SPECIAL ANALYSIS

Low inflation expectations – how are they affecting the economy and what can monetary policy do to soften their effects?

Inflation is low both in Sweden and in the euro area, and inflation expectations have fallen. This is a source of concern for both the Riksbank and the ECB. Economic theory, and to some extent experience, suggests that inflation expectations impact on both current and future inflation and macroeconomic performance. Inflation expectations are therefore relevant to monetary policy, including in the short term. This special analysis shows that falling inflation expectations can have large and lasting macroeconomic effects. These effects are particularly great if the central bank does not react quickly to lower inflation expectations.

Inflation and inflation expectations in Sweden have declined in recent years (see Diagrams 116 and 117).[43] A similar pattern has been seen in the euro area. This low inflation could undermine the credibility of the inflation target, which has given both the Riksbank and the ECB cause for concern. Economic theory implies that low inflation expectations lead to lower inflation. Inflation expectations, including in the short term, are therefore a relevant factor to be addressed by monetary policy.[44]
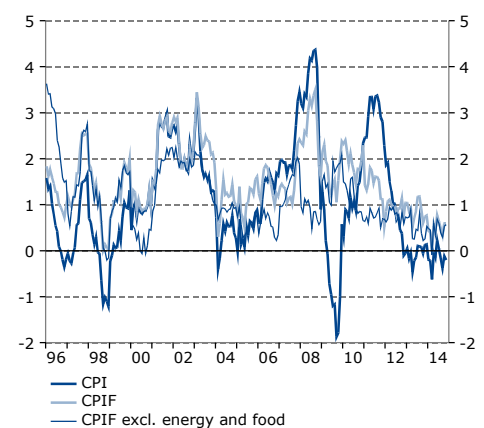
The present analysis begins with a number of possible explanations for the current low level of inflation, before outlining the theory showing how inflation and inflation expectations can reinforce each other in a negative spiral, and how central banks can act to prevent such scenarios. Empirical studies are then presented from Sweden and abroad analysing how well inflation expectations help explain future inflation. Finally, these mechanisms are described using the NIER's macroeconomic model KIMOD.

Diagram 116 Consumer prices
Annual percentage change, monthly values

— CPI
— CPIF
— CPIF excl. energy and food

Source: Statistics Sweden.

Diagram 117 Inflation and inflation expectations, one year horizon
Annual percentage change and per cent, respectively, quarterly values

— CPIF
– – Prospera, total
— Prospera, money market participants
– – Business Tendency Survey

Sources: Statistics Sweden, TNS Sifo Prospera and NIER.

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[43] In this analysis, inflation expectations are compared mainly with the actual consumer price index with constant mortgage rates (CPIF). This measure is believed to be closer to the prices that respondents have in mind when forecasting future price movements.

[44] Large negative discrepancies between actual inflation and inflation expectations will probably result in higher real wages and higher unemployment. There has been a debate about the effects of this – see, for example, Svensson (2014), Flodén (2012) and Andersson and Jonung (2014). Low inflation also results in higher real debt. These aspects will not, however, be addressed in this analysis.

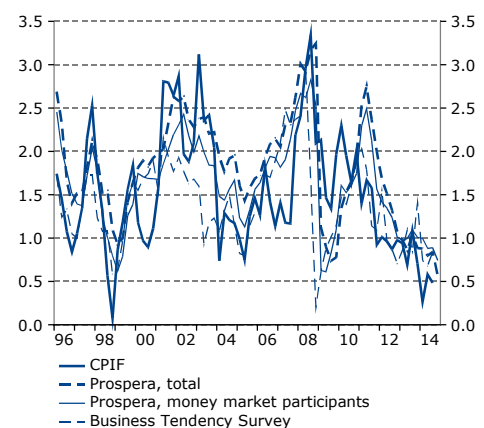**Diagram 118 Inflation and inflation expectations, two year horizon**

Annual percentage change and per cent, respectively, quarterly values

— CPIF
- - Prospera, total
— Prospera, money market participants
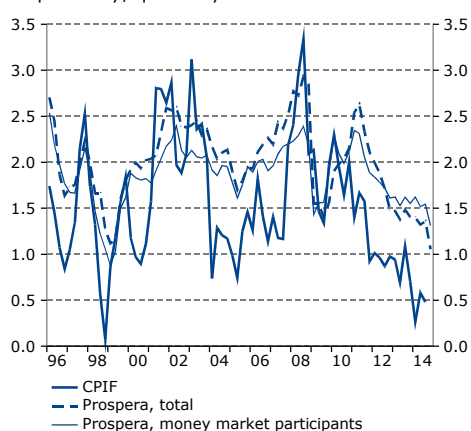
Sources: Statistics Sweden, TNS Sifo Prospera and NIER.

