

Inflation targeting with a fluctuating exchange rate

Address by Deputy Governor Jarle Berge. Conference arranged by Pareto Securities in Oslo, 27 March 2003

The address is based on the assessments presented at Norges Bank's press conference following the Executive Board's monetary policy meeting on 5 March and on previous speeches and publications. Please note that the text below may differ slightly from the actual presentation.

My subject today is the conduct of monetary policy in an environment where the exchange rate fluctuates. I will discuss why the exchange rate is important also in an inflation targeting regime and how we take exchange rate fluctuations into account when making inflation forecasts and setting the interest rate.

The Government has defined an inflation target for monetary policy in Norway. The operational objective is an inflation rate of 2 ½ per cent over time. The key interest rate is set on the basis of an overall assessment of the inflation outlook, normally with a view to achieving an inflation rate of 2 ½ per cent two years ahead.

Forward-looking inflation targeting contributes to smoothing fluctuations in the economy. Pressures in the economy and risks of higher inflation will normally be met with a tightening of monetary policy. Conversely, sluggish growth and lower inflation pressures will normally induce a relaxation of monetary policy. Hence, the monetary policy response to changes in the inflation outlook will in most cases also promote the stabilisation of the real economy.

The krone is floating. We no longer have an exchange rate target. In fact, the experience of the last half of the 1990s showed that monetary policy does not have the instruments necessary to pursue an exchange rate target. But developments in the krone exchange rate are important to the inflation outlook and must be taken into account when setting the interest rate.

Exchange rate fluctuations influence consumer price inflation through several channels:

It affects inflation through a *direct effect* on prices for *imported consumer goods* in the CPI. An appreciation of the krone reduces prices for imported goods measured in Norwegian currency.

The exchange rate also influences inflation through an *indirect effect* via prices for *imported intermediate goods*, which in turn influence prices for domestically produced goods and services in the CPI.

Furthermore, the exchange rate has an impact on inflation through a *profitability effect*. Changes in the exchange rate may influence both the activity and the profitability of

internationally exposed industries and thereby wage growth. Changes in wage growth will in turn influence the CPI.

In addition, fluctuations in the exchange rate may affect inflation through a *price- wage spiral*. Traditionally, higher inflation has been met by demands for compensation in order to maintain a given growth in real wages.

Over time, it is likely that a lasting change in the krone exchange rate passes through fully to the level of prices for imported goods, when adjusted for indirect taxes, duties and freight costs.

There are many reasons, however, why import prices are not adjusted immediately in response to a change in the exchange rate. First, with a floating exchange rate, it may be difficult for enterprises to assess the duration of a change in the exchange rate. They may want to wait and see if it lasts before adjusting the price to the consumers. Meanwhile, the exchange rate movements only affect the enterprises' margins.

Second, many enterprises and importers hedge against movements in the exchange rate in the short to medium term, either by means of financial instruments or price agreements.

Third, markets with monopolistic competition will often be subject to strategic price setting. One example of this is the car market where foreign producers often price cars in NOK in the short term, thereby assuming full or partial exchange rate risk. In this case, it may take time before the direct effects of changes in the exchange rate are reflected in the CPI.

One would assume that it takes even longer for exchange rate movements to feed through to prices for domestically produced goods and services via imported intermediate goods, not to speak of the lags in the profitability channel.

Using two different models- the macroeconomic RIMINI model and a sub-index model - we have quantified the most direct effects of a shift in the krone exchange rate on consumer prices.¹ The RIMINI model is based on estimated relationships in the Norwegian economy over the past 30 years, while the sub-index model is estimated using data for the last 20 years or so.

Imported consumer goods account for about 20 per cent of the CPI adjusted for specific taxes. In the sub-index model, we have estimated separate equations for around 10 sub-indices of the CPI. The exchange rate is incorporated as a direct explanatory factor in the estimated equations for the prices for imported consumer goods. Consequently, we capture the direct effects of a change in the exchange rate on the CPI. In addition, we would expect changes in the exchange rate to have an indirect impact on prices for domestically produced goods and services in the CPI.

In the more comprehensive macroeconomic RIMINI model of Norges Bank, the exchange rate operates through a broader range of import prices. The RIMINI model captures both the direct effect from imported consumer goods, and the more indirect effect on domestic prices through imported intermediates. However, in the calculations presented here we

have excluded any indirect effects through reduced activity and profitability in internationally exposed enterprises.

