# The effects of economic news on Norwegian market interest rates

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**Interest rates and other financial asset prices are based on expectations about economic developments. Asset prices react to new information. In this article, we explore the effects of news about key macroeconomic variables, external impulses, Norges Bank's interest rate decisions and the communication of monetary policy on Norwegian interest rates.**



## 1 Introduction

An overview of the days with the largest movements in markets rates since the beginning of 2001 shows that interest rates react strongly to certain news or surprises (see Table 1). These "large" changes, which all occurred in the period up to February 2004, reflected either surprising interest rate decisions, monetary policy signals in speeches or at monetary policy meetings, surprising CPI figures or in a few cases international interest rate movements. None of the observations on the list is from the past three years. Have market participants been exposed to fewer surprises over the past three years, or do they react less to surprising macroindicators or monetary policy signals than earlier? It is relevant to investigate this in the light of the changes in monetary policy frameworks in Norway and internationally through the period.

**Table 1.** Days with large interest rate changes. Ranked according to change in 12-month money market rate in the period 1 January 2001–30 June 2007. Interest rate changes in basis points

| Date | Interest rate change | Event |
|---|---|---|
| 03.06.2003 | –42 | Speech by central bank governor |
| 25.06.2003 | –30 | Monetary policy meeting and inflation report |
| 19.09.2001 | 30 | Monetary policy meeting |
| 18.09.2001 | –28 | Interest rate cuts by FED and ECB |
| 20.02.2003 | –27 | Annual address 2003 |
| 12.12.2001 | –26 | Monetary policy meeting |
| 17.12.2003 | –26 | Monetary policy meeting |
| 10.02.2004 | –25 | Consumer Price Index |
| 10.07.2003 | –23 | Consumer Price Index |
| 23.01.2002 | 22 | Monetary policy meeting |
| 13.08.2003 | –22 | Monetary policy meeting |
| 03.12.2002 | –21 | Speech by central bank governor |
| 11.12.2002 | –21 | Monetary policy meeting |
| 01.08.2003 | 20 | International interest rate increase |
| 10.12.2003 | –17 | Consumer Price Index |

Source: Norges Bank

The monetary policy objective of most central banks is price stability. Monetary policy operates with a lag, i.e. it takes time for changes in official policy rates to influence real economic variables and prices, and central banks' interest-rate setting will therefore reflect the outlook for output, employment and inflation. Information about the current situation in the economy is an important source of information when assessing future prospects. Central banks and market participants follow current developments in macroindicators. If they contain new information about the outlook, this affects interest rate expectations. A number of international studies confirm that key figure releases influence interest rate expectations. US key figures have a particularly strong impact on US interest rate expectations, but also on interest rate expectations in other countries.

Market participants do not fully understand how central banks assess the economic situation or how they will react to new information. Market interest rate expectations are thus also influenced by actual interest rate decisions and by central banks' communication of the monetary policy strategy ahead. The monetary policy framework in Norway and many other countries has changed considerably. A common feature is the shift to greater monetary policy transparency. Mervyn King, Governor of the Bank of England, has described this as a development where "mystery and mystique have given way to transparency and openness". With greater openness about monetary policy the degree of asymmetric information between central banks and the public has been reduced. Monetary policy has become more predictable, which has reduced the uncertainty about future interest rate developments. In tandem with the emphasis on transparency, there has been an international tendency towards a more gradualist approach to interest rate setting[2], perhaps best illustrated by the Federal Reserve's rate hikes from June 2004 in 17 increments of 0.25 percentage point. These changes have contributed to reducing the volatility of short-term interest rates and market participants have been less surprised by central banks' interest rate decisions than earlier.

[1] We thank colleagues in Norges Bank for useful input. In particular, we would like to thank Ida Slettahjell, who in the summer of 2006 systematised a large share of the data used in the article.

[2] Bernanke (2004) undescores the uncertainty of the effects of interest rate changes and the importance of not destabilising financial markets as the two most important arguments for gradualism in monetary policy.

We examine how Norwegian interest rate expectations, as measured by implied forward rates, react to macroeconomic news and monetary policy decisions, and whether these relationships have changed as a result of the shift to greater transparency in the conduct of monetary policymaking. The analysis is based on data that we have collected about news and market reactions, an overview that includes the most relevant news since the beginning of 2001.

Section 2 provides a review of the relevant literature in the field. Our selection of data and modelling strategy is explained in section 3, while the findings are discussed in section 4. Section 5 concludes.

## 2 Existing literature

Several international studies have examined how interest rates and other asset prices react to the publication of key macroeconomic figures, central banks' interest rate decisions and communication.

An often cited finding in the litterature is that news about US key macroeconomic variables have a strong impact on financial data in the US and in other economies. Goldberg and Leonard (2003) find that news about the US labour market, GDP growth and consumer confidence influence US yields, while European key figures have little impact on US interest rates. In many cases, US key figures have a stronger impact on European interest rates than European key figures. Goldberg and Leonard argue that this phenomenon probably reflects a view among market participants that developments in the US are important for global growth and that the economic situation in different countries has become more synchronised. Moreover, the European Central Bank points out that US key figures are normally published earlier than European figures, giving the former the role of leading indicators for European financial markets (ECB, Monthly Bulletin, 2006).

Most studies analyse the effects of news on a single instrument, e.g. short-term forward rates or long-term forward rates. However, Fleming, Piazzesi and Remolona (2003) analyse the effect of macroeconomic news on the entire US yield curve. They find that strongest effects on interest rates in the maturity segment one to five years, with a peak at two to three years and declining thereafter. This has been referred to as the hump-shaped yield reaction with regard to term structure.

High-frequency data can be used to examine how quickly interest rates react to the release of key figures. Fleming and Remolona (1997) find that the most of the response is completed within two minutes. Most studies confirm that new information has a rapid effect on yields.

In recent years, central bankers and others have analysed how the link between information and yield reactions has changed as a result of the shift towards more independent and transparent central banks. Kohn and Sack (2003) find that for the US communication in connection with interest rate decisions and Congressional testimonies have a significant impact on US interest rate expectations, and that communication has a greater impact on interest rate expectations in the longer term than the actual interest rate decisions.