Diagram 119 Inflation and inflation expectations, five year horizon

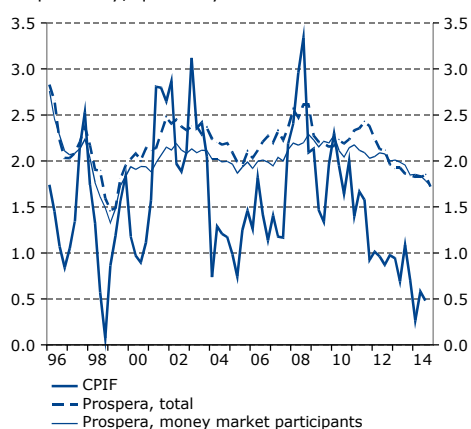Annual percentage change and per cent, respectively, quarterly values

— CPIF
- - Prospera, total
— Prospera, money market participants

Sources: Statistics Sweden, TNS Sifo Prospera and NIER.

VARIOUS EXPLANATIONS FOR LOW INFLATION

The low level of inflation in Sweden is probably due to a combination of factors. Before 2006, it was often explained by productivity growth being stronger than expected.[45] Another argument is that monetary policy has been too tight.[46] A further commonly cited explanation for inflation being so low is weak economic growth outside Sweden following the financial crisis.[47] Sweden is a small, open economy where household consumption includes a high share of imported goods and is therefore heavily influenced by changes in world market prices and exchange rates. There are also other explanations, both cyclical and structural, for the low inflation of recent years, such as firms reporting limited demand and increased competition.[48] They have therefore struggled to pass costs on to consumers.

LOW INFLATION EXPECTATIONS

One factor that has attracted too little attention as a reason for the low rate of inflation is short-term inflation expectations.[49] Firms price their goods and services largely on the basis of how they think other firms price theirs, and how they think customers will react to price changes. Viewed this way, inflation expectations will tend to explain future inflation.

Previous studies have shown that respondents in Prospera's expectations survey tend to be heavily influenced by the current rate of inflation at the time of the interview,[50] and in a way that is not compatible with how inflation normally develops. There are therefore indications that expectations are adaptive.

When it comes to the formulation of monetary policy, investment decisions, pay bargaining and so on, inflation expectations in the longer term are also of great interest. Inflation expectations two and five years ahead have diverged in recent years (see Diagrams 118 and 119). Inflation is currently expected to be 1.1 per cent in two years and 1.7 per cent in five years, which are

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[45] See, for example, Sveriges Riksbank (2006).

[46] To some extent, this is because high household debt levels have led to monetary policy being kept tighter than had it focused exclusively on stabilising inflation around 2 per cent.

[47] See, for example, Söderström and Vredin (2013). This has also been cited as an explanation by Riksbank deputy governor Per Jansson (2011).

[48] See Apel et al. (2014).

[49] See Flodén (2014).

[50] See Jonsson and Österholm (2012) and Flodén (2012). Expectations are found to be adaptive one, two and five years ahead.

the lowest expectations recorded since the financial crisis for the former and since 1999 for the latter.

Theoretical considerations and empirical studies

Under normal circumstances, the impact of inflation expectations on the real interest rate is just one of many factors to be taken into account when formulating monetary policy. When the nominal policy rate is close to zero, and inflation and inflation expectations are a long way from the inflation target, inflation expectations become more important than normal for the design of monetary policy. In such a situation, overly passive monetary policy could lead to persistently low inflation or deflation. The risk of economic stagnation also increases, because the real interest rate is not sufficiently low for demand to take off.