The cumulative effects of a shift in the exchange rate differ somewhat between the two models, with the broader RIMINI model indicating the largest impact. In the sub-index model, a 1 per cent change in the exchange rate will change the CPI by a good 0.2 per cent, while the RIMINI model indicates an effect on the CPI in the area of 0.4 per cent.

The model using sub-indices may underestimate the indirect effects of a change in the exchange rate, for example because prices for imported intermediate goods may change. On the other hand, we have not found empirical support for a direct effect of an exchange rate change on prices for domestic goods and services (which accounts for a good 70 per cent of the CPI) in this disaggregated model. This may indicate that the RIMINI model to some extent overestimates the effects.

Based on these results, we may tentatively assume that a sustained appreciation of the effective krone exchange rate of 5 per cent may reduce CPI inflation by about $\frac{1}{4}$ percentage point the first year, close to $\frac{1}{2}$ percentage point the second year and about $\frac{1}{4}$ percentage point the third year.

Both models indicate that the pass-through to consumer price inflation is strongest the second year and then declines gradually.

The estimates are subject to considerable uncertainty. First, there is model-uncertainty. The models are estimated using data from a period dominated by a monetary policy regime with a fixed exchange rate. Internationally, it has been argued that the pass-through from exchange rate changes to inflation is diminishing. New Zealand, Australia and Canada have experienced wide exchange rate fluctuations in recent years. A weaker pass-through in these countries has been explained in part by the introduction of an inflation target which provides an anchor for expectations formation and thereby contains price-wage spirals. In Norway, the period of a floating exchange rate and inflation targeting is still too short to provide empirical evidence of such effects.

Second, there is uncertainty about the timing of the pass-through. The two models indicate that the effects are strongest after two years. However, these estimates are based on a long-lasting appreciation. Different exchange rate expectations will have different implications for the pass-through to inflation. If the exchange rate is expected to return to a more "normal" level, the pass-through may prove to be negligible at least in the short and medium term. Wider exchange rate fluctuations have probably also induced enterprises to take a more 'wait-and-see' attitude to changing prices.

The value of the Norwegian krone will vary, as most exchange rates do.

Changes in the exchange rate can be desirable when they contribute to stabilising inflation. The exchange rate may also act as an automatic stabiliser. In periods when economic activity is too high - or there are expectations of overheating - the exchange rate may appreciate, even if Norges Bank does not change its key rates. Similarly, the exchange rate may depreciate if the activity level is too low.

However, fluctuations in the exchange rate can also be a source of economic disturbances. Sentiments in the foreign exchange market may at times be excessively positive towards a currency while at other times they are overly negative. This can trigger large and unnecessary fluctuations in the exchange rate.

Norges Bank's reaction to a change in the exchange rate will depend on an assessment of the effect on inflation. This requires an evaluation of the reasons for and the expected permanence of the change. There is reason to believe that short-term fluctuations in the krone exchange rate have little impact on inflation. When the changes are potentially more lasting and thus may be assumed to have a greater impact on inflation, the Bank will set the interest rate with a view to stabilising inflation. However, it is difficult to establish whether exchange rate fluctuations are persistent or temporary and thus what the impact on inflation will be. Therefore, Norges Bank will normally proceed with caution in connection with any interest rate changes in response to fluctuations in the exchange rate.

Any monetary policy reaction to changes in the exchange rate will be built on an analysis of the factors behind the exchange rate developments, so that the overall stance of monetary policy is in accordance with the objective of low and stable inflation.

What causes exchange rate movements? In the long run exchange rates reflect economic fundamentals.

There is a tendency for the real exchange rate to return to its long-term average level in accordance with the purchasing power parity hypothesis. If our inflation rate is consistently higher than that of our trading partners, our nominal exchange rate will tend to fall. When PPP holds, the real exchange rate is a constant in the long run. Movements in the real exchange rate represent deviations from PPP.