Conelly and Kohler (2004) investigate, among other things, how interest rates respond to communication by the central banks of Australia, Canada, the euro area, New Zealand, the UK and the US. They find that the predictability of actual interest rate decisions is about the same for all the countries. This indicates that the central banks are fairly similar in terms of communicating the monetary policy strategy ahead. They find that the main central bank communication channels are comments on interest rate decisions, monetary policy reports and testimonies before national parliaments.

Most studies assume that interest rate changes reflect changes in interest rate expectations and therefore disregard changes in risk premiums in markets. Using affine term-structure modelling on US rates, Beechey (2007) demonstrates that macroeconomic news announcements influence both forward rates and term premiums. At short horizons, changes in interest rate expectations account for most of the rate changes. At longer horizons, changes in term premiums account for most of the changes in forward rates.



## 3 Data and model

Our data for Norway comprises 1 637 daily observations between 1 January 2001 and 30 June 2007. For each day, the data set contains information about changes in Norwegian forward rates and any news released that day. News announcements include what is assumed to be the most important macroeconomic variables published monthly and all of Norges Bank monetary policy meetings. In addition, we have included the Governor's annual address and two additional speeches.[3] The data set is compiled using Norges Bank's ongoing internal reporting on market reactions to key macroeconomic variables, monetary policy meetings and other events of importance for market rates. We have also included euro-area interest rates as a representative of international news.

### *Key macroeconomic variables*

Key macroeconomic variables include five variables for the Norwegian economy; the consumer price index adjusted for tax changes and excluding energy products (CPI-ATE), two unemployment measures, one figure for retail trade sales and a credit indicator. These are key figures that are published monthly and that market participants have been shown to monitor closely. The variables are further described in Table 2.

The news component (or surprise) of the release of key figures is calculated as the difference between

[3] In two of the speeches delivered in the period 2001–2007, the introduction stated "an assessment of some new aspects of economic developments is also presented". The two speeches in question were given on 3 December 2002 and 3 June 2003.

actual outcomes and the anticipated value of the key aggregate. Expected value is set equal to the average survey-based market expectation, measured by expectations surveys.[4]

News components are standardised by dividing the difference between actual outcome and expected value by the series' standard deviation.[5] As a result, the series with the different key variables' surprises can be compared. Descriptive statistics for the key variables are shown in Table 3. In addition, a complete overview of all the deviations between expected and actual CPI-ATE through the period is provided in Chart 1.

In the period since the beginning of 2001, changes in the CPI-ATE and registered unemployment have on average been slightly lower than expected, while the changes in retail sales and C2 have been higher. Retail sales are considerably more volatile than the other key variables because the projections for retail sales are less accurate than for the other key variables.

In the time series for each key variable, the value is set equal to the standardised surprise on release days and zero on all other days.

## *External news*

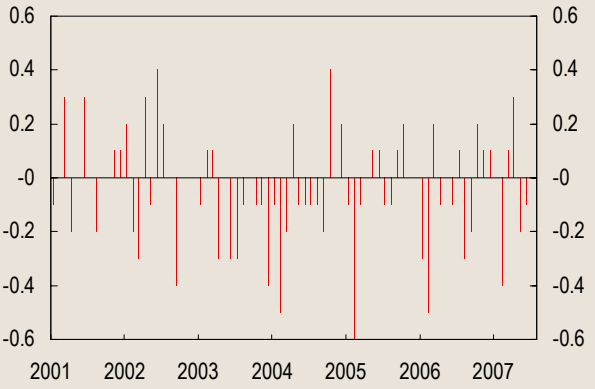
Earlier studies have shown that US key figures influence global interest rate expectations, including in the euro area. Experience indicates that Norwegian interest rates, particularly long-term interest rate are heavily influenced by European interest rates. We assume that international news in the form of key macroeconomic key variables, monetary policy decisions and communication, etc., is continuously incorporated in Europeans financial asset prices so that short-term and long-term euro area interest rates capture the most relevant international news for Norwegian interest rate expectations. Daily changes in three-month money market rates and

**Table 2:** Description of key variables

| Key variables | Explanation |
|---|---|
| Consumer price index, CPI-ATE | 12-month increase in consumer prices index adjusted for tax changes and excluding energy products (CPI-ATE). The index is published monthly by Statistics Norway and comprises personal consumer goods and services in Norway. |
| Unemployment, LFS | The unemployement rate according to the labour force survey (LFS). Measured as a seasonally adjusted moving average and published monthly by Statistics Norway. The LFS includes all persons in the age group 15–74 registered as resident in Norway.* |
| Registered unemployment | Published monthly by the Norwegian Labour and Welfare Administration and based on registered unemployed and jobseekers. |
| Retail sales | Retail sales index published monthly by Statistics Norway and describes retail sales growth in value terms. |
| Credit indicator, C2 | The credit indicator (C2) is published monthly by Statistics Norway and measures 12-month growth in private gross domestic debt. |

* Prior to 2006 the age group 16–74 was defined as age at year-end. From 2006 age is defined as age at the survey's reference date and the lower age for inclusion was reduced to 15.

**Chart 1** 12-month rise in the CPI-ATE. Difference between actual outcome and expected value. Percentage points.




Source: Statistics Norway and Norges Bank

**Table 3**: Domestic key variables, Norges Bank's interest rate decisions and external interest rate variables. Descriptive statistics for actual outcome less expected value. Percentage points

| | Number | Average | Standard-deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| *Domestic key variables:* | | | | | |
| Consumer price inflation | 78 | –0.04 | 0.21 | –0.60 | 0.40 |
| Retail sales | 67 | 0.16 | 1.19 | –3.80 | 3.50 |
| Unemployment (LFS) | 67 | 0.01 | 0.11 | –0.20 | 0.30 |
| Registered unemployed | 65 | –0.02 | 0.09 | –0.20 | 0.20 |
| Credit growth | 72 | 0.13 | 0.30 | –0.60 | 1.00 |
| Interest rate decisions[1)] | 58 | 0.00 | 0.10 | –0.42 | 0.38 |
| *External:* | | | | | |
| 3-month euro rate | 1637 | 0.00 | 0.03 | –0.35 | 0.15 |
| 10-year euro rate | 1637 | 0.00 | 0.04 | –0.14 | 0.22 |

Average and standard deviation are estimated based on actual surprises.
[1)] Change in one-month money market rate in the first hour following publication of interest rate decision.
Source: Norges Bank

[4] The main source of the expectations figures is Bloomberg News' database.