This abnormal situation can currently be said to exist in the euro area and, to some extent, also in Sweden. As in Sweden, the nominal policy rate is currently very low in the euro area, and both inflation and inflation expectations have fallen sharply in recent times (see Diagram 120).[51]

Diagram 120 Inflation and inflation expectations in euro area
Per cent, quarterly values

— Inflation
-- 1-year expectations
— 2-year expectations
-- 5-year expectations
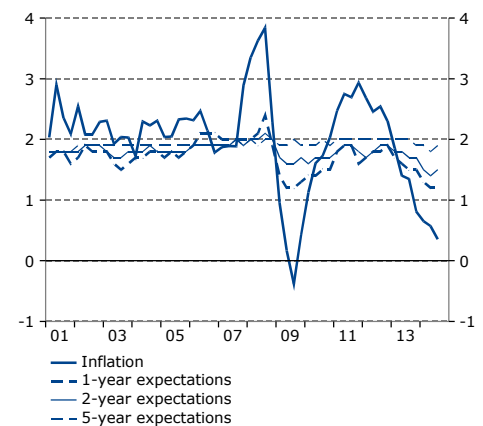
Note. Harmonised index of consumer prices, (HICP).
Sources: Survey of Professional Forecasters, ECB.

INFLATION EXPECTATIONS AFFECT THE REAL INTEREST RATE AND THEREBY ECONOMIC PERFORMANCE

The expected real interest rate commands a central position in macro theory and exists at various time horizons. The one-year real interest rate is defined as the nominal interest rate (i_t) minus expected inflation (π_{t+1}^e) over the coming year.

$$r_t^e = i_t - \pi_{t+1}^e$$

According to neo-Keynesian theory, actual inflation is determined by the following equation:

$$\pi_t = \alpha \pi_{t-1} + \beta \pi_{t+1}^e + \gamma(y_t - y_t^*),$$

where $y_t - y_t^*$ is the difference between actual and potential GDP (the output gap), and it is assumed that $\alpha, \beta, \gamma > 0$.[52] The above equation contains both backward-looking and forward-looking expectations.

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[51] This has not, however, happened in the US, for example, where CPI inflation was 1.8 per cent in the third quarter of 2014 and inflation expectations are relatively stable.

[52] See, for example, Clarida et al. (1999).

Diagram 121 Real one-year interest rate

Per cent, quarterly values

- Sweden
- Euro area
- US
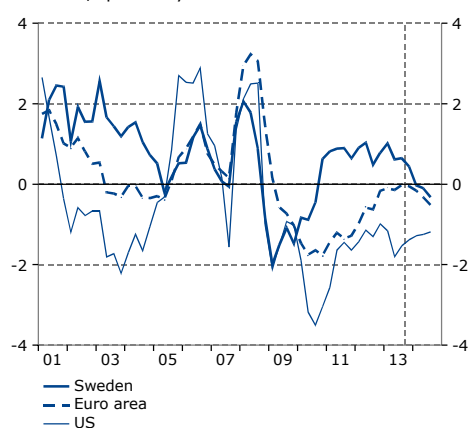
Note. Calculated ex post as the average nominal policy rate deflated by the annual percentage change in the HICP: $r_t = \frac{1}{4}\sum_{i=0}^{3} i_{t+i} - HIKP_{t+4}$. For the US, the policy rate is deflated by the CPI. Starting with 2013Q4, the real rate is based on NIER's inflation forecast.

Sources: Bureau of Labor Statistics, ECB, Eurostat, Federal Reserve, Statistics Sweden, The Riksbank and NIER.

The real interest rate's expected level and change affect consumption and investment decisions and, via the real exchange rate, foreign trade. If households and firms believe that the real interest rate in the near term is temporarily low, their incentive to consume and invest will increase. The reverse will apply if the real interest rate in the near term is believed to be temporarily high. In recent years, the real interest rate ex post in Sweden has been around 1 per cent, which is higher than in the euro area and the US (see Diagram 121). However, the real interest rate in the euro area has risen rapidly since the beginning of 2012 as a result of falling inflation.

Monetary policy can influence the expected real interest rate via several channels. The most common channel is the effect of the policy rate on nominal interest rates with short maturities. By communicating how the policy rate is expected to move in the longer term (forward guidance), central banks can also influence expectations of future interest rates.[53] Another, more indirect, way in which monetary policy can affect the real interest rate is via inflation expectations. A central bank with a high degree of credibility is able to influence inflation expectations through its communication. If, for example, near-term inflation is low, a credible central bank can prevent long-term inflation expectations from falling, and so keep the real interest rate down, by communicating how the inflation target will be reached.

