Preliminary thesis: Forward guidance affects the interest rate term structure - is this in accordance with findings in the data?

MSc in Business: Major in Finance

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1 Introduction

Central banks have been able to affect the expected interest rates using various forms of forward guidance for many years, which started out as statements from the central bank concerning their perception of future intentions. In general, forward guidance is information communicated by the central bank regarding their own assessment of the future path of policy rates, with the main objective of influencing the public's expectations (den Haan, 2013). The concept of forward guidance is not new as it was introduced, in an early form, by the Reserve Bank of New Zealand (RBNZ) in late 1990s. Previously, the standard practice of central banks was to provide forward guidance based upon forecasts of target values in regards of inflation rates and economic growth. The communication of the central bank went through channels such as statements, speeches and press conferences. However, a few years after New Zealand introduced their forward guidance, Norway and Sweden adopted the method, in 2005 and 2007 respectively, by introducing an explicit form of forward guidance (Andersson & Hofmann, 2009). They took forward guidance a step further by introducing numerical forecasts of the interest rate path a few years ahead in their projections. The reasons behind Norway's move towards a more explicit form of forward guidance were, first of all, due to a change from having an exchange rate targeting regime to a flexible inflation targeting regime. Secondly, globalization played a huge part in changing the economy in general (Brubakk, Husebø, Maih, Olsen, & Østnor, 2006).

We classify forward guidance into two categories; Delphic and Odyssean forward guidance. As the short-term interest rate has a natural floor at zero, it cannot be used to stimulate the economy further once this point is reached, hence central banks needs other tools. One way to stimulate the economy further is to try to convince the market that the short-term interest rate will not be increased once the economy recovers, as is the case historically. Instead, central banks can wait until a target variable, be it inflation or growth, reaches a certain level before increasing the interest rate. This method of forward guidance is referred to as Odyssean, much like Odysseus tied himself to the mast to resist the sirens calls, the central banks must keep the interest rate low when it may be beneficial to increase them, even when interfering may improve present and future incomes (Jeffrey Campbell, 2013). Otherwise, their credibility in the market will deteriorate, and any future attempts to stimulate the economy at the zero lower bound will likely be fruitless as the central banks statements will most likely not be believed in the market, leaving market expectations unchanged.

Another way central bank use forward guidance is referred to as Delphic, named after the oracle at Delphi, which provided forecasts of the future given the current situation, but did not promise. Hence, these two methods differ in that Delphic forward guidance only releases forecasts, while Odyssean forward guidance releases forecasts along with a commitment to follow a certain path. Delphic forward guidance can be classified as a forecast of the evolution of the private economy, and is currently adopted by Norges Bank.

After the global financial crisis, many central banks reduced the policy rates close to the effective lower bound with the intention of stimulating the economy. However, they were faced with the problem of not being able to incentivize further stimulus through conventional means. In result, a higher focus on alternative tools available to the central banks occurred, such as forward guidance and quantitative easing. In 2012, the central bank of the United States, who follows Odyssean forward guidance, announced that they would keep interest rates low until they met two target variables (J. R. Campbell, Evans, Fisher, & Justiniano, 2012). More specifically, the policy rate was held low until they achieved an unemployment rate below 6.5% and an inflation rate above 2.5%. Further, shortly after the US, the bank of England followed the same strategy of forward guidance, i.e. similar manner of conditioning the future interest rate path on the developments in the inflation and unemployment rates.