[5] Standard deviations are calculated as $\sigma = \sqrt{1/n \sum_{i=1}^{n} x_i^2}$ where $x_i$ is the deviation from expected values and $n$ is the number of observations for each key variable.

ten-year interest rates in the euro area are therefore included in the data set.

## *Norges Bank's monetary policy meetings and other monetary policy communication*

In the period 1 January 2001 to 30 June 2007, interest rate decisions and other important changes in the use of instruments have been taken at the Executive Board's scheduled monetary policy meetings, normally every sixth week. The interest rate decisions are published at 2pm and a press conference is held at 2:45pm, where the central bank explains the interest rate decision. Monetary policy reports (MPR) (previously called inflation reports (IR)) are published three times annually – in February/March, June and October/November. In the relevant period all reports have been published at the same time as Norges Bank's interest rate decisions, with one exception on 8 March 2001.

The news component of Norges Bank's interest rate decision is measured by changes in the one-month money market rate in the course of the first hour after publication of the interest rate decision. The one-month money market rate is used because it matures before the coming monetary policy meeting and is therefore not influenced by any signals from the central bank as to the monetary policy ahead. Alternatively, the news component could be measured in the same as for key macroeconomic figures, i.e. by comparing interest rate decisions with consensus among market participants. It is assumed that the interest rate effects measure the actual surprise more accurately than a measure based on expectations surveys. One reason for this is that the interest rate impact measures the surprise directly ahead of the monetary policy meeting, while expectations surveys are often conducted earlier.

The information or surprise component linked to monetary policy communication by the central bank is naturally difficult to measure. News about monetary policy strategy can be published in the form of press release statements or press conferences in connection with monetary policy meetings, monetary policy reports, speeches, lectures or media interviews.

We have chosen to construct two "communication series". The first series captures monetary policy communication on monetary policy meeting days, i.e. communication in monetary policy reports and press releases about interest rate decisions, as represented by the first three lines in Table 4. The other series includes the annual addresses of the central bank governor, which is given in February every year, and two other speeches.[6] Based on market participants' reactions, among other things to macroeconomists' comments in reports and the media, and our own assessments, we have set the communication variable at –1(+1) if communication was in the form of a more (less) expansionary monetary stance than expected by markets. If communication is assessed to be neutral, the variable is set equal to 0, which is also the value assigned to the variable on days without monetary policy communication. The variables necessarily involve discretion and comprise very different news or surprises for market participants. In the model section below, an alternative approach to treating communication variables is discussed, i.e. an approach which reduces the subjective element in the construction of the variables.

**Table 4** Perception of signals in monetary policy communication.

| Type | Surprisingly expansionary | Neutral | Surprisingly contractionary |
|---|---|---|---|
| Monetary policy meeting without IR/MPR | 9 | 25 | 5 |
| Monetary policy meeting with IR/MPR | 4 | 10 | 5 |
| IR/MPR without monetary policy meeting (8 March 2001) | 1 | | |
| Speeches and lectures | 4 | 2 | 3 |

Source: Norges Bank

## *Interest rate data*

We want to measure the effects of key figures on market interest rate expectations. Interest rate expectations cannot be observed directly. In practice forward rates or implied forward rates are used as a measure of interest rate expectations. Forward contracts, e.g. FRAs, are liquid instruments that react quickly to news about interest rate developments ahead. Norwegian FRA rates only cover a period of 1–1½ years ahead, however. In order to assess whether news affects interest rate expectations for longer horizons, we have chosen to use changes in implied interest rates in the analysis.

Implied forward rates are short-term interest rates at a future point in time derived from spot interest rates in the market. Norges Bank calculates the forward interest rate using four money market rates with maturities between one to twelve months, and nine swap rates[7] with maturities from two to ten years.[8] The calculation of forward interest rates is based on a parametric method developed by Svensson (1995). The method is often referred to as the "extended Nelson Siegel method", as it is based on Nelson and Siegel (1987).[9]

Forward rate volatility is highest from nine months to about three years, while it is lower for shorter and longer horizons (see Table 5). At the longest end of the curve, forward rate volatility increases again. Experience shows that the estimates for forward rates at the end points of the curve are the most uncertain, i.e. at the shortest horizons (less than 3 months) and for horizons longer than 9 years.

6 See footnote 3.
7 Interest rate on interest swap contracts.
8 We have used interest rate series from Reuters (EcoWin).
9 See Myklebust (2005) for a detailed description of Norges Bank's approach.

**Table 5:** Descriptive statistics for daily changes in forward interest rates. Basis points

| Horizon | Average | Standard-deviation | Mini-mum | Maxi-mum |
|---|---|---|---|---|
| 3 months | –0.1 | 4.4 | –53 | 21 |
| 6 months | –0.1 | 5.1 | –52 | 31 |
| 9 months | –0.1 | 5.6 | –45 | 31 |
| 1 year | –0.1 | 6.1 | –56 | 30 |
| 2 years | 0.0 | 6.8 | –56 | 37 |
| 3 years | 0.0 | 6.0 | –39 | 32 |
| 5 years | –0.1 | 5.1 | –33 | 25 |
| 7 years | –0.1 | 5.3 | –33 | 27 |
| 10 years | –0.1 | 9.8 | –57 | 51 |

Source: Norges Bank



### *The model*

The data consist of daily observations covering the period 1 January 2001 to 30 June 2007, or a total of 1 637 observations. We estimate the effect of macroeconomic and monetary policy news on interest rate expectations using the following model:

$$1)\quad \Delta r_t^k = \alpha_0^k + \sum_{b=1}^{5} \beta_b^k mn_{b,t} + \sum_{d=1}^{2} \gamma_d^k\ fn_{d,t} + \lambda^k rb_{\ t} + \sum_{c=1}^{2} \mu_c^k kn_{c,t}^k + \varepsilon_t^k$$

In the equation, $k$ denotes the horizon of the forward interest rates: 3, 6, 9, 12 months and 2, 3, 4, 5 og 7 years. The relationship posits that changes in the forward interest rate at horizon $k$ is determined by five domestic macroindicators *mn*, two euro interest rates *fn*, interest rate decisions *rb*, communication by Norges Bank in the two variables *kn* and a residual term. The equation is used to determine the average effects of the news variables.