The view of the PPP as a long-term international parity condition is supported by recent empirical literature testing the validity of the PPP hypothesis. Among the studies supporting PPP, there appears to be a consensus that the magnitude of the half-life of deviations from PPP is about three to five years.²

A measure of the real exchange rate is the trade-weighted exchange rate index (TWI) in relation to relative price developments between Norway and its trading partners. The real krone exchange rate has fluctuated around a long-term average level over the past 30 years. The krone exchange rate has tended to return relatively quickly to its normal level when it has deviated from the long-term average level. Studies indicate that the size of the half-life of deviations from PPP is about 1½ years.³ Differences in price inflation between Norway and other countries have gradually been evened out by changes in the krone exchange rate. This relationship has been robust even with considerable changes in economic policy over the years. However, it is still too early to say whether the revision of economic policy in spring 2001, with the introduction of a new fiscal guideline and an inflation target for monetary policy, may have an impact on how quickly differences in price inflation narrow in the future.

Economic theory serves as a guide to predict long-term movements in exchange rates. A central bank, assessing the inflation outlook, is concerned about exchange rate movements

within a horizon of a couple of years. Within this horizon, several factors may affect the exchange rate.

Generally these factors are outside the control of the central bank. The krone exchange rate is the price of our currency measured in terms of a foreign currency. Developments in other countries are just as important for the krone as developments in the Norwegian economy.

Commodity-exporting countries tend to experience wide fluctuations in their exchange rate. Australia is one example, and New Zealand another. Fluctuations in commodity prices lead to changes in countries' terms of trade, which measures the ratio of export to import prices. Fluctuations in the terms of trade affect the exchange rate. This dampens the effects of commodity price changes on profitability in business and industry. The exchange rate thus serves as a buffer against changes in the terms of trade.

In Norway, the petroleum fund mechanism and the fiscal guidelines dampen the effect on the exchange rate of changes in oil prices. Oil and gas account for the largest share of Norwegian exports. A substantial portion of the revenues from the sale of oil and gas is invested in foreign equities and bonds through the Government Petroleum Fund. As a result, short-term fluctuations in the oil price have less impact on the domestic use of petroleum revenues. In the last 20 years, fluctuations in the terms of trade have been three to four times greater for the Norwegian economy including the petroleum sector than for the mainland economy. The Petroleum Fund thus relieves pressure on the krone exchange rate.

Nevertheless, fluctuations occur. The trade-weighted krone appreciated by around 20 per cent from May 2000 until January 2003. The appreciation was particularly pronounced through 2002. The appreciation was the subject of media headlines and caused concerns among exporters. Importers were more subdued in their comments. Since end-January the krone has depreciated by around 4 per cent.

How do we explain the strong appreciation of the krone in the period between summer 2000 and January 2003? Market participants have pointed to several factors that may have contributed to the strengthening of the krone:

The appreciation occurred in tandem with a high and widening interest rate differential between Norway and other countries. Foreign interest rates fell while Norwegian interest rates remained high. This boosted demand for the Norwegian krone.

The fall in international stock markets led to increased risk aversion and expectations of a further decline in equity prices. As a consequence, many investors wanted to shift portfolios from equities to interest-bearing securities. According to market participants, the Norwegian krone, with a relatively high interest rate, may have seemed a good alternative. The krone exchange rate has been highly correlated with US equity prices over the last few years.

Market expectations concerning fluctuations between major currencies, measured by an indicator based on options prices, the Global Hazard Indicator⁴, fell. According to market participants, expectations of reduced exchange rate fluctuations between major currencies provide less scope for speculative gains in the foreign exchange market. In such periods,

investors have placed greater emphasis on interest rate differentials and invested a higher portion of their portfolios in high interest rate currencies, such as the Norwegian krone.

Oil prices rose markedly from the end of 2001. Market participants point out that, *ceteris paribus*, higher oil prices make the Norwegian krone more attractive.

Last year, the Norwegian krone was, again according to market participants, in periods considered a safe-haven currency. During turbulent periods, investors seek out safe investments. Traditionally, such investments have been gold, the Swiss franc and the US dollar. Some investors may have perceived the Norwegian krone as a temporary, safe alternative in a situation with uncertainty associated with a possible war in Iraq.

In order to examine the importance of these factors, Norges Bank has developed an econometric model of the trade-weighted exchange rate index (TWI).⁵ The model includes effects of the interest rate differential against other countries, developments in US equity prices, the magnitude of expected variability between major currencies (GHI) and the oil price. The model is estimated using monthly data from July 1999 to January 2003 and fits actual developments rather well.

