Economic Commentaries

The Riksbank's attainment of its inflation target over a longer period of time

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In this Economic Commentary we investigate the Riksbank's attainment of its inflation target over a longer period of time. Measured using real-time data, CPI inflation averaged 1.5 per cent during the period 1995-2011. The corresponding figure for CPIF inflation is 1.8 per cent. These results thus show that approximately 0.3 percentage points of the deviation in target attainment for CPI inflation can be explained by the fact that the interest rate, on average, was lowered during the period studied. As the different measures of inflation have different properties it is reasonable to study both CPI and CPIF inflation when evaluating the monetary policy conducted during a certain period.

In January 1993, the Riksbank announced that the focus of monetary policy would be on attaining an inflation target. The target means, since 1995, that the annual change in the consumer price index (CPI) should be 2 per cent. One of the reasons for setting a clear quantitative target is that it makes it easier to assess the monetary policy conducted. Such assessments are carried out both internally within the Riksbank and by external assessors. For example, the Riksdag Committee on Finance submits an annual report to the Riksdag on the monetary policy conducted. The Committee has also decided that external assessments should be carried out to complement its own assessments and two such external assessments have been carried out to date (Giavazzi and Mishkin, 2006 and Goodhart and Rochet, 2011). The Riksbank's target attainment is also discussed in wider circles.

In recent years, a number of studies have criticised the monetary policy conducted because average CPI inflation has been below the target during the periods studied. For example, Assarsson (2011) says that average CPI inflation was 1.3 per cent during the period 1995-2010 and that monetary policy had therefore been unsuccessful. Munkhammar (2011) claims that average CPI inflation was 1.5 per cent during the period January 2000-August 2011 and that the repo rate was therefore too high throughout the 2000s. Svensson (2012) finds that CPI inflation has averaged 1.4 per cent since 1997 and says that this has contributed to the rate of unemployment being too high.

When assessing monetary policy it is important to use data that were relevant to the monetary policy decision-makers at the time the decisions were made. In the studies mentioned above, the authors – with the exception of Svensson (2012) – have overlooked the change that Statistics Sweden made in the method of calculating CPI inflation in 2005. In terms of inflation data in real time, inflation averaged 1.5 per cent in the period 1995-2010 and 1.6 per cent in the period January 2000-August 2011. When measured using these data, the average inflation outcomes are thus one or two tenths of a percentage point higher than the revised figures used by both Assarsson and Munkhammar. However, even when measured using real-time data it is of course true that inflation has been lower than the inflation target during the periods studied by Assarsson, Svensson and Munkhammar. However, in all of the periods covered in the three studies interest rates in general were much lower at the end of the period than at the start. A general fall in the level of interest rates tends to exert downward pressure on CPI inflation, which could be one explanation for the low average CPI-inflation outcomes.

The aim of this Economic Commentary is to investigate monetary policy's target attainment over a longer period of time, taking into account both the change in method implemented by Statistics Sweden in 2005 and the fact that there may be trends in the repo rate that affect the average CPI-inflation outcomes.[1] In order to put the results into perspective, the Commentary also presents calculations of target attainment in other countries that pursue an inflation-targeting policy.

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[1] The inflation outcomes for individual years are analysed in detail in the Riksbank's annual publication *Material for assessing monetary policy.*

What has the average rate of inflation been?

Since 1995, CPI inflation has varied between approximately -2 and 4 per cent. Compared with the sometimes double-digit rates of inflation of the 1980s, this represents a dramatic reduction since the inflation-targeting regime was introduced.[2] Inflation outcomes have not been exactly 2 per cent because the Swedish economy is constantly exposed to unexpected events, for example the financial crisis of 2008. Monetary policy works with a time lag and cannot therefore fully stabilise inflation at exactly 2 per cent when such unexpected events occur. As the inflation-targeting policy is flexible, the Riksbank also takes the development of the real economy into account. This means that sometimes the aim is not to get back to 2 per cent as quickly as possible as this could have major consequences for the real economy. As a result, inflation sometimes overshoots the inflation target and sometimes undershoots it.

The fact that CPI inflation has varied so much since 1995 also relates to how costs for owner-occupied housing are calculated. Mortgage costs, that is, the interest that households pay on their mortgages each month, are an important component of these housing costs in Sweden.[3] When the Riksbank cuts the repo rate, mortgage rates normally also fall. If the Riksbank cuts the repo rate in order to increase inflation, the initial effect will therefore be, all other things being equal, that CPI inflation will *fall* due to the lower mortgage costs. A clear example of this was when the Riksbank lowered the repo rate from 4.75 to 0.25 per cent in connection with the financial crisis of 2008, which contributed to an average CPI inflation of -0.5 per cent during 2009.[4] How long this initial effect with "the wrong sign" remains depends on what happens to the fixed mortgage rates. If all such rates fall, the initial repo-rate cut will tend to push down CPI inflation for the next eight years.