Empirical modelling of interest rate changes most often reveals the time-varying volatility of interest rate changes. Typically, certain periods feature high volatility, while others feature low volatility. This relationship can be incorporated in the GARCH model.[10]

$$2)\quad \varepsilon_t^k = v_t^k h_t^k \sim (0,(h_t^k)^2)$$

$$3)\quad v_t^k = \frac{\varepsilon_t^k}{h_t^k} \sim iid(0,1)$$

$$4)\quad \ln(h_t^k)^2 = a_0^k + \sum_{i=1}^{p} a_i(\delta_1^k v_{t-i}^k + \delta_2^k |v_{t-i}^k|) + \sum_{j=1}^{q} b_j^k \ln(h_{t-j}^k)^2 + \sum_{m=1}^{n} c_m^k D_{m,t}$$

2) states that the residuals from the level equation 1) can be expressed by the standard deviation of the residuals $h_t$ and the standardised residuals $v_t$. The variance of the residuals $h_t$ is modelled in 4) as a function of separate lagged values, lagged values of the standardised residuals and any other explanatory variables $D_m$. We apply an exponential GARCH (EGARCH). A further description of the model we have used is provided in the annex to the article.[11]

The effects of Norges Bank's communication are more difficult to model than the other news variables because the news component in communication cannot be quantified in an unambiguous manner. In several cases, for example, it is difficult to determine whether the signals in a speech or a press release are neutral or not. Moreover, market participants do not always have the same interpretation of the signals from the central bank. Macroeconomists' comments following monetary policy meetings and speeches may be also be influenced by interest rate effects following the events.

We use macroeconomists' comments to assess the news component in Norges Bank's communications. The communication variables thus have a tendency to be determined ex post based on their impact on the market, and not ex ante as is the case for the macroeconomic news variables in the data set. The problem linked to the discretionary assessment of monetary policy signals motivates an alternative method for shedding light on the effects of monetary policy communication.

An alternative to estimating the level effect of communication on forward interest rates is to estimate the effect on the volatility of interest rates. If the variance of forward interest rates is higher on days with monetary policy communication than on other days, this would indicate that communication on average contains new information for the market.

We have therefore chosen to estimate news effects using two methods. In the first alternative, the communication variables are included in equation 1) together with the other news variables. If our discretionary determination of the communication series is correct, we will obtain a good picture of how monetary policy signals on average affect forward interest rates. In this case, the communication variables are not included in the volatility equation 4).

In the other alternative, we remove the communication variables from the level equation. We create two dummy variables for monetary policy communication and incorporate them in the volatility equation 4). The first dummy variable has value one on days with monetary policy meetings and zero otherwise, and the other has value one on days with speeches[12] and zero otherwise.

## 4 Results

The detailed results of the estimation of the level equation are shown in Table 6 in the Annex. All the estimated coefficients are included for all forward rate horizons. In other words, we have not reduced the model by removing non-significant variables. Coefficients significantly different from zero at the 10 per cent, 5 per cent and 1 per cent levels are marked with 1, 2 or 3 stars.

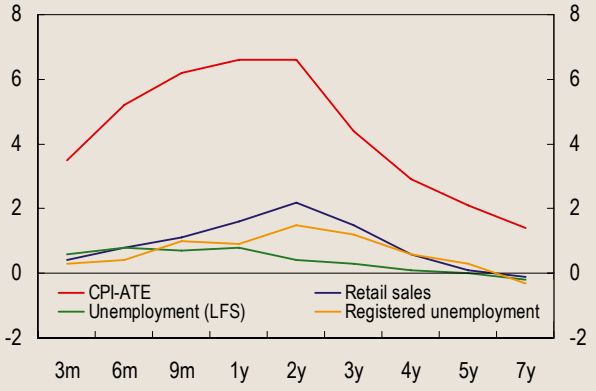
The results of the estimation of the volatility equation 4), which includes the communication variables, are shown in Table 7 in the appendix. Significant coefficients are marked in the same way as in the level equa-

[10] Garch estimation is proposed by, among others, Bollerslev (1986).

[11] See also Conolly and Kohler (2004) for a further description and use of a comparable model.

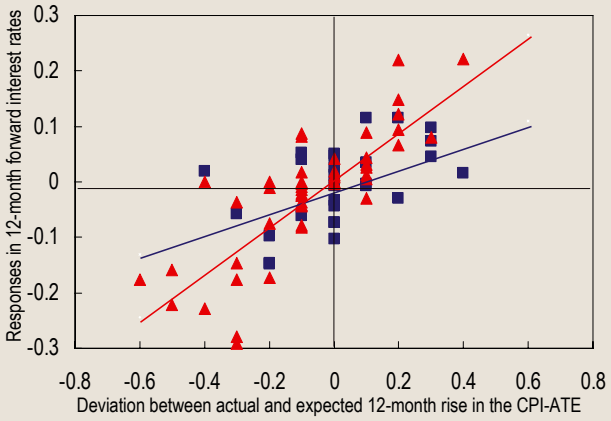
[12] Includes nine speeches, cf. description above.

**Chart 2** Macroeconomic surprises. Same day responses in implied forward interest rates from one standard deviation surprises. Basis points.




Source: Norges Bank

**Chart 3** CPI-ATE and interest rate responses. Percentage points.
Blue: CPI-ATE inside interval 1.5 – 3.5 percent.
Red: CPI-ATE outside interval 1.5 – 3.5 percent




Source: Norges Bank



tion. The lower section of Table 7 shows the estimated average standard deviation for the period as a whole and standard deviations for days when monetary policy is communicated, both measured in basis points.

Chart 2 shows the results for the macroindicators that have a significant effect on interest rates. The CPI-ATE has a significant effect on forward rates at all maturities. The effect is strongest on forward rates in the 1–2 year maturity segment, where a deviation from the expected value of 0.2 percentage point (equivalent to one standard deviation) results in a 7 basis-point change in interest rates. Retail sales and the two indicators for unemployment have some effect on forward rates in the ½–3 year segment, in the area of 1–2 basis points. These macroindicators thus have a considerably weaker effect on interest rates than the CPI-ATE. The credit indicator is not included in the chart as it only has a significant effect on 1–2 year forward rates, and the coefficients for some of the maturities have the opposite sign from that expected.

