

STAFF MEMO

Which key figures move the foreign
exchange market?

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Which key figures move the foreign exchange market?

Alexander Flatner and Hong Xu¹

A number of international studies find that financial prices are affected by announcements of economic news.² Prices change when key figures and other economic news affect market participants' view of the current state of the economy and future prospects. The effect of the news on financial prices will depend on factors such as the magnitude of the surprise relative to market expectations. In addition, the effect is assumed to vary over time and across assets.

The krone exchange rate is a financial variable that can react strongly and rapidly to new economic key figures. Information from our market contacts indicates, however, that some key figures are regarded as more important than others. This paper identifies these figures, compares with the effects on other currency crosses and examines how the focus on some Norwegian key figures has changed over time.

1. Methods and data

The effect of economic news on financial prices depends on several factors. Some key figures are regarded as more important than others and their release has a stronger impact. The impact depends on how much the key figure surprises the market relative to expectations. Reactions following the release of key figures may also be influenced by market conditions.

There are several possible methods of identifying which key figures trigger a reaction in the Norwegian krone (NOK) market. One method is to examine the exchange rate changes in absolute terms following the release of key figures.³ The effect on the exchange rate may be stronger the more important the key figure is for participants' assessment of the economic outlook. This is examined more closely in Section 2.1.

However, the magnitude of the effect on the exchange rate will also depend on the magnitude of the surprise relative to market expectations. If one key figure surprises more than others over a period, the absolute change in the exchange rate may exaggerate the importance of this key figure to market participants. It will therefore also be interesting to study exchange rate change adjusted for the surprise component in the key figure. This is examined in Section 2.2.

Our analyses are based on data from January 2002 until December 2014. Over such a long period, it is reasonable to assume that market expectations will adjust so that few key figures will systematically surprise more than others. The absolute exchange rate change will thus probably provide a representative picture of the key figures market participants focus on. By not adjusting for surprises, we can also include key figures without measurable expectations in the analysis.

The analysis is based on high-frequency intraday data for exchange rates from the electronic trading platform Thomson Reuters (Spot Matching 3000 Extra). Intraday data are divided into 15-minute

¹ We thank Tom Bernhardsen, Arne Kloster, Marit Øwre-Johnsen, André Kallåk Anundsen and Dagfinn Rime for useful input and comments. We thank Hallvard Stavnes Mørck for assistance in collecting the data.

² See Neely (2011) for an overview of articles about how the foreign exchange market is affected by economic news and key figures.

³ Another method is to study market activity after the release of key figures. We have also used this method, and the resulting estimates are in line with the result indicated by the absolute exchange rate effects.

intervals so that each 24-hour period contains 96 observations. Our basic approach is to note the reactions in the first 15 minutes after release. This short horizon reduces the probability that the exchange rate will be affected by factors other than the key figure. On the other hand, as reactions to some economic news, in particular news containing qualitative information, may take longer to occur, we also look at reactions over longer horizons.

2. Which key figures trigger a reaction in the NOK market?

2.1 Exchange rate changes in absolute terms following release of key figures

Based on a broad sample of Norwegian and selected international key figures/events as explanatory variables, we use a standard regression analysis to quantify the magnitude of exchange rate changes in absolute value. Our estimates are based on data from January 2002 until end-December 2014, and the regression coefficients reflect the average effect of the variables on the exchange rate over this period. The regression equation is given by:

$$(1) \text{abs}(\Delta \ln(S_t)) = \beta_0 + \sum_{i=1}^n \beta_i * D_{it}$$

where $\text{abs}(\Delta \ln(S_t))$ expresses the absolute value of the percentage change in the EURNOK exchange rate between $t-1$ and t (absolute value of the difference between the logarithms). D_{it} is a dummy variable for the key figure i which takes the value 1 for the 15-minute period immediately after release of the key figure and 0 otherwise.⁴ The intercept β_0 therefore reflects the average percentage change in the exchange rate in absolute value for all time periods where all the dummy variables take the value 0. β_0 is thus interpreted as average volatility in a 15-minute period in which key figures have not been released, while β_i is interpreted as the additional volatility in the 15-minute period after the release of key figure i , in excess of β_0 . The average absolute exchange rate change in the period after the release of key figure i is thereby given by $\beta_0 + \beta_i$. Table 1 show the results of the regression for all key figures with the associated statistics, while Chart 1 shows a bar diagram of the exchange rate changes.

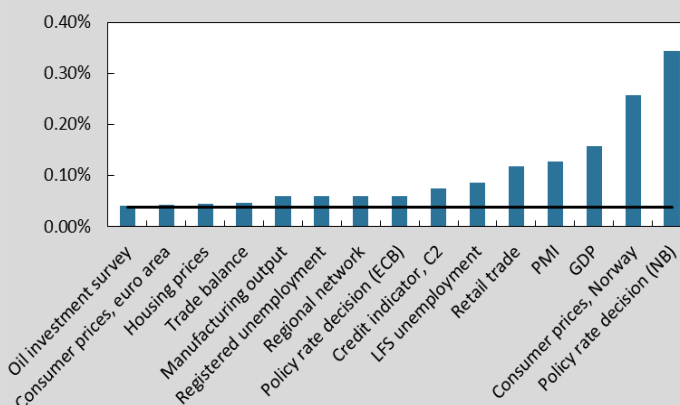
Table 1: Regression results with absolute exchange rate changes after 15 minutes. The coefficients are multiplied by 100 so that they can be interpreted as a percentage change.[#]

| Variable | Coefficient | Standard error |
|------------------------------------|-------------|----------------|
| Constant | 0.037*** | 0.000 |
| LFS unemployment | 0.048*** | 0.010 |
| GDP | 0.120*** | 0.033 |
| House prices | 0.007* | 0.004 |
| Retail trade | 0.080*** | 0.010 |
| Trade balance | 0.008** | 0.004 |
| Manufacturing output | 0.022*** | 0.008 |
| Consumer prices, euro area | 0.004 | 0.005 |
| Consumer prices, Norway | 0.220*** | 0.020 |
| Credit indicator, C2 | 0.037*** | 0.009 |
| Oil investment survey | 0.003 | 0.011 |
| PMI | 0.090*** | 0.014 |
| Regional network | 0.023 | 0.027 |
| Registered unemployment | 0.023*** | 0.007 |
| Policy rate decision (ECB) | 0.023*** | 0.008 |
| Policy rate decision (Norges Bank) | 0.306*** | 0.031 |

***, **, * indicates statistical significance at the 1, 5 and 10 percent level respectively.

[#] For example, the results indicate that the effects after the release of LFS unemployment figures have averaged 0.085 percent (0.037 percent + 0.048 percent)

Chart 1: Absolute exchange rate changes 15 minutes after the release of key figures. The black line represents the value of the intercept (β_0), while the blue bars show the effects after the release of the respective key figures ($\beta_0 + \beta_i$).