When it comes to the central bank's policy intentions, transparency could help align market expectations with monetary policy by reducing uncertainty about the future (Bernanke, 2013). Hence, central banks who are being transparent in their monetary policy can achieve their intentions in a more efficient manner by influencing private sector expectations, given that the central bank has credibility and is likely to be believed by the market participants. Woodford (2003) argue that monetary policy boils down to the “management of expectations”. Woodford’s beliefs are in accordance with the previous Governor of the Norges Bank, Svein Gjedrem (Woodford, 2005). In 2006, Gjedrem held a speech where he explained the new monetary policy to the public. According to him, communication and transparency are essential for monetary policy effectiveness. Furthermore, to communicate directly to the public is perceived to be to more probable of achieving an effective monetary policy by the central bank compared to comment implicitly on other participants expectations (Gjedrem, 2006). More specifically, he stated that monetary policy is only effective if the central bank is able to affect interest rate expectations. The latter, may prove challenging as market participants rely on their own assessment of the interest path based on their estimate of current and future economic variables. Hence, the interest rate path intended by the central bank may deviate from the interest path based upon the expectations of market participants. However, this difference decreases when the central bank has more credibility as well as a predictable monetary policy.

Inspired by the paper “Forward guidance through interest rate projections: Does it work?” by Brubakk et al. (2006) this thesis will contribute to the literature by testing how effective Norges Bank’s forward guidance is in affecting the interest rate term structure. Furthermore, this will be done through interpreting findings in the data. More specifically, we are going to investigate the relationship between the term structure of interest rates projected by Norges Bank and the interest rate path predicted by market participants. We will investigate how well these two projections align with each other through an empirical study. In order to do this, we will apply a methodology introduced by Gürkaynak et al. (2005).

2 Research question

Research question: ***“****Forward guidance affects the interest rate term structure - is this in accordance with findings in the data?”*

3 Theories and framework

3.1 Theoretical framework

One of the first theoretical framework that we will use when evaluating the communication of Norges Bank and their use of forward guidance in this thesis, is the Communication Theory developed by Shannon (1948). In this theory there is a "sender" that communicates a "message", or a piece of information, to a "receiver". This information is passed through a "channel" from the sender to the receiver, which typically contains some "noise" which may distort the message to various degrees. In our case, the sender is represented by Norges Bank and the receiver by the market participants. The channel Norges Bank uses is the monetary policy and the following press conferences. Norges Bank publish the expected three-month money market rates over the horizon of up to three years and indicate that, depending on other future assessment of the economy, the future rates can be expected to be equivalent to the published path. However, the market rate does not necessarily fully adjust to the published interest rate path for several reasons, one being that the market participants may not find the path credible or that it does not align with their own assessments of key economic variables in the future. Another reason is that the information that Norges Bank sends to the receivers, the market participants, which include the forecasts as well as their assessment of the uncertainty attached to the forecasts, may be unclear or inconsistent with the interest rate path message. Thus, the noise in the channel may distort the message causing the market participants reaction to deviate from the reaction intended by Norges Bank (Brubakk, ter Ellen, & Xu, 2017).

3.2 The expectation hypothesis

One of the most applied theories used to describe the term structure of interest rates, or the shape of the yield curve, is the expectations hypothesis (Fisher, 2001). According to the expectation hypothesis (EH), a major part of the prices of long-term bonds depends on expectations of future short-term interest rates. These expectations are extracted from forecasts of the future outlook of the economy and is thus determined by the market. Whereas the other interest rates are determined without any direct control by the central bank, however, the interest rates also depend on the current short-term interest rate, which is determined by the central bank. Specifically, the long-term rates are dependent on the current short-term interest rates. Thus, the lower the short-term interest rate is, the lower the long-term interest rate has to be. These assumptions are fundamental in the EH, other fundamental elements are that a no- arbitrage condition must hold and that investors are risk neutral (Bodie, Marcus, & Kane, 2014).