The Riksbank has been well aware that mortgage costs have this effect on the CPI and this is an important reason why a number of measures of so-called *underlying inflation* are calculated.[5] One such complementary measure to the development of the CPI that is often studied is the CPI with a fixed mortgage rate (the CPIF). In the CPIF, mortgage rates are held constant so that the initial effect of the repo-rate change is excluded. The CPIX performed this function before 2008.[6] These two measures of underlying inflation have been more stable than the CPI (see Figure 1).

Prior to 2005, Statistics Sweden attempted to calculate the rate of inflation as the change in the price of an unchanged basket of goods. In 2005, Statistics Sweden decided that the rate of inflation should be calculated as the 12-month change in the CPI.[7] As the basket of goods in the CPI is changed every year, the inflation rate now relates to the change in the price of a basket of goods that changes over time. The basket of goods is changed partly because in general the households choose to consume smaller quantities of goods that become more expensive. If you download data from Statistic Sweden's website you now get the inflation rate calculated as the 12-month change in the CPI also for the period before 2005. The figures for the rate of inflation have thus been revised backwards in time despite the fact that the CPI itself has not been changed. According to the new, revised data, CPI inflation has averaged 1.3 per cent since the inflation target was introduced. The corresponding averages for the CPIX and CPIF are 1.6 per cent and 1.7 per cent, respectively (see Table 1).

However, it is not appropriate to use this revised data when assessing monetary policy. Let us take 2003 as an example. According to the data available in 2003, average CPI inflation in this year was 2.0 per cent. However, the new method of calculating inflation instead results in a figure of 1.9 per cent. Does this mean that the monetary policy conducted in the years before 2003 was too tight? No, such a conclusion would mean that the Riksbank should have been able to predict that there

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2. It is also worth noting that inflation volatility has declined as well.
3. In practice, mortgage costs are calculated on the entire purchase sum, that is, including the down payment.
4. See the article "The CPI and measures of underlying inflation" in *Monetary Policy Report*, July 2010.
5. See for example Heikensten (1999) and Hansson, Johansson and Palmqvist (2008).
6. The CPIX no longer plays the same prominent role in the monetary policy analysis. One of the reasons why the Riksbank phased out this measure in 2008 was that the mean value of the rate of increase in the CPIX would deviate from the mean value of the CPI for a long time to come, see for example Wickman-Parak (2008). The difference compared with the CPI is that the CPIX excludes mortgage costs and the direct effects of changes in indirect taxes and subsidies.
7. The change in calculation method is described in the article "Changes in the methods for calculating the inflation rate" in *Inflation Report* 2004:2.

would be something like a general revision of the statistics two years later, which is unreasonable. The decisions must be assessed in the light of the information that was available at the time the decisions were made. One should thus use real-time inflation data.[8, 9] This is shown as "real time" in Table 1 and these averages are one or two tenths of a percentage point higher than the revised inflation figures.

With real-time data we see that inflation in terms of the CPI has averaged 1.5 per cent, that is, 0.5 percentage points lower than the target, since 1995. Inflation in terms of the CPIF and the CPIX was also somewhat below the target in the period 1995-2011.[10] The averages for the CPIF and CPIX are 1.8 and 1.7 per cent respectively. The difference between the CPIF and the CPI thus shows that approximately 0.3 percentage points of CPI inflation's deviation from the inflation target is due to the fall in mortgage rates during the period. This relates in turn to the fact that the repo rate was cut from just below 8 per cent to 1.5 per cent during the period. Due to the structure of the CPI, it takes up to eight years before the effects of changes in interest rate levels entirely disappear from the index. This fact should, in other words, be borne in mind when assessing monetary policy.

Does the deviation from the target mean that monetary policy needs to be conducted differently?

All of the measures of inflation have thus on average been below the inflation target since 1995. This raises the question of whether monetary policy needs to be conducted differently in order to bring average inflation closer to the target in the future. For example, Giavazzi and Mishkin (2006) recommended the Riksbank to change its monetary policy strategy somewhat and deliberately try to "overshoot the target" following a period in which inflation had consistently been below the inflation target. However, it is not self-evident that such changes in monetary-policy strategy are required to ensure that average inflation will be 2 per cent in the future. It may be the case that the period studied is so short that the undershooting of the target is due to chance. Examples of random shocks that may have affected inflation are that import prices have been unexpectedly low or that productivity growth has been unexpectedly strong, as previously indicated by the Riksbank's analyses.[11] If the target deviation is due to chance, inflation could average 2 per cent in the future without any changes in the way monetary policy is conducted.