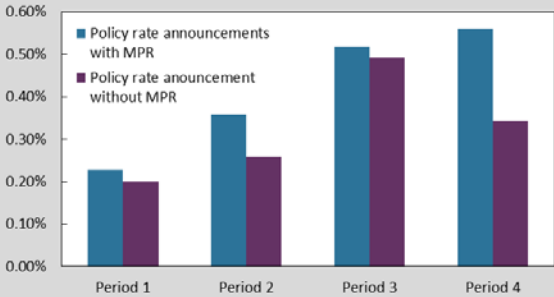
⁴ The key figures in Norway and in the euro area we have studied are listed in Appendix Table A.1.

The coefficients of all the key figures (β_i) are greater than zero. This indicates that the exchange rate shows higher volatility 15 minutes after the release of the key figures ($\beta_0 + \beta_i$) than when no figures are released (β_0). The effect is significant at the 10 percent significance level for all key figures except the regional network, euro area consumer prices and the oil investment survey.

The coefficients also vary in size, indicating that market participants' focus on the various key figures varies. The two key figures that contribute to the largest exchange rate effects are Norges Bank's policy rate announcements and consumer prices in Norway. Absolute exchange rate changes following the policy rate announcements averaged 0.343 percent⁵, while absolute changes after the release of consumer prices averaged 0.257 percent.⁶ The results thus indicate that participants in the NOK market focus in particular on consumer prices and Norges Bank's policy rate announcements.⁷ This is in line with the findings in Eeg (2005) concerning Norwegian market rates. Of the real economy indicators, GDP is the most important. Norwegian key figures also seem to have a more pronounced effect on the EURNOK exchange rate than corresponding European figures.

We have also replaced the the dummy variable for Norges Bank's policy rate announcements with two separate dummy variables, one for policy rate announcements accompanied by the publication of the *Monetary Policy Report* (MPR), and one for those that are not. The results indicate that the absolute exchange rate changes are larger when policy rate announcements are accompanied by the MPR. According to our market contacts, the exchange rate effects are larger because Norges Bank also publishes an interest rate path when policy announcements are accompanied by the MPR. We have therefore examined the effects after policy rate announcements with and without the MPR in four periods (see Chart 2). The first period ends when Norges Bank began publishing the interest rate path in November 2005. We see that the effects after policy rate announcements accompanied by the MPR are only marginally larger than after policy rate announcements that are not accompanied by the MPR. In period 2, which runs from Norges Bank's first publication of the interest rate path until the onset of the financial crisis, we see an increase in absolute exchange rate changes after policy rate announcements whether accompanied by the MPR or not. However, the exchange rate effects after policy rate announcements accompanied by the MPR are markedly larger than after policy rate announcements when the interest rate path is not published. In period 3, during the financial crisis, the largest effects occur after policy rate announcements that include an interest rate path. The difference is, however, smaller than in period 2. This may be related to the unusual circumstances prevailing in this period and a high level of uncertainty, which resulted in considerable short-termism in the market. In period 4, after the financial

Chart 2: Absolute exchange rate effects 15 minutes after policy rate announcements with and without the MPR. #



Period 1: 1 January 2002 – 1 November 2005
 Period 2: 2 November 2005 – 30 June 2008
 Period 3: 1 July 2008 – 30 September 2009
 Period 4: 1 October 2009 – 31 December 2014

The policy rate announcement of 17 December 2008 was accompanied by the publication of the interest rate path even though the MPR was not published. The effects of this announcement are included in the effects of "Policy rate announcements with MPR" in the chart.

⁵ Effects after Norges Bank's policy rate announcements: $0.306 + 0.037 = 0.343$, cf. Table 1

⁶ Effects after release of consumer price figures for Norway: $0.220 + 0.037 = 0.257$, cf. Table 1

⁷ So-called F-tests indicate that the coefficient for Norges Bank's policy rate announcements is significantly higher (at the 1 percent significance level) than the coefficient for consumer prices, which in turn is significantly higher than the coefficients for other Norwegian and international key figures/events.

crisis, we see that policy rate announcements including publication of the interest rate path have a stronger impact than policy rate announcements that do not include publication of the interest rate path.

If we use the same regression model as (1), but replace the left-hand side variable with the absolute exchange rate change 1 hour and 24 hours respectively after the release of the key figures, we obtain the results as shown in Tables 2 and 3 and in Charts 3 and 4. In these regressions, β_0 could be interpreted as average volatility in the course of 1 hour and 24 hours respectively when key figures have not been released, while β_i would represent the additional volatility over the same periods after the release of key figure i .

Table 2: Regression results with absolute exchange rate changes after 1 hour. The coefficients are multiplied by 100 so that they can be interpreted as a percentage change.

| Variable | Coefficient | Standard error |
|------------------------------------|-------------|----------------|
| Constant | 0.073*** | 0.000 |
| LFS unemployment | 0.037*** | 0.011 |
| GDP | 0.121*** | 0.039 |
| House prices | 0.011 | 0.008 |
| Retail trade | 0.064*** | 0.013 |
| Trade balance | 0.008 | 0.006 |
| Manufacturing output | 0.026*** | 0.010 |
| Consumer prices, euro area | 0.017* | 0.009 |
| Consumer prices, Norway | 0.197*** | 0.021 |
| Credit indicator, C2 | 0.047*** | 0.011 |
| Oil investment survey | 0.019 | 0.018 |
| PMI | 0.098*** | 0.018 |
| Regional network | 0.061* | 0.033 |
| Registered unemployment | 0.038*** | 0.015 |
| Policy rate decision (ECB) | 0.059*** | 0.012 |
| Policy rate decision (Norges Bank) | 0.322*** | 0.036 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

Chart 3: Absolute exchange rate changes 1 hour after the release of key figures. The black line represents the value of the intercept (β_0), while the blue bars show effects after the release of the respective key figures ($\beta_0 + \beta_i$).