Summarized, the EH specify that interest rates with different maturities vary due to changes in the future short-term interest rates, which are determined by the market based on macroeconomic forecasts. In accordance with the prediction of the theory, one can know what investors are expecting the future interest rate to be, by solely looking at the present period's yield curve. Hence, the EH can be used to explain why bonds with different time to maturity may have various yields, as the current yields reflects investors beliefs in regards of future interest rates. In general, the hypothesis can be expressed as follows:

$$(1+r_k)^k \times [1+E({}_kr_n)]^{n-k} = (1+r_n)^n \qquad (1)$$

$$\Rightarrow \; [1+E({}_kr_n)]^{n-k} = \frac{(1+r_n)^n}{(1+r_k)^{\,k}} \qquad (2)$$

Thus, one can see that the present interest rate, denoted as r_n , depends on a previous period's interest rate, $r_{k,}$ multiplied with a previous period's *expected* interest rate for the period present period, denoted as $E({}_kr_n)$. Further, one can apply the following, commonly used, relationship in finance where one derives the forward rate from today's spot rates from the yield curve:

$$ {}_{n-1}f_n = E({}_{n-1}r_n)] \qquad (3)$$

According to the relationship, the higher the expected future spot rate is, the higher the forward rate will be. In addition, one notices the close relation between the predictions of the expectations theory and the forward interest rate, since the forward rate is derived from the present spot rate.

Another way of presenting the EH is the following. The hypothesis of the term structure of interest rates asserts that the long-term rate is equal to the expected short-term rate over the holding period of the long-term security, in addition to a constant risk premium. Further, the EH implies that a change in the short-term rate set by the central bank will have a greater impact on longer-term yields the longer the central bank commits to keep the policy rate at the chosen level. Furthermore, increased predictability of the short-term rate influences the predictability of long-term rates as well, as implied by the EH (Kool & Thornton, 2012).

According to Della Corte, Sarno & Thornton (2008) the EH can be expressed the following way, in case of pure discount bonds:

$$i_t^{(n)} = \frac{1}{k}\sum_{i=0}^{k-1} E_t\left[i_{t+mi}^{(m)}\right] + c^{(n,m)} \qquad (4)$$

Here, $i_t^{(n)}$ refers to the interest rate over a long-term *n-* period which can be related to a short-term *m- period* interest rate, expressed as $i_t^{(m)}$. The term premium between the *n-* and *m-* period bonds, which may also vary with the maturity of the rates, is denoted as $c^{(n,m)}$. Further, $k = n/m$ and is restricted to be an integer, whereas E_t refers to the mathematical expectation conditional on information set I_t available at time *t.*

Unfortunately, a majority of the literature regarding the EH have struggled in finding evidence supporting the validity of the hypothesis, as it has been rejected several times in empirical studies. Studies performed by, among others, Roll (1970), Fama and Bliss (1987), Campbell and Shiller (1991), Bekaert, Hodrick and Marshall (1997) and Sarno, Thorton and Valente (2007) have all found evidence in disfavor of the theory. However, Longstaff (2000) and the extended work done by Della Corte et al. (2008), have found favorable evidence of support by using a different approach in their studies (by testing at the extreme short end of the yield curve).

3.3 Term structure of interest rates (the yield curve)

In 1987, Nelson and Siegel introduced a parsimonious model of the term structure of yield curves. The need for such a model was recognized ten years before its introduction by Milton Friedman (1977). The fairly simple and flexible model is aimed at representing the range of shapes generally associated with yield curves, which concerns the monotonic, humped and S shapes of the term structure of interest rates (yield curves).

The yield curve is a graphical representation of the different interest rate paid by bonds with the same level of risk but different maturities. Further, the yield curve portrays the relationship between both short- and long-term interest rates as the yield-to-maturity (YTM) acts as the interest rates for bonds with different maturity dates. The YTM of a bond is the expected return of a bond if it is held to maturity, assuming that it does not default. Campbell (1995), Ang and Piazzesi (2003) and Rudenbusch and Wu (2007; 2008) argue that working with continuously compounded yields, log yields, are preferable when working with YTM.

We can find the yield, YTM, of a zero-coupon bond as:

$$P_{m,t} = \frac{\$1}{(1+Y_{m,t})^m} \qquad (5)$$

Where $P_{m,t}$ is the price of a m-year zero-coupon bond with a current face value of \$1, at time *t*. To be able to work with continuously compounded yields we need to take logs of equation (5) and get:

$$y_{m,t} = \frac{-1}{m}\log(P_{m,t}) \qquad (6)$$

where $y_{m,t} = \log(1 + Y_{m,t})$.