The interest rate differential, RDIFF, is important in explaining short-term movements in the exchange rate. But, as the two last components of the equation indicate, the importance of the interest rate differential increases in periods of reduced expected variability between major currencies and negative growth in equity prices. Rises in equity prices are represented in the model only multiplied by the interest rate differential. Hence, equity prices will, according to this model, have no effect when the interest rate differential is zero.

The model is well-specified judged by standard criteria. The *t-statistics* of the estimated coefficients are generally high. Accordingly, the standard deviation of the residuals is quite low.

The focus of attention, or "themes", in foreign exchange markets shifts over time. The autumn of 1998 was marked by turbulence in international financial markets. Despite a high interest rate in Norway, investors shifted out of the Norwegian krone and into the Swiss franc and US dollar. In the last half of the 1990s, capital flows were heavily influenced by investor focus on stock market returns. During the period of the krone appreciation, which began in May 2000, investors placed considerable emphasis on interest rate differentials. The effect of the high and widening interest rate differential on the krone was amplified by conditions in international capital markets.

We have used the model to study how the different factors have influenced the krone exchange rate since May 2000.

The model indicates that the widening interest rate differential can explain about 40 per cent of the krone appreciation between May 2000 and January 2003. The stock market decline and falling variability between major currencies can explain about 55 per cent of the krone appreciation in the period. These factors contributed because the interest rate differential was positive. Higher oil prices also made some contribution to the appreciation of the krone in this period.

The factors make a varying contribution over time. As some of the conditions have changed markedly within the period, it is interesting to look at also a shorter sub-sample, beginning at the end of 2001. At that time, oil prices started to increase. According to the model, higher oil prices can explain about 35 per cent of the appreciation between December 2001 and January 2003. This may partly reflect the effects of the perception of the krone as a safe-haven currency. Developments in the interest rate differential explain some 30 per cent of the appreciation of the krone in the period, while the stock market decline and reduced volatility between major currencies can explain the remaining 35 per cent.

The model implies that the interest rate differential has a greater impact on the exchange rate the more equity prices are falling and the lower expected variability is between major currencies. The expected gain from speculating in equities or currencies may be limited when equity prices are falling and when exchange rates are relatively stable. In this situation, investors will place greater emphasis on interest rate differentials than when equity prices are rising and exchange rates fluctuate widely. The effects of a change in the interest rate differential at different points in time vary considerably. The interest rate effect increased markedly between March 2000 and January 2003. In March 2000, there was high expected variability between major currencies and equity prices had risen sharply. In January 2003, on the other hand, expected variability between major currencies was low and equity prices had fallen sharply.

The estimation results, as already mentioned, showed the model to be well-specified. The model fits the historical data very well. Looking backwards, the model tells a sensible story. However it should be kept in mind that although the model fits historical data very well, it is not necessarily suitable for forecasting purposes. We know the historical values of equity prices, the oil price, interest rate differentials and the measure of expected variability between major currencies. But in order to forecast future movements in the exchange rate, we need to predict the future values of these other variables as well. This is certainly not easy.

Exchange rate movements are important in determining future inflation. We need to take account of this in our inflation projections. But what should be our point of departure with regard to the exchange rate assumption? It would be nice to have a reliable and well-specified forecasting model for the exchange rate. Unfortunately, as we have seen, such models are not easily available.

Empirical research indicates that the better projection for exchange rates in the short term is a random walk.⁶ Thus, assuming a constant exchange rate for the next couple of years may be simple but nevertheless defensible. In our inflation reports, we have mostly assumed a constant rate equal to the average exchange rate for the last three months, or sometimes the last month. Very short term fluctuations in the krone will therefore have limited influence on the inflation forecast. If a shift in the krone exchange rate lingers on it will gradually feed through to the exchange rate assumptions and thus have an effect on the inflation projections and monetary policy decisions.

The impact on inflation of exchange rate fluctuations is, however, strongest at around 4-6 quarters ahead. By setting interest rates with a view to achieving an inflation rate at the operational target two years ahead, the importance of krone movements is reduced. With a

shorter horizon for monetary policy, interest rates would have been changed more frequently. This would imply more fluctuations in demand and production.

Alternatively, the exchange rate assumption could be based on economic theory. The uncovered interest rate parity condition is often used as a reference when "projecting" exchange rates. One could also use different definitions of equilibrium (real) exchange rates as a starting point, assuming the exchange rate, if it is perceived to be over- or undervalued, in turn will return to its equilibrium level. Although such assumptions may be attractive from a theoretical viewpoint, it is highly uncertain if the exchange rate will return to its equilibrium level within a two-year horizon.