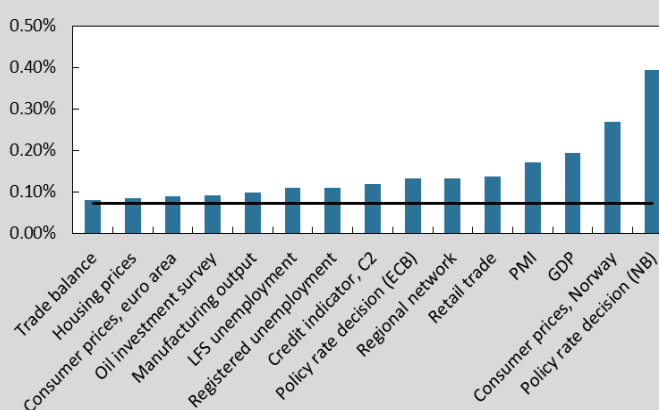


Table 2 indicates that absolute exchange rate changes in the hour after the release of the key figures we have studied are larger than in the 60-minute periods in which no economic news is released. The effect is largely significant at the 10 percent level, indicating that the effect on the exchange rate of most key figures is persistent 1 hour after release.

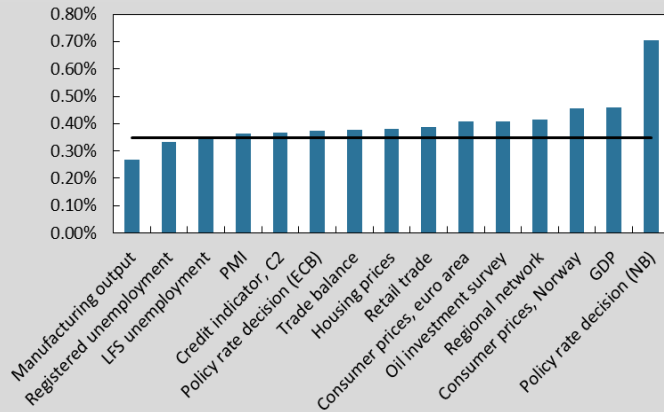
The ranking of absolute exchange rate changes by key figure after 1 hour is relatively similar as their ranking after 15 minutes, although it is worth noting that the Norges Bank regional network, which is more qualitative in character, shows markedly larger effects after 1 hour than after 15 minutes. This indicates that it takes longer to react to some key figures than to others. We find the same picture for the ECB's policy rate decision, which is probably because the ECB's press conference often begins 45 minutes after the policy rate decision is announced. Table 3 indicates that only Norges Bank's policy rate announcements, Norwegian consumer prices and GDP have significantly larger exchange rate effects after 24 hours than 24-hour periods in which no economic figures are released.

Table 3: Regression results with absolute exchange rate changes after 24 hours. The coefficients are multiplied by 100 so that they can be interpreted as a percentage change.

| Variable | Coefficient | Standard error |
|------------------------------------|-------------|----------------|
| Constant | 0.348*** | 0.003 |
| LFS unemployment | 0.005 | 0.036 |
| GDP | 0.113* | 0.058 |
| House prices | 0.032 | 0.035 |
| Retail trade | 0.040 | 0.037 |
| Trade balance | 0.030 | 0.039 |
| Manufacturing output | -0.079*** | 0.030 |
| Consumer prices, euro area | 0.059 | 0.047 |
| Consumer prices, Norway | 0.107*** | 0.038 |
| Credit indicator, C2 | 0.019 | 0.030 |
| Oil investment survey | 0.060 | 0.056 |
| PMI | 0.015 | 0.039 |
| Regional network | 0.065 | 0.085 |
| Registered unemployment | -0.016 | 0.040 |
| Policy rate decision (ECB) | 0.026 | 0.029 |
| Policy rate decision (Norges Bank) | 0.358*** | 0.064 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

Chart 4: Absolute exchange rate changes 24 hours after the release of key figures. The black line represents the value of the intercept (β_0), while the blue bars show effects after the release of the respective key figures ($\beta_0 + \beta_i$).



2.2 Exchange rate changes adjusted for key figure surprises

An alternative to examining absolute exchange rate changes is to study the relationship between the magnitude and direction of the exchange rate change and the degree to which the key figure is a surprise compared with expectations. We define ‘surprise’ as the difference between the actual value and the expected value⁸ of the key figure divided by the historical standard deviation of this difference.⁹ The regression gives us an indication of sensitivity of the exchange rate to key figure surprises and whether the direction of the exchange rate changes is in line with economic theory. The regression equation is given by:

$$(2) \quad \Delta \ln(S_t) = \beta_0 + \sum_{i=1}^n \beta_i * Surprise_{i,t}$$

where $\Delta \ln(S_t)$ expresses the percentage change in the EUR/NOK exchange rate between t-1 and t (difference between the logarithms). $Surprise_{i,t}$ is a variable for key figure i that takes the value of the surprise component in the 15-minute period immediately after the release of the key figure¹⁰ and the value 0 for all other periods. For example, if LFS unemployment was expected to be 3.0, while the actual outcome was 3.3, and the historical standard deviation is 0.12, the surprise value is $2.5 \left(\frac{3.3-3.0}{0.12} \right)$. β_0 measures the average percentage exchange rate change for all periods in which key figures were not released, while β_i is an estimate of the magnitude and direction of the exchange rate change in the event of a key figure surprise of 1 standard deviation.

Table 4: Regression results with exchange rate changes after 15 minutes. The coefficients are interpreted as the percentage exchange rate change per standard deviation surprise.

| Variable | Coefficient | Std. Error |
|-------------------------|-------------|------------|
| Constant | 0.000 | 0.000 |
| LFS unemployment | 0.056*** | 0.015 |
| GDP, total | -0.088** | 0.035 |
| GDP, mainland | -0.183*** | 0.036 |
| Retail trade | -0.103*** | 0.016 |
| Manufacturing output | -0.045*** | 0.013 |
| Credit indicator, C2 | -0.033*** | 0.010 |
| CPI | -0.041** | 0.018 |
| CPI-ATE | -0.287*** | 0.025 |
| PMI | -0.128*** | 0.016 |
| Registered unemployment | 0.007 | 0.008 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

⁸ Average response in the Bloomberg expectations surveys.

⁹ Dividing by the standard deviation normalises the surprises, enabling us to compare the regression coefficients of the various key figures. Information about the surprise series is provided in Appendix Table A.2.