Barr and Campbell (1997) argue that studying the prices of long-term bonds show information about expectations of the future that cannot be observed any other way.

Hence, the yield curve has proven itself as a tool for economists such as policy setters and other financial investors. As previously explained, Norges Bank regulate the short-term interest rate, while the long-term interest rate is regulated by a combination of banks, market participants as well as supply and demand. Norges Bank's ability to influence the long-term interest rates are subjected to market participant's expectations of the average short-term interest rates. Barr and Campbell (1997), as well as Goodfriend (1998), presents that the long-term bonds also differ from short-term bonds by containing a premium for expected inflation, which may serve as an indicator of Norges Bank's credibility in their managing of inflation targets.

4 Research methodology

The objective of this thesis is to study the extent the forward guidance by Norges Bank is conveyed to market rates after the announcement of their published interest rate path. Based on data from Norges Bank we investigate the impact of the Norges Bank's forward guidance on various interest rates. The research methodology we will use will follow a similar fashion as the one used by Brubakk et al. (2017), who were inspired by the methodology developed by Gürkaynak et al. (2005). The latter, from now on referred to as GSS, can be used in order to test the effects of the monetary policy, communicated by Norges Bank, on various interest rate instruments. The data used, which will be specified more in the next section, is high-frequency data around announcements. This will be done in order to identify monetary policy surprises and its corresponding effects on different interest rates' term structures. Through the interest rate instruments, one can get knowledge of the market participants' expectations in regards of future interest rate settings. In return, this enables us to extract the market's expectations of Norges Bank's rate setting at the next meeting, as long as we use an instrument that has a horizon short enough to solely include the expectations in terms of the next interest rate meeting. Therefore, a monetary policy surprise can be measured by studying the change in the chosen short-term instrument from right before the meeting until shortly after the meeting is held.

Further, we will apply the factor- based methodology introduced in GSS. This enables us to summarize a set of correlated observed variables by a smaller set of independent unobserved variables, i.e. factors, which are the typical components of the observed variables:

$$X = F \wedge + \varepsilon \qquad (7)$$

In Equation (7) we let X denote a T x n matrix, where the columns of X corresponds to changes in money market instruments, and the rows corresponds to announcements regarding monetary policy. The matrix summarizes desired variables for our research, which will consist of various responses in money market instruments, with less than approximately 1 year to maturity, caused by monetary policy announcements from the central bank. Furthermore, matrix F is a T x k matrix with T rows and $k < n$ columns, consisting of unobserved factors, whereas $\wedge$ is a k x n matrix of factor loadings and ε is a T x n white noise disturbances matrix. Based on these relations, we want to investigate further how many factors (columns of F) we need in order to describe X sufficiently. Similar to the investigation performed by Brubakk et al. (2017), we intend to perform a rank test (as in GSS) in order to choose the number of adequately factors to employ when explaining the ordinary variation of the instruments used.

5 Data collection

We will use high-frequency data from Norges Bank from 2001 to present day to study the effect of the monetary policy by Norges Bank on the yield curve. To do this we intend to use the same approach as Brubakk et al. (2017) in order to measure the target and path factor, as well as their influence on several financial instruments before and after 2005. The reason for the chosen dates is that Norges Bank started with inflation targeting in 2001 and later started publishing the interest path in 2005. In order to assess the effect these published interest rate paths have had on the term structure of interest rates we compare data from 2001-2005 and 2005-present date.

However, due to the limited size and liquidity in the Norwegian government bond market we use swaps instead of government bond yields in the analysis of long-term rates. We will also have to create a synthetic one-month interest rate instrument by using the covered interest rate parity.

Regarding data collection for the forward guidance by the Norges Bank we are going to use the announced interest rate paths, which appear in the monetary policy reports.

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