The relatively greatest effect on forward rates occurs in the 1–3 year segment. This hump shape has been shown in other studies of, for example, the US bond market, cf. Fleming, Piazzesi and Remolona (2003). These authors interpret the hump shape as an expression of the market's assessment of the balance kept by the central bank between two different monetary policy considerations: the desire to make rapid policy changes on the basis of economic news, and the desire to adjust the interest rate in measured steps (interest rate smoothing). The hump shape may indicate that monetary policy strategy is assumed to be relatively fixed in the short term, so that new information will only influence interest-rate setting over time.

The strong influence of consumer prices on interest rates distinguishes Norway relatively clearly from other countries, where interest rates are affected most by real economic indicators. This is particularly true for the US, where the reaction of interest rates to news about labour market and real economic developments is considerably stronger than their reaction to news about inflation. This may be related to the absence of an explicit inflation target for monetary policy in the US. In the UK, with an economy more similar to our own, news about inflation has approximately the same impact on interest rates as news about the real economy.[13]

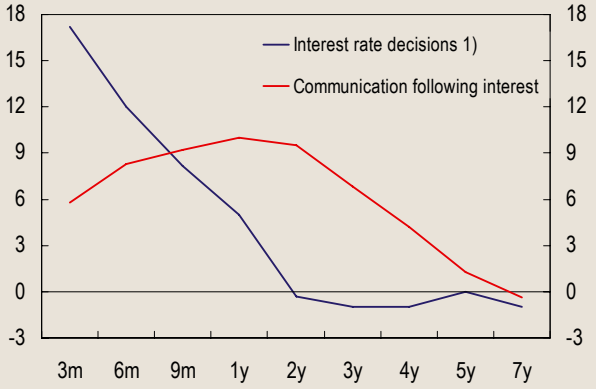
The strong effect of surprises in the CPI-ATE may be due to a level of inflation that has been considerably below the target in some of the period under consideration here. For given surprises in consumer prices, the interest rate impact appears to be greater in periods when the CPI-ATE deviated more than one percentage point from the inflation target (red triangles in Chart 3) than in periods when the CPI-ATE was closer to the target (blue squares).

New external information, contained in the financial variables from the euro area, have a significant effect on Norwegian interest rates. The impact of short-term euro rates is strongest for forward rates out to the two-year horizon, while long-term euro rates have the strongest impact over one-year horizons.

Norges Bank's interest rate decisions have a considerable impact on forward rates at horizons below one year. If Norges Bank raises the interest rate by 25 basis points, while the market has been expecting that the interest rate would be kept unchanged, the results show that three-month forward rates will rise by 17 basis points. The effect unwinds relatively quickly and is no longer significant at the two-year horizon. Market interest rate expectations thus change less than the surprise element in the interest rate decision. This may indicate that surprising interest rate changes have primarily occurred when there has been uncertainty as to monetary policy timing. In these cases, market expectations further ahead will naturally be affected to a lesser extent than expectations in the very short term.

[13] Reeves and Sawecki (2005).

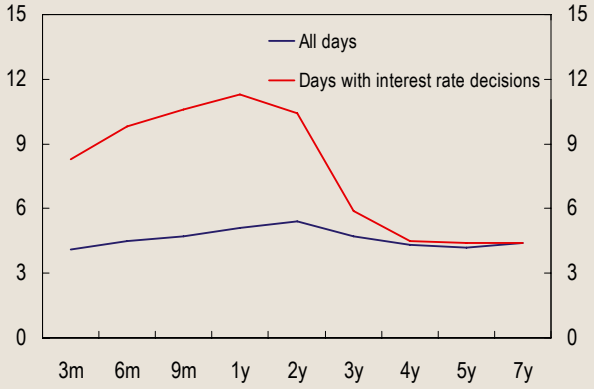
**Chart 4** Monetary news and responses in implied forward interest rates. Basis points




1) Responses from an hypothetical, unexpected interest rate rise of 25 basis points

Source: Norges Bank

**Chart 5** Monetary policy news. Effects on the volatility of implied forward interest rates. Standard deviation in basis points




Source: Norges Bank



If an unexpected interest rate increase is combined with signals of further increases, the impact on forward rates will be stronger.[14] The total impact can be illustrated by the sum of the blue and red lines in Chart 4. Three-month to one-year forward rates change in this case by 15–25 basis points.

Communication from Norges Bank following monetary policy meetings has a significant effect on forward interest rates out to the five-year horizon. The effect is strongest in the ½–2 year segment and the curve illustrating this effect has a hump shape. The interpretation of the coefficients for communication in Table 7 is different from that of the other variables since the communication variables can only have the values –1, 0 and +1. The coefficients thus indicate the estimated average effect on forward rates on days when new monetary policy signals are communicated.

The results of the volatility equation, where communication variables are included, are shown in Chart 5 and Table 8 in the Annex. The results indicate that communication in connection with monetary policy meetings affects volatility out to two-year forward rates. In this segment, volatility is about twice as high on monetary policy meeting days as on other days. The results of the volatility equation confirm the findings from the level equation: communication from Norges Bank in the form of press releases about key policy rate decisions and in monetary policy reports contains significant information for interest rate instruments. Some speeches also have a strong impact on forward rates. However, it must be emphasised that only nine speeches are included in the data set, and that some of these contained relatively clear signals about changes in monetary policy strategy. The results are therefore not assumed to be representative for this type of monetary policy communication.

The model explains about 1/3 of the daily variation in forward rates. This is on a level with findings in previous studies.[15]

We have not discussed the relationship between interest rate expectations and risk premiums. Beechey (2007) argues that both interest rate expectations and risk premiums for US forward rates are affected by news. She finds that movements in short-horizon forward rates are typically due to changes in expected interest rates, and that movements in distant-horizon forward rates are mainly due to changes in risk premiums. It cannot therefore be ruled out that the relatively strong impact of the consumer price index and monetary policy communication on forward rates at relatively long horizons is more a result of changes in risk premiums than of changes in interest rate expectations.