¹⁰ In this dataset, there are cases where there are no values for the surprise series around the time of release of key figures. For these cases, we have chosen to exclude the 15-minute period immediately after the time of release from the regression in order to achieve a more precise estimate of the key figure’s surprise series.

Table 4 shows the estimation results. The sign of the coefficient is consistent with economic theory for all the key figures. All the coefficients, except the coefficient for registered unemployment, are significantly different from zero. The result is thus well in line with the findings in Section 2.1 and indicate that most key figures have a significant effect on the EURNOK exchange rate for a period up to 15 minutes after release. For example, a positive CPI-ATE surprise of 1 standard deviation will result in a strengthening of the krone against the euro of 0.287 percent.

For both consumer prices and GDP, several measures are released at the same time. Our analyses indicate that the exchange rate effect of surprises concerning the CPI, CPI-ATE, total GDP and mainland GDP is significant. However, the effect of the CPI-ATE is considerably larger than the effect of the CPI, while the effect of mainland GDP is greater than the effect of total GDP. This indicates that market participants focus more on the CPI-ATE than the CPI and more on mainland GDP than on total GDP. Chart 5 shows that there is a clear tendency for the krone exchange rate to appreciate (depreciate) when consumer price inflation is higher (lower) than expected. The connection seems, however, to be clearer for the CPI-ATE than for the CPI. Chart 6 shows a similar picture for the two GDP measures and supports the results in Table 4.

Chart 5: Scatter plot between exchange rate changes after 15 minutes (percent, vertical scale) and CPI and CPI-ATE surprises (number of standard deviations, horizontal scale).

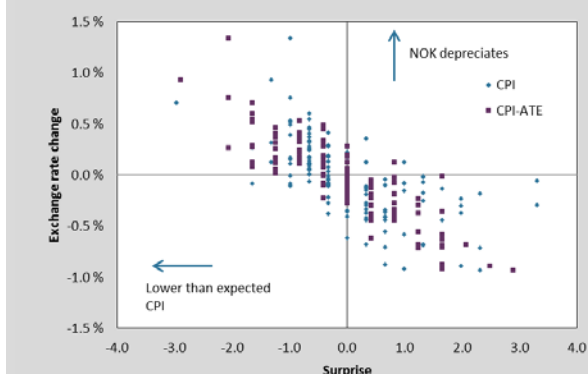


Chart 6: Scatter plot between exchange rate changes after 15 minutes (percent, vertical scale) and total GDP and mainland GDP surprises (number of standard deviations, horizontal scale).

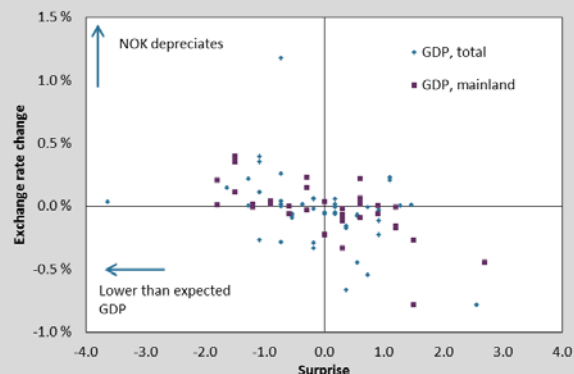


Table 5 shows the estimation results from three regressions when the variable in the left-hand column in regression (2) is measured by the exchange rate change 1 hour, 24 hours and 1 week after release of the key figures. The results indicate that very few key figures have a significant effect on the

Table 5: Regression results with exchange rate changes after 1 hour, 24 hours and 1 week. The coefficients are interpreted as the percentage exchange rate change per standard deviation surprise.

| Variable | 1 hour | | 24 hours | | 1 week | |
|-------------------------|-------------|------------|-------------|------------|-------------|------------|
| | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error |
| Constant | 0.001 | 0.000 | 0.011** | 0.005 | 0.034*** | 0.010 |
| LFS unemployment | 0.053*** | 0.015 | -0.039 | 0.045 | -0.005 | 0.080 |
| GDP, total | -0.086 | 0.060 | -0.145 | 0.100 | 0.123 | 0.150 |
| GDP, mainland | -0.205*** | 0.051 | -0.283*** | 0.085 | -0.350** | 0.148 |
| Retail trade | -0.087*** | 0.017 | -0.015 | 0.057 | -0.094 | 0.085 |
| Manufacturing output | -0.050*** | 0.014 | -0.001 | 0.053 | 0.023 | 0.114 |
| Credit indicator, C2 | -0.041*** | 0.015 | -0.018 | 0.053 | -0.015 | 0.083 |
| CPI | -0.017 | 0.025 | -0.018 | 0.044 | 0.150 | 0.172 |
| CPI-ATE | -0.299*** | 0.031 | -0.422*** | 0.055 | -0.550*** | 0.141 |
| PMI | -0.124*** | 0.021 | -0.043 | 0.053 | 0.113 | 0.100 |
| Registered unemployment | -0.007 | 0.023 | 0.040 | 0.048 | -0.049 | 0.066 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

krone exchange rate beyond a 1-hour horizon.¹¹ Only the CPI-ATE and mainland GDP have a significant effect over a 24-hour period. This is in line with the results in Section 2.1, where only these key figures (in addition to Norges Bank’s policy rate decision) contributed to significantly larger exchange rate effects than the average effect after 24 hours. The results also hold for the changes over a period of 1 week, indicating that exchange rate changes resulting from surprises in these two variables are very persistent.

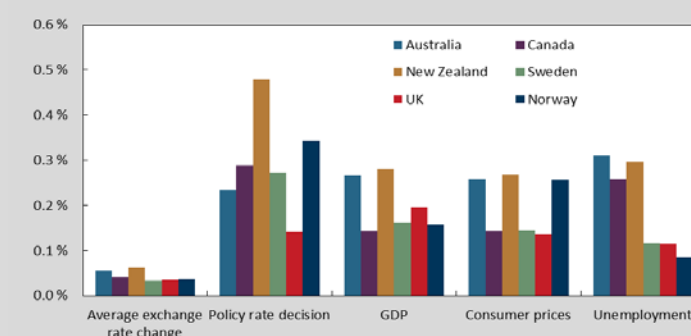
3. Exchange rate effects of key figures in the Norwegian foreign exchange market compared with other currencies