The equation for the real interest rate above illustrates clearly the problems that arise in the situation currently facing Sweden and the euro area. The nominal policy rate is zero, and it is not considered possible to lower it much further. At the same time, inflation expectations are low. If these expectations cannot be influenced through the central bank's communication, the real interest rate cannot be brought down even if the economy is in need of this. This problem is well-known and discussed widely both by policy institutes and in the research literature.[54] In this situation, there is a risk of protracted stagnation, and this risk is not considered insignificant, especially in the case of the euro area. Because a large share of Swedish exports head to the euro area, this will also impact on economic developments in Sweden.

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[53] This action can only succeed if the central bank has a high degree of credibility. Central banks can also use "unconventional" measures to influence the nominal interest rate at longer maturities, as they did during the financial crisis and the ensuing economic downturn.

[54] See, for example, IMF (2014), Bullard (2010) and Benhabib et al. (2012).

LOW INFLATION AND LOW INFLATION EXPECTATIONS CAN REINFORCE EACH OTHER IN A NEGATIVE SPIRAL

The importance of expectations for macroeconomic performance and economic policy came to the fore in the 1960s and 1970s when theories of rational expectations were launched.[55] The probability of an economy ending up in a very difficult position where low inflation and low inflation expectations reinforce each other in a negative spiral is limited in models where rational expectations are assumed and the central bank's inflation target is credible.[56]

This assumption about participants' expectations has been challenged, however, by a literature which, according to its proponents, applies more realistic assumptions about the understanding households and firms can be expected to have of how the economy works, and about the information their expectations are based on.[57] Theories of limited rationality and learning have been applied not least in monetary policy theory.[58] This means that participants rely to a significant extent on backward-looking information when forming their expectations of the future.

This can present monetary policy with problems when it comes to achieving the desired real interest rate and economic recovery following major shocks. This applies particularly if households and firms attach considerable importance to recent inflation data when forming their inflation expectations.[59] A shock that causes inflation and inflation expectations to fall could then result in a long period of low inflation, especially if the nominal policy rate is already close to zero.[60] The real interest rate could then end up higher than is compatible with economic recovery. This, in turn, will lead to expectations of lower production and demand going forward, further reducing inflation expectations and pushing up the real interest rate in the near term. In the worst case, this process could lead to stagnation and deflation. For this reason, it is important to identify how mone-

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[55] See, for example, Phelps (1967), Friedman (1968) and Lucas (1972, 1976). Rational expectations mean that participants are assumed to take account of all relevant information and understand the functioning of the economy.

[56] See Benhabib et al. (2001).

[57] See, for example, Evans and Honkapohja (2001) and Milani (2007).

[58] See, for example, Evans and Honkapohja (2001, 2005) and Evans et al. (2008).

[59] So-called constant-gain learning – see Orphanides and Williams (2005, 2008). Such a strategy may be both more appropriate and more realistic as the participants in the economy then adapt more quickly to structural changes.

[60] See Evans et al. (2008).

tary policy can be used to minimise the chances of such situations.[61]

MONETARY POLICY STRATEGIES TO ADDRESS LOW AND FALLING INFLATION EXPECTATIONS

The literature provides important insights into how monetary policy should be pursued to stop the aforementioned situations from arising, and how to deal with them if they do still arise.[62] One insight is that the central bank should assume that, at least to some extent, the participants in the economy base their expectations on historical information. This is significant for the central bank's reaction pattern, which should therefore take account of inflation expectations in order to reduce the risk of undesirable developments following major shocks.

Another lesson is that monetary policy must be especially expansionary when inflation and inflation expectations are very low. In such a situation, the economy is vulnerable to further negative shocks to inflation and inflation expectations. Acting quickly and decisively to move the economy away from this exposed position will reduce vulnerability if a major shock occurs. Of course, the central bank must also act quickly and decisively if such a shock has already occurred and put the economy in a difficult position. This may mean that in such circumstances the central bank has to deviate from its normal reaction pattern.