## *Has news affected interest rates differently since 1 July 2004?*

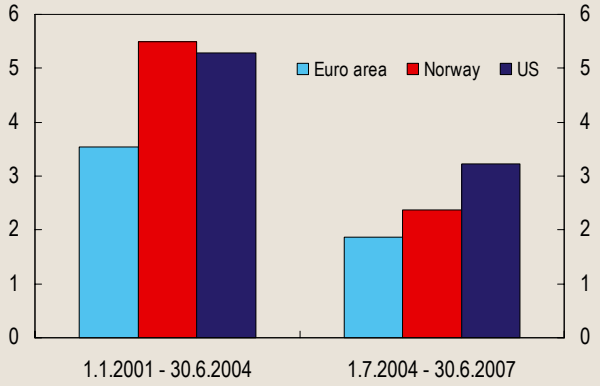
In the period since the beginning of 2001, the communication of monetary policy has changed both internationally and in Norway. There has been a trend towards increased monetary policy transparency and more gradual changes in key rates. Since 2003 the Federal Reserve has commented on the probable monetary policy strategy ahead in connection with its key rate decisions. Other central banks have also to a greater extent signalled their intentions prior to monetary policy meetings. The emphasis given to gradual interest rate changes is reflected in the almost exclusive use of ¼ percentage point changes in recent years.

The shift towards greater monetary policy transparency and more gradual changes in key rates have had an impact on international fixed income markets. It has

[14] The surprise element in interest rate decisions is positively correlated with the news series for monetary policy communication following monetary policy meetings. The coefficient estimates described here and shown in Table 7 are from the alternative where both of these news variables are included in the level equation. If the communication series is excluded from the level equation and included in the volatility equation, we find that the impact of unexpected interest rate decisions is stronger.

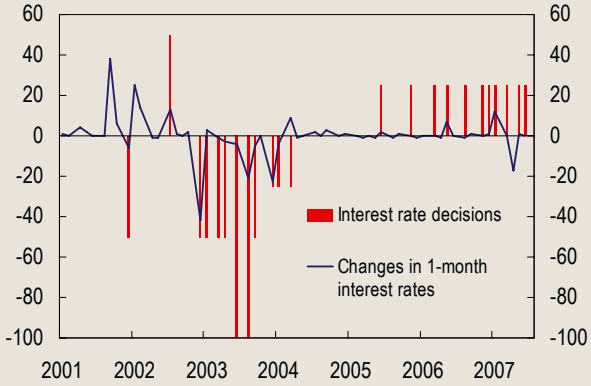
[15] Connolly and Kohler (2004) find that the same type of model can explain between 0.14 and 0.61 of the variation in rates for Australia, Canada, the euro area, New Zealand, the UK and the US.

**Chart 6** 12-month interest rates. Standard deviation in basis points




Source: Reuters (EcoWin) and Norges Bank

**Chart 7** Interest rate decisions and immediate responses in 1-month interest rate. Basis points.




Source: Norges Bank



been suggested that this is an important reason behind the marked fall in volatility of short-term rates (Chart 6), and perhaps also somewhat lower volatility of more long-term interest rates.[16] Relatively low interest rate volatility in this period is probably also ascribable to low key rates in a number of countries and low long-term interest rates internationally. It is normally assumed that volatility measured in basis points is positively correlated with the interest rate level, and there was little uncertainty as to the direction of interest rate changes ahead when key rates were low. It is therefore not a given that the reduction in volatility will be a permanent phenomenon.

Norway introduced an inflation target for monetary policy on 29 March 2001. There have been substantial changes in monetary policy communication since then. Norges Bank has published strategy intervals for the key policy rate for the next strategy period since 1 July 2004. This date has been chosen as the dividing date in the analysis. However, changes in communication have occurred gradually. Since November 2005 Norges Bank has published its own forecast for the interest rate in the monetary policy reports. As a result, the market receives considerably more information about the central bank's monetary policy strategy than in the initial years of inflation targeting. In addition, it must be assumed that in the course of this period market participants have increased their knowledge of Norges Bank's response pattern.

The predictability of Norges Bank's interest rate decisions has been considerably higher since July 2004 than in the preceding period. Chart 7 shows the immediate relationship between interest rate decisions in Norway and the impact on one-month rates, as a measure of the surprise component in interest rate decisions. Since 2004 the effect on short-term money market rates has been small; with a few exceptions, decisions have been as expected. In the few cases where money market rates have shown a marked reaction, there has been some uncertainty in the market as to the timing of the interest rate decision. For example, it was said that prior to the monetary policy meeting in April 2007 market participants were uncertain whether the interest rate would be raised in April or May.

Reduced volatility in financial markets and the move towards greater monetary policy transparency may have changed the relationships between news and movements in forward rates. The relationships in the two periods before and after 1 July 2004 have been estimated separately. A problem in the interpretation of the data is that the interest rate declined through most of the first period, while it rose in the second. The findings referred to below can therefore also be interpreted as showing the difference in market response when the interest rate falls and when it rises. In this article, it is assumed that the results are related to changes in transparency.

Chart 8 shows the coefficient estimates for four of the macroindicators. The calculations indicate that the effect of surprises in the CPI-ATE has declined somewhat for short-term forward rates, while the effect from one year and onwards is about the same in the two periods. The coefficient for registered unemployed has the wrong sign for several horizons in the first period, but is significant with the right sign in the last period. This may reflect the historically low levels of unemployment in recent years and the greater weight given by market participants to labour market developments as a leading inflation indicator. Surprises in retail trade seem to have had less effect on forward rates in the last period. For the Labour Force Survey (LFS), the effect is marginal and the differences between the two periods are small. (This also applies to C2, which is not included in Chart 8.)

Macroindicators' influence on forward rates is also hump-shaped in the last period, cf. the description of the results for the period as a whole.

The effect of monetary policy communication following monetary policy meetings has been examined using

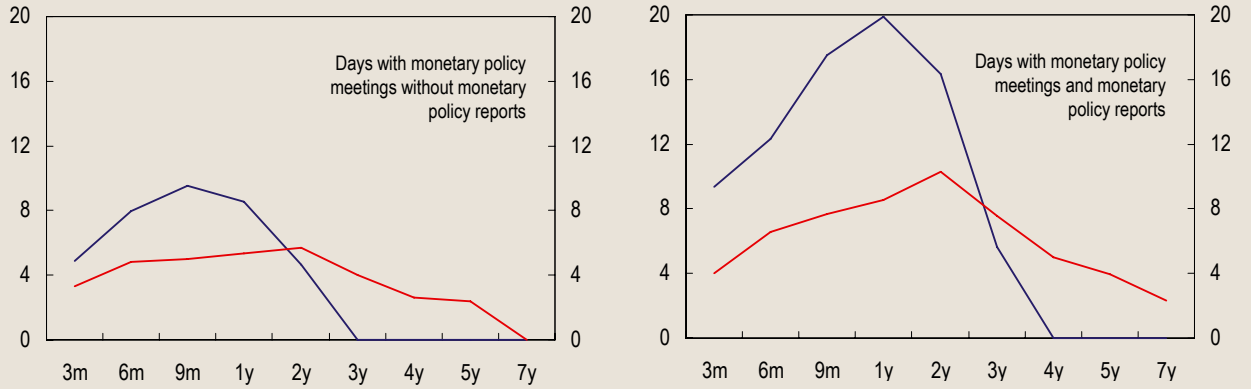
[16] BIS (2006) discusses how changes in the conduct of monetary policy in many countries have played a role in reducing volatility in financial markets. The authors point out that the drop in volatility occurred around the time that forward-looking communication was introduced by central banks in a number of countries.