One way of analysing whether the deviations from the target may have been driven by chance – rather than by any systematic feature of monetary policy – is to investigate whether the deviations are statistically significant. We do this by estimating the equation

$$\pi_t - \pi^* = c + \varepsilon_t, \tag{1}$$

where π_t is the 12-month figure for inflation, π^* is the inflation target and ε_t is a serially-correlated error term.[12] The variance in the error term ε_t reflects the size of the shocks that drive inflation and that mean we cannot expect individual outcomes to always be 2 per cent. The results of the estimation of the equation are shown in Table 2.

The table shows the average deviation from the inflation target for the different inflation measures according to real-time data. As CPI inflation has averaged 1.47 per cent, the deviation for the CPI is -0.53 percentage points. Similarly, the deviation for the CPIF is -0.15 percentage points, while for the CPIX it is -0.32 percentage points.

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8. For more general discussions of the importance of real-time data see for example Croushore and Stark (2001) and Orphanides (2001).
9. In the *Material for assessing monetary policy* that covered 2005 and the transition to the new calculation method, both real-time outcomes for inflation and the outcomes from the new calculations were presented.
10. It should be noted that the calculation of the CPIF did not begin until June 2008 and that the real-time series for the CPIF thus shows how it would have looked if it had been available in real time during the period.
11. These factors have often been discussed in reports, articles and speeches. See for example Bergström and Boije (2005) and Assarsson (2007) as well as the articles "Why are Swedish import prices so low?" in *Inflation Rapport* 2005:2 and "Productivity drivers" in *Monetary Policy Report* 2007:2.
12. The CPI is calculated as the CPI for the previous month plus the price changes that have taken place since then. This means that a single price change will remain in the 12-month figures for precisely 12 months, so that eleven such monthly price changes are common to two consecutive monthly outcomes. Standard error cannot therefore be calculated in the usual way. Newey-West-standard errors are used here instead.

A hypothesis test of whether the measured deviations are significantly different from zero shows that the null hypothesis can be rejected for the CPI and the CPIX, but not for the CPIF. We can thus reject the hypothesis that the CPI outcomes stem from a distribution with a mean of 2 per cent. This hypothesis can also be rejected for the CPIX. It cannot, on the other hand, be rejected for the CPIF.

The results thus indicate that the CPIF's deviation from 2 per cent may be due to chance.[13] If this is the case the future mean for the CPIF – as new data becomes available – may be 2 per cent even if the Riksbank does not change the way it conducts monetary policy. However, in line with this interpretation, the results also indicate that something must be changed if the future mean of the CPI is to be 2 per cent.

This may seem somewhat contradictory as the CPIF is designed so that its growth rate should coincide with the CPI inflation in the long term. However, a prerequisite for the CPIF inflation having the same mean as the CPI inflation is that there is no interest-rate trend.[14] As there has been a clear downward trend in interest rates since the inflation target was introduced, the CPI and the CPIF inflation do not have the same mean. The downward trend in interest rates relates above all to two particular episodes. At the beginning of the period studied here the repo rate was just below 8 per cent. One reason for this, in today's terms, high repo rate was that the Riksbank wanted to gain credibility for the recently-announced inflation target. The period in which the credibility of the inflation target was established can be seen as a transition to a new regime and is an isolated case that poses problems when studying a limited period of time. The second episode that contributes to a downward trend in interest rates occurred when the Riksbank cut the repo rate substantially in connection with the financial crisis in 2008. Although the repo rate has been raised somewhat since then, it is still much lower than what can be regarded as a normal level.[15]

One way of handling the problem of a downward trend in interest rates is simply to study periods in which the general level of interest rates is approximately the same at the beginning as at the end of the period.[16] One could, for example, select the period 2000 to 2008. During this period, both CPI and CPIF inflation were on average close to the target and when subjected to the same analysis as in Table 2 neither of the measures deviates significantly from 2 per cent.[17] The conclusion is then that the deviation from the inflation target that nevertheless does occur during the period 2000-2008 may be due to chance, irrespective of which measure of inflation is studied.

To sum up, it thus appears that the downward trend in the repo rate is a very important explanation of why CPI inflation has deviated significantly from 2 per cent when we study the entire period 1995-2011. One interpretation of the results is thus that monetary policy does not necessarily need to be conducted differently in order for a future mean value of any of the inflation measures studied to be 2 per cent.