One related lesson is that monetary policy may need to be "irresponsible".[63] In order to push up inflation expectations and so bring down the real interest rate, the central bank may need to communicate that it intends to allow inflation to overshoot the target in the future. This is an example of forward guidance.[64, 65]

Internationally, the Bank of England and the Federal Reserve, among others, have increased the supply of money in the economy by buying government bonds on the open market in order to avoid overly low inflation. This so-called quantitative

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[61] The present analysis does not take account of any fiscal measures.

[62] See, for example, Evans and Honkapohja (2008).

[63] Krugman (1998), p. 139: "Monetary policy will in fact be effective if the central bank can credibly promise to be irresponsible, to seek a higher future price level."

[64] Another example is when the Federal Reserve announced in December 2012 that it would not raise its policy rate until unemployment falls below 6.5 per cent with inflation below 2.5 per cent. The Bank of England took a similar line in August 2013.

[65] Another approach often referred to in the literature is replacing the inflation target with a price-level target. See, for example, Svensson (1999) for an analysis of the pros and cons of this.

easing has been used to stimulate the economy when the policy rate could not be lowered any further.[66]

Finally, one seemingly drastic but theoretically appropriate option would be to raise the inflation target. This could have its drawbacks, of course, but it might also be part of the solution for a stagnant economy with an overly high real interest rate when the policy rate is close to zero.[67]

THEORY HAS SOME EMPIRICAL SUPPORT

As mentioned above, Swedish data show signs of inflation expectations being to some extent adaptive.[68] Table 15 reveals, however, that inflation expectations offer better forecasting accuracy than the fully backward-looking, or naïve, forecast.[69] This indicates that inflation expectations are also to some extent forward-looking.

Table 15 Root mean square errors for inflation, 1997–2014[70]

	1 year	2 years	5 years
Prospera, total	0.88	0.98	0.96
Prospera, employee organisations	0.89	0.98	0.93
Prospera, employer organisations	0.90	0.97	0.93
Prospera, purchasing managers, manufacturing	0.95	1.07	1.06
Prospera, purchasing managers, trade	0.91	0.96	1.00
Prospera, money market	0.80	0.89	0.85
NIER, households	0.95		
NIER, businesses	0.73		
Naïve forecast	1.36	1.33	1.59
Fixed forecast, 2 per cent	0.85	0.86	0.82

Note. All root mean square errors have been estimated on quarterly data. Households' inflation expectations in the NIER survey have been converted from monthly to quarterly data.

Sources: TNS Sifo Prospera and NIER.

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[66] A summary of the potential effects of quantitative easing can be found in Söderström and Westermark (2009).

[67] See Ball (2013) and Blanchard et al. (2010).

[68] See, for example, Jonsson and Österholm (2012).

[69] In a naïve forecast, the forecast h periods ahead is equal to the most recent observation. In this way, the naïve forecast is fully backward-looking. Despite its simplicity, a naïve forecast is a widely used benchmark in macroeconomic research – see, for example, Atkeson and Ohanian (2001).

[70] The root mean square error at horizon h is calculated as $\sqrt{(1/n)\sum_{i=0}^{n-1}\left(e_{t+h+i|t+i}\right)^2}$, where n is the number of observations of inflation expectations, and $e_{t+h+i|t+i} = y_{t+h+i} - \hat{y}_{t+h+i|t+i}$, where $e_{t+h+i|t+i}$ is the forecast error, y_{t+h+i} is the actual CPIF at time $t+h+i$, and $\hat{y}_{t+h+i|t+i}$ is expectations for CPIF inflation at $t+i$. The root mean square errors here are calculated for the period 1997q1 to 2014q3.

All categories of respondents have lower forecasting errors than the naïve forecast in both the short and the longer term. The difference in forecasting accuracy is also statistically significant.[71] Participants in the money market have the best predictive performance of Prospera's categories.

The results therefore indicate that Swedish inflation expectations are to some extent also forward-looking, which means that there is a good chance of credible monetary policy returning the economy to full capacity despite low inflation and low inflation expectations.

