Economic Commentary

Evaluation of measures of core inflation

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Evaluation of measures of core inflation

The Riksbank has evaluated different measures of core inflation in an Economic Commentary and in an article from 2018.[1] A few years have now passed and over the period the Riksbank has started to use more measures. In particular, in recent years we have increasingly analysed measures of price changes over periods shorter than one year.[2] In this Economic Commentary, we evaluate the new measures, which are based on price changes over periods shorter than one year, and the old ones evaluated in 2018.

One conclusion is that measures of price changes over periods shorter than one year are usually not very good at forecasting future inflation measured as an annual percentage change in the CPIF. However, over the past five years, which includes the period of rapidly rising and then rapidly falling inflation, measures calculated over shorter periods have been better, relatively speaking.

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Measures of core inflation

In Sweden, inflation is usually measured as the annual percentage change in the CPIF. Measured inflation rates are often affected by temporary price changes, which are of no significance for the development of inflation in the longer term. Like other central banks, the Riksbank therefore calculates different measures of core inflation, to get a picture of how high the more persistent part of the measured inflation rate is.[4]

Although many central banks use measures of core inflation in their communication, there is no clear definition of this concept and there are many different ways of calculating them. A common approach is to exclude certain predetermined components from CPIF inflation, namely those that are considered to reflect more temporary and short-term movements in the measured inflation rate than the other components do.

[1] Economic Commentaries are brief analyses of issues with relevance for the Riksbank. They can be written by individual members of the Executive Board or by employees at the Riksbank. Employees' Commentaries are approved by their head of department, while Executive Board members are themselves responsible for the content of their Commentaries.

[2] In recent Monetary Policy Reports, for example, we have shown measures of 1-month and 3-month changes in the various measures of core inflation based on seasonally adjusted price indices.

[3] Thanks to Mikael Apel, Mattias Erlandsson, Johanna Heden, Åsa Olli Segendorf and Anders Vredin for their valuable comments.

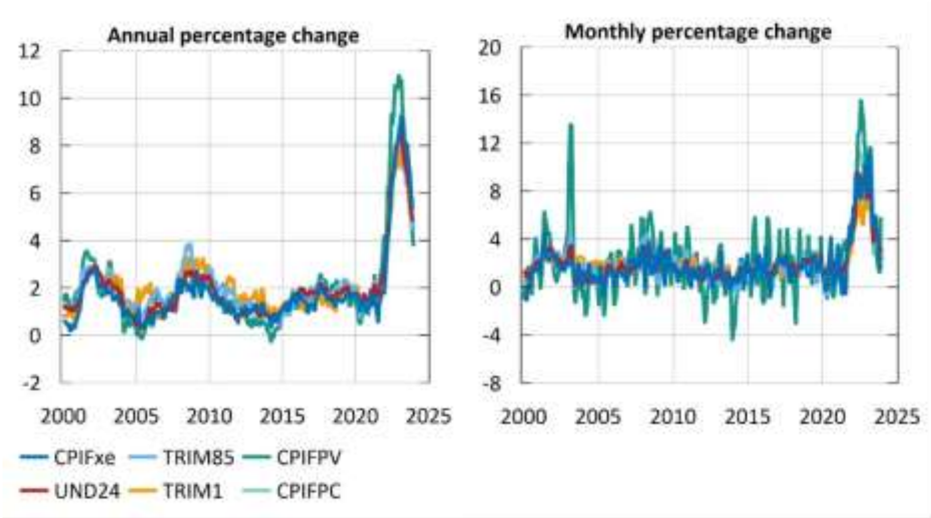
[4] See the article "Why measurements of core inflation?" in Monetary Policy Report October 2018 and J. Johansson, M. Löf, O. Sigrist and O. Tysklind, "Measures of core inflation in Sweden", Economic Commentaries No. 11, 2018.

The CPIF excluding energy is an example of such a measure. Another way is to use statistical methods to systematically exclude or lessen the significance of components in the CPIF whose prices fluctuate sharply. The Riksbank's TRIM85, UND24, CPIFPV and CPIFPC are examples of such measures. These measures are described in the appendix.[5]

Inflation is normally measured as the annual percentage change in a price index. To obtain a more up-to-date picture of how high inflationary pressures are, we can instead look at price changes calculated over shorter periods.[6] In recent years, therefore, the Riksbank has increasingly analysed measures of seasonally adjusted price changes over periods shorter than one year (see Figure 1).[7]

Diagram 1. Measures of core inflation

Percentage changes



Note. The graphs show the annual percentage change on the left and the monthly percentage change of annualised seasonally adjusted data with a three-month moving average on the right.

Sources: Statistics Sweden and the Riksbank

[5] The measures of core inflation discussed and evaluated in this Economic Commentary are those that use statistical methods to reduce the significance of those goods and services whose prices have historically varied the most, or which exhibit the most extreme price changes in a given month.

[6] A challenge when analysing monthly rates, is that they vary more than annual percentage changes as they are often affected by seasonal factors, which can be difficult to exclude entirely using existing methods.

[7] An implication of this is that the seasonal adjustment is re-estimated for the entire history each time new data are added and that the history of the measures changes for each new month of data added.

Evaluation

An ideal core inflation measure shall thus measure the more common and persistent component of the measured inflation rate and show how high inflation is when temporary effects have faded.[8] Based on this desirable characteristic, the measures should therefore be forward-looking and already contain information on future inflation. It can also be concluded that the measure should be correlated with macroeconomic drivers of inflation, such as the demand situation.