What about target attainment abroad?

So what is the situation regarding target attainment in other countries? In Table 3 we present the result of the regression in equation (1) for a number of other countries that have inflation targets. Details on the inflation targets and the measures used are available in Table 4.[18]

13. However, it should be pointed out that it is also possible that the deviation is actually different from zero and that the null hypothesis could not be rejected due to low power, that is, an inability to reject a false null hypothesis.
14. See page 36 in Hansson, Johansson and Palmqvist (2008).
15. See the box "What is a normal level for the repo rate?" in *Monetary policy Report*, February 2010.
16. One disadvantage of this, however, is that a smaller number of observations reduces the power of the test.
17. During the period January 2000-September 2008, both CPI and CPIF inflation averaged 1.8 per cent. The repo rate and the variable mortgage rates were raised by just over 1 percentage point at the same time as the fixed, five-year mortgage rates fell by approximately 1 percentage point during the period. All in all, the period January 2000-September 2008 is therefore one in which the general interest rate level was approximately the same at the end of the period as at the beginning, that is there was no trend in the interest rates.
18. The inflation targets used to calculate the left side of equation (1) should in general be fairly uncontroversial, apart from the case of Australia, where the mid-point of the interval has been used as the target, and the UK, where the longer time series contains a slightly asymmetrical target formulation for the first few years. In the case of the UK, two different time periods are therefore used. However, there are several cases where it can be discussed exactly when the inflation target was introduced or began to apply.

The table shows that among the reference countries the coefficient is significantly different from zero in the case of Norway (where average inflation has been below the target) and the UK (where on average it has been above the target). In Sweden's case, the coefficient is significant for the CPI and the CPIX but not for the CPIF.

The deviation of CPI inflation from the target in Sweden is among the largest in this international comparison. However, three things should be borne in mind when comparing the figures in Table 3. First, it should be noted that mortgage costs are only included in the CPI in Canada and Sweden. When comparing Sweden with the reference countries it is thus more reasonable – with the exception of Canada – to look at the deviation of CPIF inflation from the target. Second, the periods studied are different because the inflation targets were introduced at different times.[19] Third, the various countries are exposed to shocks that are specific to each country. This means that even if a common period is studied it is difficult to determine how well different central banks have performed their tasks.

However, the overall impression is that the deviations from the respective inflation targets have been relatively limited in the different countries.

Conclusions

Measured using real-time data, CPI inflation averaged 1.5 per cent during the period 1995-2011, while the corresponding figure for CPIF inflation was 1.8 per cent. Although the analyses in previous studies that have not used real-time data have arrived at slightly different figures, there is no doubt that average inflation has been lower than the target. However, an important point is that a large part of the deviation in target attainment for CPI inflation, approximately 0.3 percentage points, can be explained by the fact that the interest rate, on average, was lowered during the period studied. It therefore appears that the general level of interest rates is an important explanation of the low average level of CPI inflation. The lowering of interest rates during the period is in turn due to the fact that the transition to the new monetary policy regime was not fully completed in 1995 and to the substantial cuts in the repo rate in connection with the financial crisis in 2008. Substantial cuts in the repo rate exert downward pressure on CPI inflation for some time to come due to lower mortgage costs. It turns out that the deviation from the inflation target is limited during a period when there is no trend in the general level of interest rates, for example 2000-2008.

With this in mind, we believe that it is reasonable to not focus solely on target attainment in terms of a certain measure of inflation when assessing monetary policy. One should instead attempt to take a more holistic view and analyse both CPI and CPIF inflation, and also take into account changes in the general level of interest rates.

With regard to the different inflation measures' deviations from 2 per cent it is of course possible to have different opinions on whether these deviations are large or small. But also the 0.2 percentage points by which CPIF inflation has deviated from the target should be taken seriously and this deviation, as well as the potential consequences of the deviation for the real economy, should be analysed and discussed.

19. Table 5 presents the results for the common period 2001Q1-2011Q4. The differences worth noting there are that there are significant results for Australia while no inflation measure for Sweden provides significant results.