In the euro area and the US, survey-based inflation expectations have proved better forecasting instruments than simple models.[72] This indicates that there is a risk of the low inflation expectations in the euro area (see Diagram 120) being followed by low inflation in the future too. The ECB has repeatedly expressed concern about self-fulfilling inflation expectations in the euro area.[73]

This growing concern has led to a large number of empirical studies which attempt in various ways to shed light on aspects of these problems. For example, Decressin and Laxton (2009) use panel data for 36 countries in 1994−2008 to examine the risk of deflation as a result of the financial crisis. Sweden is one of the countries in the sample with relatively less persistent inflation, which means that it takes less time for inflation to return to the target level after a period of unexpectedly low price rises. The risk of a downward spiral is therefore smaller.

Scharnagl and Stapf (2014) show that inflation expectations have shown a decreasing mean but increasing variance since the debt crisis in the euro countries erupted in mid-2011. By studying the change in long-term interest rates around the times of monetary policy decisions, they also believe that the efficacy of expansionary monetary policy has decreased. Against this background, they draw the conclusion that the market has become more uncertain about the ability of monetary policy to prevent a deflation scenario in the euro area. They also find that the probability of a deflation scenario in the euro area has increased since

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[71] According to the Diebold-Mariano (1995) test, where Newey-West (1987) standard errors are used, inflation expectations are better than the naïve forecast for the CPIF in almost all cases at a 1 per cent significance level and in all cases at a 5 per cent significance level. For the CPI, only firms in the NIER's survey had significantly better forecasting accuracy than the naïve forecast. In Prospera's survey, respondents are asked how they expect the annual percentage change in the CPI to move one, two and five years ahead. In the NIER's survey, they are asked instead how they expect *prices*, measured as the annual percentage change, to move.

[72] See, for example, Mestre (2007), Forsells and Kenny (2002) and Ang et al. (2007).

[73] See, for example, Moghadam et al. (2014) and Financial Times (2014).

2011. Coenen and Warne (2013) also show with a structural macro model that the deflation risk in the euro area has increased as a result of the zero lower bound binding. Amisano et al. (2014) obtains similar results for the euro area using money supply as an indicator for deflation. The risk of deflation is, however, considered to be unchanged in the US and have fallen in Japan.

Effects in the macroeconomic model KIMOD

This section uses the NIER's macroeconomic model KIMOD to illustrate the mechanisms discussed in the sections above. The main scenario – the NIER's current forecast – is compared with two alternative scenarios where it is assumed that inflation expectations fall by 1 percentage point in 2015 for some unexplained exogenous reason.[74]

In the first alternative scenario, the model is permitted to choose the repo rate without restrictions. The estimated repo rate then falls below zero (see Diagram 122), making it possible to study the expected macroeconomic effects of further reductions in the repo rate. In order to analyse further the significance of monetary policy, the second alternative scenario assumes that the zero lower bound binds (see Diagram 122).
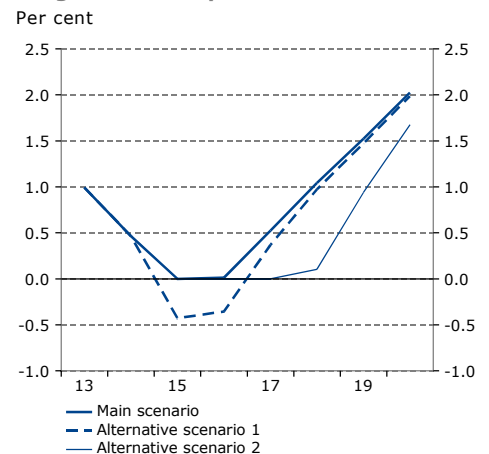
In KIMOD, the expected real interest rate is calculated as the nominal interest rate deflated by expected inflation, in the form of the GDP deflator, one year ahead. The three parts of this equation are presented in Diagrams 122−124.[75] Inflation expectations are estimated in KIMOD as a weighted average of adaptive expectations and the 2 per cent inflation target.

Inflation expectations are lowest in alternative scenario 2 where the Riksbank is unable to react in 2015−2016 due to the zero lower bound. This, in turn, means less favourable macroe-

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[74] The model is conditioned on input data through to the fourth quarter of 2014 and therefore starts from the first quarter of 2015. In alternative scenarios 1 and 2, expected inflation one year ahead is assumed to fall temporarily by 1 percentage point. These reduced inflation expectations in 2015q1 mean that, other things being equal, expected inflation four quarters ahead (i.e. the expected inflation between 2015q1 and 2016q1) will be 1 percentage point lower. It is unusual for inflation expectations one year ahead to fall by a whole point from one quarter to the next, but it does happen from time to time, most recently from 2008q4 to 2009q1 (see Diagram 117).