**Chart 8** Macroeconomic news and responses in implied forward interest rates. Basis points

Blue line : 1.1.2001 – 30.6.2004 Red line : 1.7.2004 – 30.6.2007


**Chart 9** Volatility increases on days with monetary policy meetings. Standard deviation in basis points[1]

Blue line: 1.1.2001 – 30.6.2004 Red line: 1.7.2004 – 30.6.2007

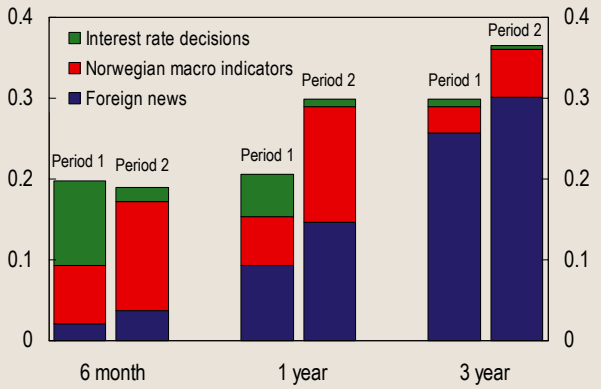



[1] Estimated volatility on days with monetary policy meetings less estimated average volatility in the period. Estimated using egarch(0.2) with communication variables included in volatility equation

the volatility equation 4). The estimated rise in volatility on monetary policy meeting days is illustrated in Chart 9. One of the panels in the chart shows the increase in volatility following monetary policy meetings that include the publication of a monetary policy report. The other panel shows the corresponding increase following other monetary policy meetings. In the first period, volatility at the one-year horizon rose by about 20 basis points following the publication of a monetary policy report. Following other monetary policy meetings, volatility rose by 10 basis points. In the last period, volatility was considerably lower. This may indicate that communication in this period conveyed more gradual changes in monetary policy or that market participants were more prepared for the signals provided, which may indicate that their interpretation of Norges Bank's response pattern has improved.

The effect on forward rates further ahead is greater

**Chart 10**. Contribution from various news variables to explained variation in forward interest rates at different horizons. Share of total variation.
Period 1: 1.1.2001 – 30.6.2004 Period 2: 1.7.2004 – 30.6.2007




Source: Norges Bank

in the last period than in the first. This may reflect the longer horizon encompassed by central bank communication, for example through the publication of Norges Bank's own interest rate forecast.

Chart 10[17] illustrates the variation in forward rates that can be explained by different types of news before and after 1 July 2004. News variables as a whole explain a greater proportion of the variation in forward rates in the 1–3 year segment in the last period. This must be seen in the context of lower volatility of forward rates in the last period. Less noise in daily interest rate changes result in lower explained variance.

All in all, Norwegian macroindicators explain a greater share of the variability in forward rates in the last period. This is partly due to somewhat more unexpected consumer price figures in this period than in the preceding period. Surprises in the indicator for registered unemployed also seem to have a stronger effect on forward rates in the last period, cf. above.

Interest rate decisions explain a considerably smaller share of the variability in short-term forward rates in the last period. The main reason for this is that interest rate changes in this period have not surprised market participants to any great extent.

Changes in euro area market rates explain a greater share of the variability in Norwegian forward rates in the last period than in the first.

## 5 Summary

We have examined the effect of different types of news on market interest rate expectations, as measured by implied forward interest rates. We find that Norwegian forward rates are affected by monetary policy news, external impulses and macroeconomic news, particularly consumer prices. The relationships we find between news and interest rate changes are generally consistent with earlier findings for other countries. One exception is that while real economic indicators seem to have the strongest influence on interest rates in the US and other countries, consumer prices have had the greatest impact on Norwegian interest rates. This may be due to the low level of CPI-ATE inflation in parts of the period since 2001.

Key macroeconomic figures and signals from the central bank have the largest effect on forward rates in the 1–3 year segment. The impact of news on forward rates can be described as a hump-shaped curve, a phenomenon earlier studies have also found for other countries.

Greater monetary policy transparency and a tendency towards more gradual interest rate changes have probably contributed to a reduction in interest rate volatility internationally, particularly for short-term rates. Reduced volatility in financial markets must also be seen in the context of low key rates in many countries and low long-term interest rates internationally. Low volatility may therefore be a temporary phenomenon.

We find that key macroeconomic figures, particularly consumer price figures, and external impulses through changes in euro area interest rates explain a greater share of the variation in Norwegian interest rates in the last three-year period than in the period from the beginning of 2001 up to July 2004. In the last three-year period, Norges Bank's interest rate decisions have with few exceptions been in line with market expectations, and explain a considerably smaller share of the variability in forward rates in this period.

Norges Bank's monetary policy communication following monetary policy meetings seems to have affected short-term forward rates to a lesser extent after 1 July 2004, when Norges Bank started publishing strategy intervals for the key policy rate for the next strategy period. However, there are indications that monetary policy communication also affects long-term market interest rate expectations to a greater extent than previously.

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[17] The chart shows estimated marginal contributions from the various news variables with respect to explained variance in daily forward rate changes. Under this method, the order in which the variables are included may affect the results. In our calculations, we first included foreign interest rate changes, then macroindicators and interest rate decisions. However, changes in the order do not have a significant effect on our results.