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Figures and tables

Figure 1. Inflation 1995-2011
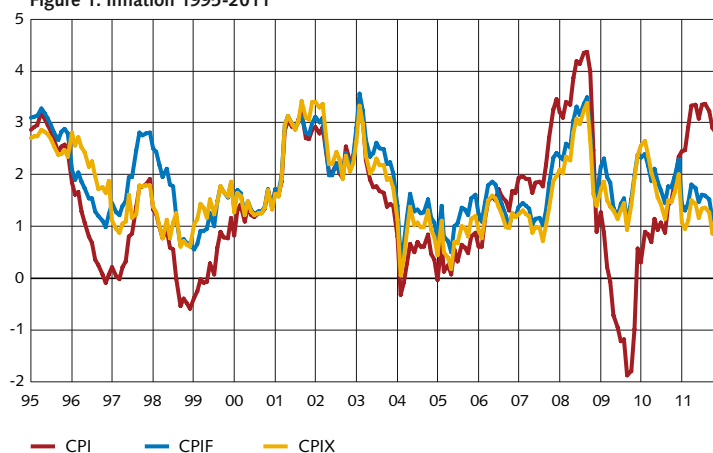
Note. Monthly real-time data, January 1995-December 2011.

Sources: Statistics Sweden and the Riksbank.

Table 1. Mean value of inflation according to different measures of inflation

CPI, new	1.34
CPI, real time	1.47
CPIF, new	1.71
CPIF, "real time"	1.85
CPIX, new	1.56
CPIX, real time	1.68

Note. Calculations based on monthly data, January 1995-December 2011.

Table 2. Is inflation's deviation from 2 per cent significant? Estimated coefficient from equation (1)

	$\hat{c}$
CPI, real time	-0.53[b]
	(0.25)
CPIF, "real time"	-0.15
	(0.14)
CPIX, real time	-0.32[b]
	(0.15)

Note. Calculations based on monthly data, January 1995-December 2011. The table gives estimates of the coefficient c in equation (1). Newey-West-standard errors in brackets (). a indicates significance at the one per cent level, b at the five per cent level and c at the ten per cent level.

Table 3. Has inflation significantly deviated from the inflation target?
Estimated coefficient from equation (1)

	$\hat{c}$	Period
Australia	0.21	1993Q1-
	(0.25)	2011Q4
Canada	-0.00	1995Q1-
	(0.15)	2011Q4
Euro area	0.03	1999Q1-
	(0.16)	2011Q4
Norway	-0.55[b]	2001Q1-
	(0.24)	2011Q4
United Kingdom	0.34[b]	1992Q4-
	(0.14)	2011Q4
United Kingdom	0.34[c]	1997Q2-
	(0.18)	2011Q4
Sweden, CPI real time	-0.52[b]	1995Q1-
	(0.23)	2011Q4
Sweden, CPIF "real time"	-0.15	1995Q1-
	(0.13)	2011Q4
Sweden, CPIX real time	-0.31[b]	1995Q1-
	(0.13)	2011Q4

Note. Calculations based on quarterly data. The table gives estimates of the coefficient c in equation (1). Newey-West-standard errors in brackets (). a indicates significance at the one per cent level, b at the five per cent level and c at the ten per cent level.

Table 4. Inflation targets and inflation measures for compared countries

	Period	Inflation target	Inflation measure
Australia	1993Q1-2011Q4	2.5	CPI
Canada	1995Q1-2011Q4	2	CPI
Euro area	1999Q1-2011Q4	2	HICP
Norway	2001Q1-2011Q4	2.5	CPI
United Kingdom	1992Q4-2011Q4	2.5 1992Q2-2003Q4 and 2 thereafter	RPIX 1992Q2-2003Q4 and CPI thereafter

Note. The formulation of the inflation target differs somewhat from country to country. In Australia, the target is that inflation should be 2 to 3 per cent, on average, over the cycle. Canada has a target range of 1 to 3 per cent and the Bank of Canada aims to keep inflation in the middle of this interval. The ECB's target is expressed such that inflation should be below, but close to, 2 per cent over the medium term. In Norway, the target is that inflation should be approximately 2.5 per cent. The definitions of the CPI also differ somewhat from country to country. Mortgage costs are included in the Canadian measure of inflation but not in that of the other countries.

Table 5. Has inflation significantly deviated from the inflation target?
Estimated coefficient from equation (1) for common sample
2001Q1-2011Q4

	$\hat{c}$
Australia	0.54[a]
	(0.20)
Canada	0.10
	(0.20)
Euro area	0.11
	(0.18)
Norway	-0.55[b]
	(0.24)
United Kingdom	0.48[b]
	(0.23)
Sweden, CPI real time	-0.31
	(0.30)
Sweden, CPIF "real time"	-0.13
	(0.17)
Sweden, CPIX real time	-0.30
	(0.18)

Note. Calculations based on quarterly data. The table gives estimates of the coefficient c in equation (1). Newey-West-standard errors in brackets (). a indicates significance at the one per cent level, b at the five per cent level and c at the ten per cent level.