[75] These inflation expectations are, of course, not "correct" in the sense that they are those held by "the market". In Diagram 124, the decline in inflation expectations in the first year in alternative scenarios 1 and 2 is slightly more than 1 percentage point. This is because KIMOD is permitted to respond immediately to the decline in inflation expectations in 2015q1.
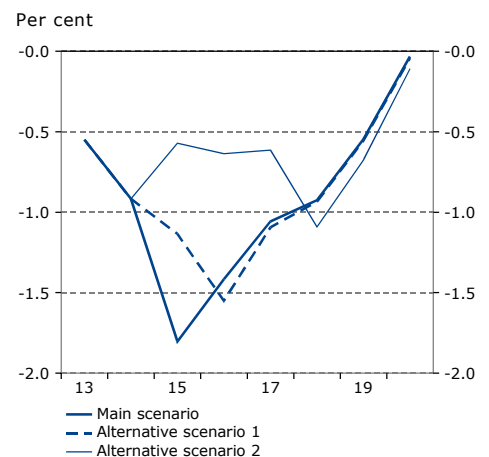
Diagram 122 Repo rate
Per cent

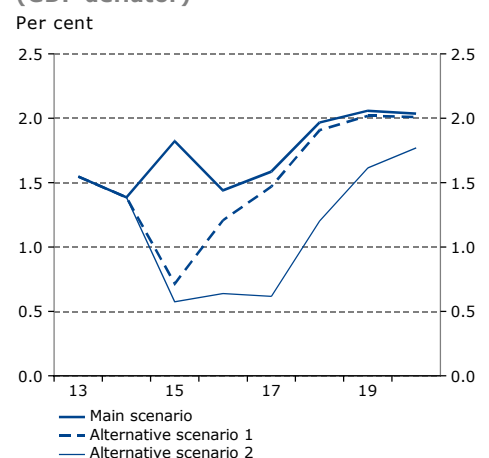Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

Diagram 123 Expected real interest rate
Per cent

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

Diagram 124 Inflation expectations (GDP deflator)
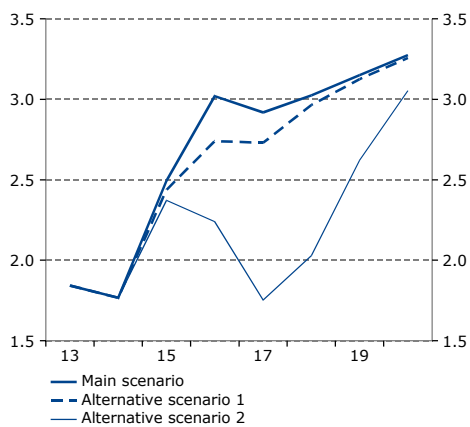Per cent

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

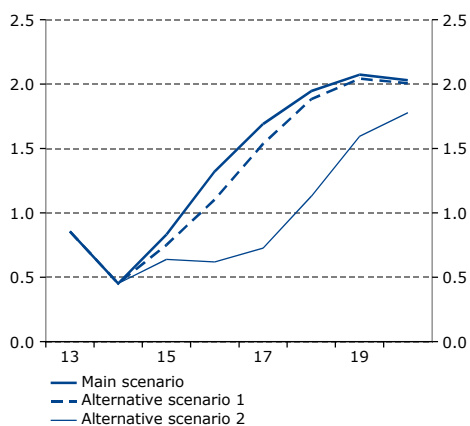**Diagram 126 Labour costs in business sector**
Percentage change

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.
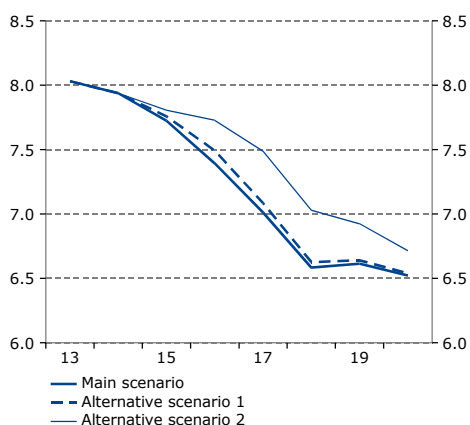
Diagram 125 CPIF inflation
Per cent

