depends on the choice of forward rate agreement, and therefore implicitly the horizon to which it pertains.

We focus on Sweden in this section, as there is data available for forward rate agreements that cover all successive three month rates three years out.\(^9\) The results are sum-

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\(^9\)For Norway we only have forward rate series for a maximum of four quarters ahead. We provide some results for Norway in appendix XX using swap rates to calculate money market rate expectations beyond the one year horizon.
marized in Figure 3. For all of the identified forward guidance shocks, we report both the short run responses (after 6 months) and the maximum (in absolute terms) responses.

For inflation and activity, the results convey a fairly clear message. Following a forward guidance shock, the impulse responses in inflation and activity are weaker the more forward the shock is. This holds true both when we look at the short-run responses and the maximum impact. For the exchange rate the results are more hump-shaped. Taken at face value, the reported responses of the exchange rate seem to suggest that the impact increases, both measured by the short-run and maximum responses, as the horizon to which the promised rate hike pertains approaches 6 quarters into the future. As we continue further out, the responses decrease. Announcing an increase in the policy rate next quarter affects the exchange rate in much the same way as announcing a corresponding increase three years from now.

Overall, the results indicate that forward guidance aimed at moving expectations about policy rates in the near term is much more effective than forward guidance pertaining to policy rates further out on the horizon. This runs contrary to the implications from a simple New Keynesian model, where the exact opposite holds true.

We reach a somewhat different conclusion than D’Amico and King (2017), who found that the economic responses grow larger as the horizon of the guidance moves further into the future. One reason could be related to the fact that they use survey data in order to identify the anticipated shocks. In addition they impose rational expectations on the part of the agents in the economy, implying that expectations on average are in line with actual outcomes. The different conclusions could also be due to institutional differences. For example, in Norway and Sweden, most debt contracts are based on adjustable rates, mostly linked to the 3-month NIBOR rate, whereas in the US fixed rates, based on longer term contracts, are more common. Hence, in Norway and Sweden, economic decisions will be more sensitive to movements in money market rates, and expectations thereof.

4.3 Variance decompositions

In this subsection, we take a closer look at the relative importance of the three identified disturbances in driving the variation in both the high- and low-frequency variables. To this end, we calculate a set of forecast error variance decompositions. This is
Figure 3: Sweden IRFs

Notes: This figure shows the
not straightforward given the fact that we rely on sign restrictions when identifying the structural shocks. In the case of weak identification, the identified disturbances are not unique. In fact, we identify a vector of shocks for each rotation of the C-matrix. Hence, in principle we would have a set of variance decompositions, i.e. one for each rotation. Here, we report the forecast error variance decomposition based on the median impulse responses.\footnote{Other approaches followed in the literature include applying the impulse responses that comes closest to the median or, restricted to the Bayesian case, using the impulse responses from the most likely (mode) model. We also tested these alternative approaches as a robustness check, and the conclusions did not change in a qualitative manner.}

Figure 4: Variance decompostion high-frequency data

We start out by identifying the relative contributions of the three identified disturbances on the changes in the high-frequency variables on policy announcement days. The results can be found in Figure 4. We note that in both countries, the main bulk of the high frequency variation in the one month money market rate (short rate) is interpreted as driven by conventional monetary policy shocks. However, surprise revisions in the short rate due to revisions in fundamentals, i.e. driven by information shocks, appear to be more important in Norway than in Sweden. By construction, the forward guidance shock cannot explain high frequency movements in the short rate. Turning to changes in the forward three-month rate three quarters out (FRA3) on announcement days, we see that more than half of the variation is accounted for by the forward guidance shock, whereas the remaining variation is due to the information shock. The effect of the conventional monetary policy shock on the FRA3 is negligible. The results are quite similar for the two countries. Interestingly, the information shock is relatively more important for the FRA3 then the policy rate, especially in Sweden. Although the stock market is not the focus of this study, we note that variation in stock prices on announcement days...
are driven to a large extent by the information shock in Sweden, whereas conventional monetary policy shocks are relatively more important in Norway.

Table 2: Forecast error variance decomposition: Sweden

<table>
<thead>
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<th>Conventional</th>
<th>Forward guidance</th>
<th>Information</th>
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<td>4.1 3.3 3.2</td>
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<td>Inf</td>
<td>5 4.8 5.3</td>
<td>12.5 9.6 10.3</td>
<td>4.8 4.4 4.3</td>
</tr>
</tbody>
</table>

Notes: Forecast error variance decomposition of identified shocks for inflation, activity and the exchange rate at different horizons in per cent. Based on the median shocks at each announcement.

Table 3: Forecast error variance decomposition: Norway

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Forward guidance</th>
<th>Information</th>
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<td>CPI Act. FX</td>
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</table>

Notes: Forecast error variance decomposition of identified shocks for inflation, activity and the exchange rate at different horizons in per cent. Based on the median shocks at each announcement.

In Table 2 and Table 3, respectively, we show the forecast error variance decomposition for the low-frequency variables in Norway and Sweden at various horizons. For both inflation and activity, we note that the contributions are quite moderate at short horizons, but in general increase for longer horizons, as would be expected. In the long run, the three disturbances account for roughly 30 pct. of total monthly variation in inflation and activity in Norway. In Sweden, the corresponding number is close to 20 pct. Focusing on the two monetary policy shocks, we see that in Norway their relative importance is roughly equal, whereas in Sweden the forward guidance shock seems to dominate, accounting for roughly two thirds of the combined contribution to the variation in both inflation and activity. Turning to the exchange rate, we note that the highest relative contribution occurs after about 6 months. In general, the identified shocks explain a larger share of the exchange rate movements in Norway than in Sweden, both for the shorter and longer horizons.
5 Conclusion

In this paper we empirically assessed the power of forward guidance over different horizons. To this aim, we estimated a VAR in which current rate shocks, information shocks, and forward guidance shocks are identified by means of combining sign and zero restrictions on the impact matrix.

The results indicate the importance of controlling for the information component of monetary policy surprises obtained from high frequency identification (HFI). In line with recent findings in the literature, surprises based on information shocks have impulse responses that are very similar to those for demand shocks, and the opposite of a typical monetary policy shock. Both a conventional monetary policy shock and a forward guidance shock leads to an economic contraction. In terms of low-frequency variation, contributions from the forward guidance shock, i.e. revisions in expected future interest rates unrelated to revisions in fundamentals, is in general larger than the corresponding contribution from a conventional monetary policy shock, especially for Sweden.

We find that the macroeconomic effects of a forward guidance shock are smaller as the horizon of the guidance lengthens. Hence, our results indicate that forward guidance aimed at moving expectations about policy rates in the near term is more effective than forward guidance pertaining to policy rates further out on the horizon. We thus conclude that the effect of a forward guidance shock is not only exaggerated in standard New Keynesian models, its slope is also reversed.
Bibliography


Appendix

In this section we show that the results are robust to various specifications.

*Under construction.*

Using intra-day changes in stock prices and money market rates

Proxy-VAR

Sub-sample analysis

The forward guidance puzzle in Norway