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## Annex

The model is described in section 3 and consists of equation 1) and 4), reproduced below:

$$1)\quad \Delta r_t^k = \alpha_0^k + \sum_{b=1}^{5} \beta_b^k mn_{b,t} + \sum_{d=1}^{2} \gamma_d^k \, fn_{d,t} + \lambda^k rb_t + \sum_{c=1}^{2} \mu_c^k kn_{c,t}^k + \varepsilon_t^k$$

$$4)\quad \ln(h_t^k)^2 = a_0^k + \sum_{i=1}^{p} a_i(\delta_1^k v_{t-i}^k + \delta_2^k \left| v_{t-i}^k \right|) + \sum_{j=1}^{q} b_j^k \ln(h_{t-j}^k)^2 + \sum_{m=1}^{n} c_m^k D_{m,t}$$

We have examined whether lagged values of the news variables are significant in level equation 1). We found a significant lag for long-term euro rates, while the other news variables did not exhibit significant lags. The coefficient estimates for the level equation are shown in Table 6.

The volatility equation 4) is specified as an exponential GARCH where the conditional volatility depends on its own lagged values, the standardised residual's lagged values and any other variables $D_m$. We found that standardised residuals occur with two significant lags, i.e. that $p$ equals 2 in equation 4). Lagged values of the conditional volatility were not significant for forward rates at most horizons. We have therefore set $q$ equal to zero in equation 4). The volatility equation is thus estimated by an EGARCH (0.2) for forward rates at all horizons.

It is usually assumed that volatility measured in basis points is positively correlated with the interest rate level. We have therefore included the level of forward rates in the volatility equation. The interest rate level affects volatility in forward rates with a horizon up to one year, and to some extent forward rates with a five to seven year horizon.

The coefficient estimates for the volatility equation are shown in the upper section of Table 7. The lower section of Table 7 shows the estimated average standard deviation for the period as a whole and standard deviations for days when monetary policy is communicated, both measured in basis points.

**Table 6:** Effect of news on forward interest rates. Level equation. Change in basis points[1)]

| Horizon (in years) | 0.25 | 0.5 | 0.75 | 1 | 2 | 3 | 4 | 5 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| *Domestic variables* | | | | | | | | | |
| CPI | 3.5*** | 5.2*** | 6.2*** | 6.6*** | 6.6*** | 4.4*** | 2.9*** | 2.1*** | 1.4*** |
| LFS | –0.6 | –0.8** | –0.7** | –0.8* | –0.4 | –0.3 | –0.1 | 0.0 | 0.2 |
| Registered unemployed | –0.3 | –0.4 | –1.0* | –0.9 | –1.5** | –1.2* | –0.6 | –0.3 | 0.3 |
| Retail trade | 0.4 | 0.8*** | 1.1*** | 1.6*** | 2.2*** | 1.5*** | 0.6*** | 0.1*** | –0.1 |
| Credit growth | 1.3 | –0.4 | –0.3 | 0.5*** | 1.2*** | 0.3 | –0.3 | –0.3 | –0.2 |
| *Abroad:* | | | | | | | | | |
| 3-month euro rate | 0.7 | 0.5*** | 0.4*** | 0.5*** | 0.5*** | 0.3*** | 0.2* | 0.1*** | 0.2 |
| 10-year euro rate | 0.0 | 0.5*** | 1.0*** | 1.5*** | 2.9*** | 2.9*** | 2.5*** | 2.3*** | 2.2*** |
| 10-year euro rate (t–1) | 0.5*** | 0.7*** | 0.8*** | 0.9*** | 0.7*** | 0.9*** | 1.1*** | 1.1*** | 1.1*** |
| *Monetary policy:* | | | | | | | | | |
| Interest rate decision | 6.9*** | 4.8*** | 3.3*** | 2.0*** | –0.1 | –0.4 | –0.4 | 0.0 | –0.4 |
| Communication following monetary policy meetings | 5.8 | 8.3*** | 9.2*** | 10.0*** | 9.5*** | 6.8*** | 4.2*** | 1.3*** | –0.4 |
| Other communication | 12.9 | 19.4*** | 22.1*** | 22.8*** | 15.2*** | 8.0*** | 4.7** | 4.4** | 6.4*** |
| $R^2$ | 0.22 | 0.35 | 0.41 | 0.40 | 0.40 | 0.39 | 0.35 | 0.32 | 0.30 |

1) Impact on interest rate by surprise of standard deviation for domestic variables, abroad and interest rate decisions. For communication variables: interest rate impact of non-neutral monetary policy signals.

**Table 7:** Effect of monetary policy communication on forward interest rates. Volatility equation[1)]

| Horizon (in years) | 0.25 | 0.5 | 0.75 | 1 | 2 | 3 | 4 | 5 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| Constant | 1.1*** | 1.4*** | 2.0*** | 2.6*** | 3.2*** | 3.0*** | 2.6*** | 2.2*** | 1.7*** |
| *Standardised residuals:* | | | | | | | | | |
| v(t–1) | 0.1 | –0.1 | –0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| \|v(t–1)\| | 0.6*** | 0.6*** | 0.5*** | 0.4*** | 0.3*** | 0.4*** | 0.4*** | 0.4*** | 0.4*** |
| v(t–2) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| \| v(t–2) \| | 0.3*** | 0.3*** | 0.3*** | 0.3*** | 0.2*** | 0.2*** | 0.2*** | 0.1 | 0.1 |
| Interest rate level | 0.3*** | 0.3*** | 0.2*** | 0.1** | 0.0 | 0.0 | 0.0 | 0.1** | 0.2*** |
| Monetary policy meetings | 1.4*** | 1.6*** | 1.6*** | 1.6*** | 1.3*** | 0.5* | 0.1 | 0.1 | –0.2 |
| Speeches | 3.4*** | 3.2*** | 3.1*** | 3.0*** | 2.1*** | 1.3*** | 0.8* | 0.7* | 0.7 |
| *Volatility in basis points:* | | | | | | | | | |
| Average | 4.1 | 4.5 | 4.7 | 5.1 | 5.4 | 4.7 | 4.3 | 4.2 | 4.4 |
| Monetary policy meeting days | 8.3 | 9.8 | 10.6 | 11.3 | 10.4 | 5.9 | 4.5 | 4.4 | 4.4 |
| Other monetary policy communication days | 22.7 | 21.9 | 22.4 | 22.5 | 15.0 | 9.2 | 6.3 | 6.0 | 6.3 |

1) Coefficients from EGARCH(0.2) estimation of equations 1) and 4).