3.1 Comparison of absolute exchange rate changes

In order to compare with other currencies, we have conducted regressions similar to (1) for the Swedish krone (SEK), British pound sterling (GBP), Australian dollar (AUD), New Zealand dollar (NZD) and Canadian dollar (CAD) with the absolute exchange rate change after 15 minutes as the left-hand side variable.¹² Dummy variables for policy rate decisions, unemployment, GDP and consumer prices in these countries are included in the regressions, and Chart 7 shows the estimated exchange rate effects by key figure across countries.¹³

The chart indicates that the exchange rate effects after the release of these figures are larger than the average absolute exchange rate change in a 15-minute period where no key figures have been released. The absolute exchange rate changes after the release of unemployment figures are smaller in NOK than in the other currencies.¹⁴ For consumer price figures, however, the exchange rate effects are largest in NOK, NZD and AUD. The effect on NOK is also larger than the effect on most other currencies after policy rate decisions announced by the various central banks. A comparison of exchange rate effects across key figures indicates relatively even changes for some of the other currencies. The effects of consumer prices and Norges Bank figures on NOK show wider differences, indicating considerable focus on these figures in Norway, cf. Section 2.

Chart 7: Absolute exchange rate changes 15 minutes after release of key figures.



Average effects are equal to the intercepts in the regressions (β_0), while the effects after the release of key figures are given by $\beta_0 + \beta_i$. All the coefficients are significant at the 1 percent significance level.

¹¹ A regression of exchange rate changes over the four quarters after release of the key figure indicates that the exchange rate changes most in the first 15 minutes after release. There is little change in the exchange rate over the next three quarters of an hour, i.e. there is little sign of amplification or reversal of the exchange rate change. The results are in line with findings in other literature (see for example Ederington and Lee (1993) and Andersen et al. (2003). The results do show one exception, the PMI, where the exchange rate has a tendency to reverse its initial movement in the second 15-minute period after the release of the key figure.

¹² For the Swedish krone and British pound sterling, we have applied, as for the Norwegian krone, the bilateral exchange rate against the euro (EURSEK and EURGBP). For the Australian, Canadian and New Zealand dollar, we have applied the bilateral exchange rate against the US dollar (AUDUSD, USDCAD and NZDUSD).

¹³ Information about the key figures is provided in Appendix Table A.1. In the regressions, we have also controlled for the effect of other key figures that could influence the results.

¹⁴ We have used LFS unemployment as a measure of the effects after the release of unemployment figures in Norway as this measure resulted in larger exchange rate effects than registered unemployment in the period 2002 – 2014.

3.2 Comparison of exchange rate changes adjusted for key figure surprises

We have also conducted regression (2) for the other currencies to examine the relationship between exchange rate changes (not absolute) and the surprise series for the various key figures. We have therefore estimated (2) on four different horizons for five foreign currencies and compared with the results for NOK in Section 2.2¹⁵. Table 6 shows the coefficients of the surprise series for consumer price figures taken from the different regressions.

Table 6: Regression results with exchange rate changes after 15 minutes, 1 hour, 24 hours and 1 week. Coefficients and standard errors for the consumer price surprise series. The coefficients are interpreted as the percentage exchange rate change per standard deviation surprise.

| Country | 15 minutes | | 1 hour | | 24 hours | | 1 week | |
|-------------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
| | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error |
| Australia | 0.184*** | 0.035 | 0.199*** | 0.045 | 0.058 | 0.115 | -0.380 | 0.234 |
| Canada (CPI Core) | -0.068** | 0.033 | -0.092*** | 0.030 | -0.180 | 0.141 | -0.116 | 0.153 |
| New Zealand | 0.233*** | 0.043 | 0.277*** | 0.043 | 0.535*** | 0.150 | 0.370 | 0.275 |
| Sweden (CPI) | -0.123*** | 0.039 | -0.121*** | 0.045 | -0.299*** | 0.077 | 0.007 | 0.151 |
| UK (CPI) | -0.092*** | 0.019 | -0.085*** | 0.029 | -0.052 | 0.084 | 0.076 | 0.133 |
| Norway (CPI-ATE) | -0.287*** | 0.025 | -0.299*** | 0.031 | -0.422*** | 0.055 | -0.550*** | 0.141 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

We see that the sign¹⁶ of the coefficients for consumer price figures in the regressions at the 15-minute and 1-hour horizons are as expected. For all the countries, higher-than-expected inflation figures contribute to an appreciation of the exchange rate, and the effect is significant for up to 1 hour after release. The magnitude of the coefficient indicates that the effect of surprising consumer price figures is strongest in Norway and New Zealand. However, only Norwegian consumer prices show a significant effect 1 week after release, indicating that the effect is more persistent in Norway than in the other countries.

Table 7: Regression results with exchange rate changes after 15 minutes, 1 hour, 24 hours and 1 week. Coefficients and standard errors for GDP surprise series. The coefficients are interpreted as the percentage change per standard deviation surprise.

| Country | 15 minutes | | 1 hour | | 24 hours | | 1 week | |
|-------------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
| | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error |
| Australia | 0.230*** | 0.028 | 0.238*** | 0.030 | 0.238* | 0.129 | 0.398* | 0.226 |
| Canada | -0.065*** | 0.017 | -0.077*** | 0.021 | -0.007 | 0.060 | 0.004 | 0.136 |
| New Zealand | 0.239*** | 0.046 | 0.259*** | 0.053 | 0.171 | 0.203 | 0.254 | 0.227 |
| Sweden | -0.115*** | 0.039 | -0.118*** | 0.045 | -0.201** | 0.090 | -0.149 | 0.195 |
| UK | -0.188*** | 0.033 | -0.264*** | 0.048 | -0.384*** | 0.065 | 0.074 | 0.173 |
| Norway (Mainland) | -0.183*** | 0.036 | -0.205*** | 0.051 | -0.283*** | 0.085 | -0.350** | 0.148 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

The results for GDP figures are also in line with economic theory (see Table 7). Surprisingly high GDP growth contributes to an appreciation of all the respective countries' currencies, and the effect is significant for up to 1 hour after the release of the figure. The effect of surprising GDP figures seems to be strongest in Australia, New Zealand and the UK. The effect is somewhat smaller in Norway, but seems at the same time to be more persistent than in most of the other countries.

¹⁵ We have used the surprise series as shown in Appendix Table A.2 for the respective countries. This means that we have also included several surprise series for consumer prices in the regressions where relevant. Only the most significant surprise series for consumer prices is referred to in the results in Table 6. For Canada, we have also controlled for the effect of US labour market figures (nonfarm payrolls) in the regressions as this key figure has in many cases been released at the same time as Canadian key figures and the exchange rate is against USD.