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

Diagram 127 Unemployment
Per cent of labour force

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

conomic performance and so lower inflation expectations. The lower inflation expectations, and the higher expected real interest rate, impact on wage expectations and, in turn, on growth in nominal labour costs (see Diagram 125). This contributes to lower underlying inflation as measured by the CPIF in alternative scenario 1, and especially in alternative scenario 2 where the main scenario's interest rate in 2015−2016 is assumed (see Diagram 126). The higher real interest rate results in a stronger real exchange rate. Once the Riksbank is able to react in alternative scenario 2, it is forced to keep interest rates low for longer in order to bring down the real interest rate and the exchange rate and so stimulate recovery. This also leads gradually to rising inflation.

The output gap is wider, and unemployment higher, in both the alternative scenarios (see Diagrams 127 and 128). The effect is not insignificant when the Riksbank is not permitted to take the repo rate below zero.[76]

Closing remarks

Inflation is currently low both in Sweden and in the euro area. Inflation expectations at all horizons have also fallen and are now below the inflation target. Combined with nominal interest rates that cannot be lowered much further, this could result in excessively high real interest rates, leading to an increased risk of stagnation and even lower inflation. This could put a further damper on inflation expectations. In the worst case, it could trigger a deflationary spiral where the lower inflation leads to lower inflation expectations, which result, in turn, in even lower inflation, and so on. The risk of falling inflation expectations causing deflation is considered small in Sweden, but not insignificant in the euro area.

According to the NIER's macroeconomic model KIMOD, falling inflation expectations have tangible macroeconomic effects unless the central bank reacts immediately to lower inflation expectations. According to KIMOD, a binding zero lower bound has a major impact on macroeconomic developments.

[76] OECD (2014) presents an alternative scenario with falling inflation expectations in the euro area. The scenario assumes a simultaneous decrease in inflation expectations of 50 basis points and decrease in equity prices of 10 per cent. It also assumes a 100 basis point increase in the corporate bond spread, the equity risk premium and the spread between household borrowing and lending rates. The simulations are performed in the macroeconomic model NiGEM where short-term interest rates and nominal exchange rates are held constant. The effects on Swedish GDP in the OECD's study are somewhat smaller than those presented in the present analysis.

In situations where inflation expectations have fallen sharply, both theory and experience provide support for central banks assuming that participants in the economy will, at least to some extent, have adaptive expectations in the near term. Monetary policy should act quickly and decisively so that inflation expectations do not fall too far. To push up inflation expectations and so bring down the real interest rate, the central bank may also need to communicate that it intends to allow inflation to overshoot the target in the future. In an extreme case, the central bank could even raise the inflation target. There are also other approaches central banks can take. A number of the world's central banks have undertaken extensive asset purchases (quantitative easing) to avoid excessively low inflation. This is a way of stimulating demand when the policy rate cannot be lowered much further. Forward guidance to bring down long-term interest rates is another option, as are measures to weaken the currency.
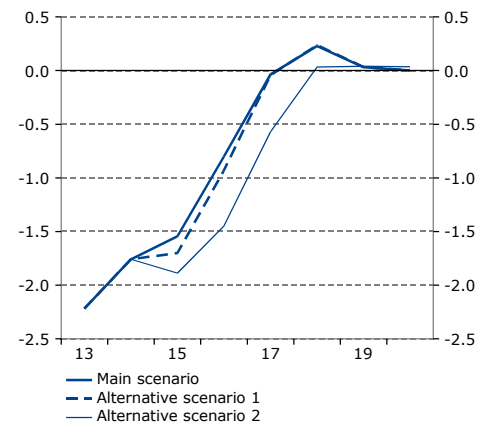
Economic policy may also need to be co-ordinated so that, for example, fiscal policy is temporarily given a more expansionary bias (see Benhabib et al., 2012).

Diagram 128 Output gap
Per cent of potential GDP

— Main scenario
- - Alternative scenario 1
— Alternative scenario 2

Note. Effects according to NIER's macroeconomic model KIMOD.
Source: NIER.

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