Turning to our latest *Inflation Report*, the baseline scenario is based on the technical assumption of a constant sight deposit rate of 5½ per cent and a constant krone exchange rate equal to the average for February. Norges Bank's projections must be understood as conditional on these assumptions.

With an exchange rate equal to the average for February, prices for imported consumer goods were projected to fall gradually. The negative contribution to underlying inflation was expected to be most significant around summer and into late autumn. In the course of 2004 and 2005, the effect would gradually be reduced. In this scenario, inflation could reach 2¼ per cent two years ahead.

As an alternative to the baseline scenario, we also examined a possible scenario where the interest rate was reduced and the krone depreciated in line with market expectations. The forward rate for the Norwegian krone indicated a depreciation of about 7 per cent up to end-2005 compared with the baseline scenario in the report, corresponding to a further fall in short-term interest rates of a good 1 percentage point. Even though the forward rate is not necessarily a good predictor of actual developments, a depreciation of the krone of this magnitude was reflected in the expectations survey conducted by Consensus Forecasts.

In such a scenario, underlying inflation could reach 2¾ per cent two years ahead. Looking beyond the two-year horizon, inflation might edge up further.

By using different technical assumptions, we indicated different paths for inflation. Actual developments may, however, deviate from both paths. Norges Bank will continuously assess developments in the global economy, the Norwegian economy and the krone exchange rate, and set interest rates with a view to achieving the inflation target.

Norges Bank has reduced the sight deposit rate from 7 to 5.5 per cent since 11 December. A narrowing interest rate differential has been followed by a depreciation of the krone. Monetary policy has been relaxed.

Summary

Although we have models that can explain historical developments in the exchange rate well, such models are not necessarily suitable as forecasting models. In the short-term, the exchange rate can fluctuate widely. However much we may understand what has driven the exchange rate *ex post*, it must be admitted that economists do not have a great track record for forecasting exchange rates in the short and medium term.

Relationships in the foreign exchange market are unstable. The effect on the exchange rate from a change in the interest rate varies over time. The impact of exchange rate fluctuations on inflation will also vary.

Experience has shown that monetary authorities do not have the means to control the exchange rate. Monetary policy has nevertheless been successful in keeping inflation low and stable. It is the overall stance of monetary policy that will determine the path of inflation.

The key interest rate is set on the basis of an overall assessment of the inflation outlook, normally with a view to achieving an inflation rate of 2 ½ per cent two years ahead. Fluctuations in the exchange rate are important in the conduct of monetary policy to the extent that they can be expected to have an impact on inflation.

By having a two-year horizon for monetary policy and including changes in the exchange rate gradually in the inflation forecasts, monetary policy contributes to reducing variability in economic activity.

References:

Akram, Q. F. (2002). *PPP in the medium run despite oil shocks: The case of Norway*. Working Paper No. 4, Norges Bank

Bernhardsen, T. and Ø. Røisland (2000). Factors that influence the krone exchange rate, *Economic Bulletin* 4/2000

Frankel, J.A. and A. Rose (1995). Empirical research on nominal exchange rates. In G. Grossman and K. Rogoff (eds.), *Handbook of International Economics*, Vol. 3, Amsterdam, North Holland

Norges Bank (2003). *Inflation Report* 1/2003

Norges Bank (2002). *Inflation Report* 2/2002

Sarno, L. and M. P. Taylor (2002): *The Economics of Exchange Rates*, Cambridge University Press

Footnotes

¹ See also the box in Norges Bank's *Inflation Report* 2/2002: "How does the krone exchange rate influence the CPI?", page 32-33

² See Sarno and Taylor (2002), Chapter 3, page 87

³ See Akram (2002)

⁴The GHI is derived from prices for currency options (implied volatility) for the euro, the US dollar and Japanese yen. The GHI falls when expected volatility between major currencies is reduced. See Bernhardsen and Røisland (2000) for a further description of the GHI.

⁵See also the box "Factors behind developments in the exchange rate", in Norges Bank's *Inflation Report 1/2003*, page 37-39, for a further description of the model.

⁶See Frankel and Rose (1995), Chapter 1.3