¹⁶ Exchange rates for the Australian and New Zealand dollar (NZDUSD and AUDUSD) are quoted as the number of US dollars per unit of Australian and New Zealand dollars. A positive regression coefficient for the surprise series will therefore indicate that higher-than-expected consumer price figures contribute to an appreciation of the respective currencies against the US dollar. For the other four currencies, a negative coefficient will indicate an appreciation of the respective currencies against the euro/US dollar as these currency crosses are quoted as the number of units per euro/US dollar (EURNOK, EURSEK, EURGBP and USDCAD).

Table 8: Regression results with exchange rate changes after 15 minutes, 1 hour, 24 hours and 1 week. Coefficients and standard errors for the unemployment surprise series. The coefficients are interpreted as the percentage change per standard deviation surprise.

| Country | 15 minutes | | 1 hour | | 24 hours | | 1 week | |
|---------------------------|-------------|------------|-------------|------------|-------------|------------|-------------|------------|
| | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error | Coefficient | Std. Error |
| Australia | -0.191*** | 0.021 | -0.178*** | 0.025 | -0.199*** | 0.053 | -0.285** | 0.135 |
| Canada | 0.161*** | 0.021 | 0.171*** | 0.024 | 0.373*** | 0.074 | 0.203** | 0.100 |
| New Zealand | -0.219*** | 0.040 | -0.237*** | 0.046 | -0.146 | 0.187 | -0.268 | 0.257 |
| Sweden | 0.095*** | 0.018 | 0.091*** | 0.023 | 0.182*** | 0.054 | 0.002 | 0.131 |
| UK | 0.042** | 0.019 | 0.030 | 0.025 | 0.054 | 0.038 | 0.037 | 0.106 |
| Norway (LFS-unemployment) | 0.056*** | 0.015 | 0.053*** | 0.015 | -0.039 | 0.045 | -0.005 | 0.080 |

***, **, * indicate statistical significance at the 1, 5 and 10 percent levels respectively.

The sign of the unemployment surprise series is also in line with economic theory (see Table 8). Higher-than-expected unemployment leads, according to the regressions, to a depreciation of the exchange rate. The effect of surprising unemployment figures seems to be strongest in Australia, Canada and New Zealand. For the first two countries, the effects are also significant a week after release. Compared with these countries, surprising unemployment figures in Norway have less effect on the exchange rate and are less persistent. This is in line with the results in Section 3.1 and reinforces the impression that there is relatively little focus on unemployment in Norway compared with other countries and also compared with other types of Norwegian key figures.

4. How has the focus on key figures changed over time?

So far, we have only looked at estimated averages of the krone exchange rate effect in the period between 2002 and 2014. In addition to the effect of the key figure surprise itself, there are a number of factors that could influence the effect on the exchange rate. It is therefore likely that the effects might also vary over time irrespective of the magnitude of the surprise in the key figure. The effect on the exchange rate could, for example, depend on market conditions at the time of the release. High volatility and low liquidity could in isolation reinforce the exchange rate effects of the release for a given magnitude of surprise. Moreover, anecdotal information from our counterparties indicates that the focus on key figures varies over time, partly because the importance of a specific indicator for the economic outlook varies with the situation in the economy at the time.

Chart 8 shows annual average exchange rate changes (in absolute terms) 15 minutes after the release of Norwegian consumer prices. The effects were less pronounced in the period between 2004 and 2012, but have since increased considerably. In this period, CPI-ATE surprises did not increase to the same extent. This picture is supported by a regression estimated for each year of this period with 15-minute exchange rate changes as the left-hand side variable and a constant, and the surprise series for the CPI-ATE as the right-hand side variable.¹⁷ Chart 9 shows the coefficient of the surprise series for the CPI-ATE from these regressions and a 95 percent confidence interval. The graph illustrates that higher- (lower-) than-expected CPI-ATE figures have consistently contributed to a stronger (weaker) krone exchange rate and that this effect has been significant every year except 2011. However, the effect has shown wide variations. In 2004, one standard deviation higher inflation than expected resulted in an appreciation of the krone against the euro of 0.58 percent after 15 minutes. Through the previous decade, however, there were signs that the effect of consumer price surprises on the krone exchange rate was gradually decreasing. A possible interpretation could be that Norges Bank's inflation targeting regime was perceived as more flexible in this period, reducing the emphasis on

¹⁷ We have controlled for CPI surprise effects in these regressions.

current inflation figures in favour of key figures that could give some indication of inflation developments further ahead. In recent years, we have seen signs of stronger effects from consumer price surprises than in previous years. According to our market contacts, this may reflect higher uncertainty regarding the outlook for the Norwegian economy and periodically volatile market conditions.

Chart 8: Annual average of absolute exchange rate changes 15 minutes after the release of consumer price figures (percent) and of the absolute value of the CPI-ATE surprise series (number of standard deviations). 2003 – 2014.

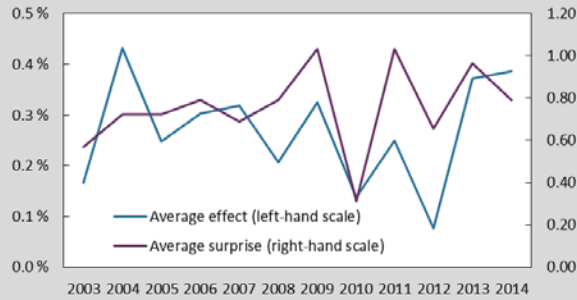
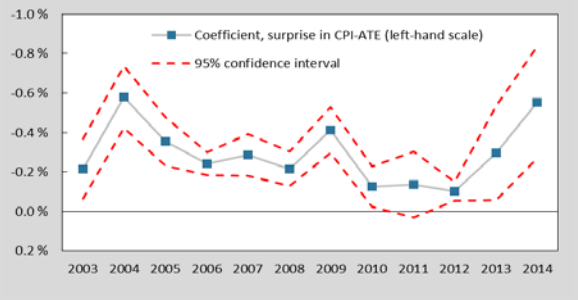


Chart 9: Coefficient of the CPI-ATE surprise series shown with a 95 percent confidence interval (inverted scale). 2003 – 2014.



Charts 10 and 11 show that the exchange rate effects for GDP and LFS unemployment have also shown signs of increasing in the past two years. This has occurred despite the fact that the GDP surprise has been smaller than previously. Chart 12 shows, however, that retail trade figures have not exhibited the same developments. Through the 2000s, investment in oil and gas activities has been high and there has been little focus on the oil investment survey. Recently, however, higher cost pressures in the petroleum sector, markedly lower oil prices and Norges Bank’s communication that a fall in oil investment could influence monetary policy have contributed to increased focus on this key figure.

Chart 10: Annual average of absolute exchange rate changes 15 minutes after the release of GDP figures (percent) and of the absolute value of the mainland GDP surprise series (number of standard deviations). 2003 – 2014.

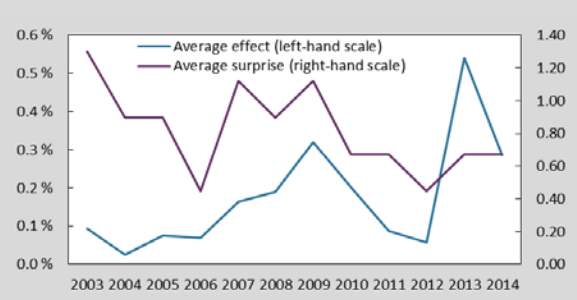


Chart 11: Annual average of absolute exchange rate changes 15 minutes after the release of LFS unemployment figures (percent) and of the absolute value of the LFS unemployment surprise series (number of standard deviations). 2003 – 2014.

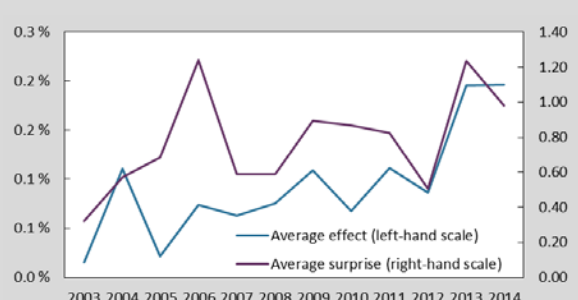
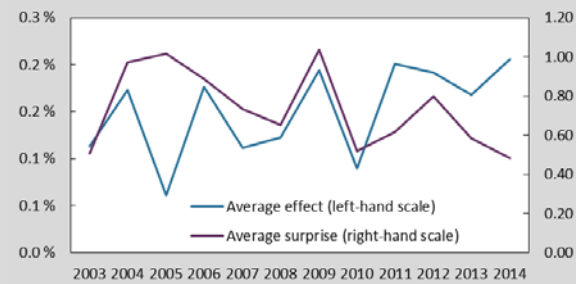


Chart 12: Annual average of absolute exchange rate changes 15 minutes after the release of retail trade figures (percent) and of the absolute value of the retail trade surprise series (number of standard deviations). 2003 – 2014.



5. Summary

Our analysis indicates that most Norwegian key figures have a significant effect on the krone exchange rate up to 1 hour after release as the absolute exchange rate changes are larger than in an average period without the release of key figures. For most of the Norwegian figures, the direction of the exchange rate changes is also in line with economic theory given the direction of the surprise. The exchange rate effects are strongest after announcement of Norges Bank’s policy rate decisions and the release of consumer price figures, indicating that these key figures constitute the main focus for participants in the NOK market. The most important figure for the real economy is GDP. The focus on policy rate decisions and consumer price figures also seems to be greater in NOK than in most of the other currencies we have studied in comparison. Similarly, there seems to be less focus on unemployment in NOK than in other currencies. The effect of consumer price and GDP figures seems to be more persistent in NOK than in other currencies.

The analysis also indicates that the focus on key figures varies over time. In recent years, the tendency has been for increased uncertainty concerning developments in the Norwegian economy and deteriorating market conditions to contribute to stronger exchange rate effects after the release of several Norwegian key figures.

Appendix

Table A.1: Key figures included in the analyses with absolute exchange rate changes.

| Country | Name | Time period | Number of observations | Source | Description |
|-----------------|------------------------------------|----------------------------|------------------------|--|--|
| Norway | LFS unemployment | 2002 - 2014 | 134 | Bloomberg | Labour Force Survey unemployment |
| | GDP | 2002 - 2014 | 52 | Bloomberg | Gross Domestic Product |
| | House prices | 2005 - 2014 | 120 | Norsk Eiendomsmeglerforbund, Eiendom Norge | House prices |
| | Retail trade | 2002 - 2014 | 154 | Bloomberg | Retail trade turnover |
| | Manufacturing output | 2002 - 2014 | 155 | Bloomberg | Manufacturing output |
| | Credit indicator, C2 | 2002 - 2014 | 143 | Bloomberg | Credit indicator for domestic credit, C2 |
| | Consumer prices | 2002 - 2014 | 156 | Bloomberg | Consumer price index |
| | Policy rate decision (Norges Bank) | 2002 - 2014 | 105 | Norges Bank | Policy rate decision, Norges Bank |
| | Oil investment survey | 2002 - 2014 | 52 | Statistics Norway | Investment survey, oil and gas activities |
| | PMI | 2007 - 2014 | 85 | Bloomberg | Purchasing Manager Index, for manufacturing |
| | Regional network # | 2009 - 2014 | 24 | Norges Bank | Regional network |
| | Trade balance | 2002 - 2014 | 156 | Bloomberg | Trade balance |
| | Registered unemployment | 2002 - 2014 | 157 | Bloomberg | Registered unemployment from the Norwegian Labour and Welfare Administration (NAV) |
| | Euro area | Policy rate decision (ECB) | 2002 - 2014 | 157 | Bloomberg |
| Consumer prices | | 2002 - 2014 | 156 | Bloomberg | Consumer Price Index |
| Australia | Policy rate decision (RBA) | 2002 - 2014 | 143 | Bloomberg | Policy rate decision, Reserve Bank of Australia |
| | GDP | 2002 - 2014 | 52 | Bloomberg | Gross Domestic Product |
| | Consumer prices | 2002 - 2014 | 52 | Bloomberg | Consumer Price Index |
| | Unemployment | 2002 - 2014 | 156 | Bloomberg | Unemployment |
| Canada | Policy rate decision (BoC) | 2002 - 2014 | 105 | Bloomberg | Policy rate decision, Bank of Canada |
| | GDP | 2002 - 2014 | 156 | Bloomberg | Gross Domestic Product |
| | Consumer prices | 2002 - 2014 | 156 | Bloomberg | Consumer Price Index |
| | Unemployment | 2002 - 2014 | 156 | Bloomberg | Unemployment |
| New Zealand | Policy rate decision (RBNZ) | 2002 - 2014 | 104 | Bloomberg | Policy rate decision, Reserve Bank of New Zealand |
| | GDP | 2002 - 2014 | 52 | Bloomberg | Gross Domestic Product |
| | Consumer prices | 2002 - 2014 | 52 | Bloomberg | Consumer Price Index |
| | Unemployment | 2002 - 2014 | 52 | Bloomberg | Unemployment |
| UK | Policy rate decision (BoE) | 2002 - 2014 | 156 | Bloomberg | Policy rate decision, Bank of England |
| | GDP | 2002 - 2014 | 52 | Bloomberg | Gross Domestic Product |
| | Consumer prices | 2003 - 2014 | 139 | Bloomberg | Consumer Price Index |
| | Unemployment | 2002 - 2014 | 152 | Bloomberg | Unemployment |
| Sweden | Policy rate decision (Riksbanken) | 2002 - 2014 | 85 | Bloomberg | Policy rate decision, Riksbanken |
| | GDP | 2002 - 2014 | 65 | Bloomberg | Gross Domestic Product |
| | Consumer prices | 2002 - 2014 | 156 | Bloomberg | Consumer Price Index |
| | Unemployment | 2007 - 2014 | 87 | Bloomberg | Unemployment |

Release dates for figures from Norges Bank's regional network have only been included as from 2009.

Table A.2: Information about the surprise series. ¹⁸

| Country | Name | Time period | Number of observations | Average of expected minus actual value #1 | Standard deviation of expected minus actual value #2 | Source | Description |
|-------------|----------------------|-------------|------------------------|---|--|-----------|---|
| Norway | LFS unemployment | 2003 - 2014 | 134 | 0.001 | 0.12 | Bloomberg | Labour Force Survey unemployment, in percent |
| | GDP, total | 2003 - 2014 | 48 | -0.050 | 0.55 | Bloomberg | GDP growth in percent. Released at the same time as mainland GDP |
| | GDP, mainland | 2003 - 2014 | 47 | 0.023 | 0.33 | Bloomberg | Growth in mainland GDP, in percent |
| | Retail trade | 2003 - 2014 | 141 | 0.055 | 1.13 | Bloomberg | Growth in retail trade, in percent |
| | Manufacturing output | 2005 - 2014 | 110 | 0.059 | 1.26 | Bloomberg | Growth in manufacturing output, in percent |
| | Credit indicator, C2 | 2003 - 2014 | 139 | 0.059 | 0.28 | Bloomberg | Growth rate for credit indicator C2, in percent |
| | CPI | 2003 - 2014 | 143 | -0.001 | 0.30 | Bloomberg | Rise in Consumer Price Index, in percent. Released at the same time as the CPI-ATE |
| | CPI-ATE | 2003 - 2014 | 140 | -0.016 | 0.24 | Bloomberg | Rise in Consumer Price Index adjusted for tax changes and excluding energy products, in percent |
| | PMI | 2007 - 2014 | 83 | -0.200 | 2.50 | Bloomberg | Purchasing Managers' Index, for manufacturing. Level of index |
| Australia | GDP | 2002 - 2014 | 52 | 0.019 | 0.27 | Bloomberg | GDP growth, in percent |
| | CPI | 2002 - 2014 | 52 | -0.002 | 0.25 | Bloomberg | Rise in Consumer Price Index, in percent |
| | Unemployment | 2002 - 2014 | 156 | -0.049 | 0.15 | Bloomberg | Unemployment, in percent |
| Canada | GDP | 2002 - 2014 | 156 | -0.040 | 0.17 | Bloomberg | GDP growth, in percent |
| | CPI | 2002 - 2014 | 156 | -0.005 | 0.20 | Bloomberg | Rise in Consumer Price Index, in percent. Published at the same time as Core CPI |
| | CPI (Core) | 2003 - 2014 | 138 | 0.004 | 0.19 | Bloomberg | Rise in Consumer Price Index excluding the eight most volatile components and indirect taxes (Core), in percent |
| | Unemployment | 2002 - 2014 | 155 | -0.030 | 0.14 | Bloomberg | Unemployment, in percent |
| New Zealand | GDP | 2002 - 2014 | 52 | 0.030 | 0.29 | Bloomberg | GDP growth, in percent |
| | CPI | 2002 - 2014 | 52 | -0.054 | 0.21 | Bloomberg | Rise in Consumer Price Index, in percent |
| | Unemployment | 2002 - 2014 | 52 | -0.042 | 0.33 | Bloomberg | Unemployment, in percent |
| UK | GDP #3 | 2002 - 2014 | 52 | -0.044 | 0.25 | Bloomberg | GDP growth, in percent |
| | CPI | 2004 - 2014 | 132 | 0.017 | 0.18 | Bloomberg | Rise in Consumer Price Index, in percent. Published at the same time as Core CPI |
| | CPI (Core) | 2005 - 2014 | 112 | -0.003 | 0.19 | Bloomberg | Rise in Consumer Price Index excluding energy, food, alcohol and tobacco, in percent |
| | Unemployment | 2002 - 2014 | 151 | -0.005 | 0.10 | Bloomberg | Unemployment, in percent |
| Sweden | GDP | 2002 - 2014 | 63 | 0.086 | 0.44 | Bloomberg | GDP growth, in percent |
| | CPI | 2002 - 2014 | 149 | -0.012 | 0.18 | Bloomberg | Rise in Consumer Price Index, in percent. Published at the same time as the CPIF |
| | CPI (CPIF) | 2009 - 2014 | 65 | -0.018 | 0.16 | Bloomberg | Rise in Consumer Price Index with a fixed mortgage rate (CPIF), in percent |
| | Unemployment | 2007 - 2014 | 86 | 0.017 | 0.30 | Bloomberg | Unemployment, in percent |

#1 Average of difference between expected and actual values for key figures, whole period.

#2 Standard deviation for difference between expected and actual values for key figures, whole period.

#3 In the series for UK GDP, only surprises in connection with initial release have been included.

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¹⁸ Surprise series for policy rate decisions have not been included since communication (either verbal or through publication of the interest rate path) can also affect financial prices to a considerable extent. A surprise series for the policy rate decision would therefore not always provide a representative picture of monetary policy surprises.