In an Economic Commentary and an article from 2018, the Riksbank's then existing measure of core inflation were evaluated.[9] This was done based on their ability to forecast future CPIF inflation and how well correlated they were with resource utilisation in the economy. The KPIFPC and UND24 measures appeared to be the most useful.

This section evaluates the new measures based on price changes over periods shorter than one year alongside the old measures evaluated in 2018, which are based on annual percentage changes. The measures are evaluated first according to how well they predict future CPIF inflation and then according to how well they are correlated with measures of resource utilisation.

How good are the measures at predicting future CPIF inflation?

In Table 1 we present a measure of how well the different measures of core inflation are able to forecast future CPIF inflation. The calculation is made for January 2000 to December 2023 and shows how good the latest monthly outcomes of the various measures are at forecasting the annual rate of increase in the CPIF 6, 12, 18, 24, 30 and 36 months ahead. The calculation thus captures how well the various measures already reflect the future development of the annual percentage change in the CPIF.

The figures we present are the relative mean squared forecast error (RMSE) for forecasts when the current outcome of each measure is used to forecast the CPIF 6-36 months ahead.[10] The top six measures, without a suffix, are those based on annual percentage changes. The next six, with the suffix _anr, are those based on monthly seasonally adjusted changes. The figures thus show the relative forecasting ability of the other measures in relation to the forecasting ability of the CPIF. The forecasting ability (RMSE) of the CPIF itself is shown in the last row. Figures below 1 indicate that the measure is better at predicting future CPIF inflation than the rate of increase in the CPIF itself. The lower and therefore better the value of the measure, the greener

[8] See, for example, Khan et al. (2015), Roger (1998), Rich et al. (2005) and Wynne (2008) for a discussion of the desirable characteristics of a measure of core inflation.

[9] See Johansson et al. (2018).

[10] The calculations are made on real-time versions of the data, i.e. where we have only seasonally adjusted up to the last available outcome in each period.

the colour of the table. Conversely, the redder the colour of the measure, the higher, and therefore worse, the value it has for each forecast horizon.

In this analysis, the measures TRIM85 and UND24 calculated on monthly changes appear relatively good at the shortest horizon of 6 months. At longer horizons, the measures calculated from annual percentage changes appear to be relatively good, in particular the UND24 and CPIFPC measures.

Tabell 1. Relative ability to forecast future annual percentage changes in the CPIF for each inflation measure at different forecast horizons for the period 2000-2023.
Percentage points or ratio

	6 months	12 months	18 months	24 months	30 months	36 months
CPIFPC	1.31	1.05	0.97	0.89	0.85	0.86
CPIFPV	1.13	1.03	0.97	0.94	0.96	0.99
TRIM1	1.17	1.00	1.00	0.94	0.90	0.92
TRIM85	1.10	0.97	0.96	0.93	0.93	0.94
UND24	1.09	0.95	0.93	0.89	0.89	0.92
CPIFxe	1.23	1.02	0.99	0.95	0.92	0.93
CPIFPC_anr	1.01	1.02	0.99	0.89	0.87	0.89
CPIFPV_anr	2.32	1.80	1.58	1.47	1.48	1.50
TRIM1_anr	1.08	0.95	1.00	0.94	0.90	0.91
TRIM85_anr	0.98	0.98	1.03	0.97	0.98	1.01
UND24_anr	0.97	0.96	0.98	0.89	0.89	0.92
CPIFxe_anr	1.28	1.08	1.13	1.03	0.99	1.02
CPIF	1.16	1.77	1.96	2.15	2.24	2.22

Note. The figures for the CPIF refer to the RMSE (Root Mean Squared Error) for the annual percentage change in the CPIF. Other figures refer to the relative RMSE to the RMSE of the CPIF. Thus, the figure of 1.15 for the CPIFPC at the 6-month horizon means that the RMSE is 1.15*1.12=1.29. The estimation period is 2000-2023. The measures with the suffix _anr are calculated from monthly changes in seasonally adjusted data. The results were then annualised and a 3-month moving average was calculated.

Source: The Riksbank

The results in Table 1 are affected by the fact that some of the measures based on monthly changes have had good forecasting ability in recent years, when inflation first rose rapidly and then fell back quickly. Therefore, if we compare the projections with data from 2018 to 2023, the picture is different and the measures calculated on a monthly percentage change basis appear relatively better (see Table 2). In particular, the measures TRIM85_anr and UND24_anr appear to be relatively good. At the same time, it is clear that the forecast errors have become significantly larger compared to the longer period in Table 1.

Tabell 2. Relative ability to forecast future annual percentage changes in the CPIF for each inflation measure at different forecast horizons for the period 2018-2023.
Percentage points or ratio

	6 months	12 months	18 months	24 months
CPIFPC	1.31	0.99	0.89	0.80
CPIFPV	1.08	0.93	0.87	0.83
TRIM1	1.10	0.90	0.87	0.80
TRIM85	1.08	0.88	0.85	0.82
UND24	1.08	0.88	0.84	0.79
CPIFxe	1.30	1.06	1.02	0.96
CPIFPC_anr	0.96	0.94	0.89	0.81
CPIFPV_anr	1.29	1.11	0.95	0.86
TRIM1_anr	0.94	0.82	0.88	0.81
TRIM85_anr	0.73	0.79	0.87	0.81
UND24_anr	0.86	0.85	0.88	0.79
CPIFxe_anr	1.06	0.90	0.96	0.86
CPIF	2.28	3.77	4.47	5.17

Note. See the note in Table 1

Source: The Riksbank

How well do the measures correlate with resource utilisation?

Figure 2 shows how the various core measures interact with the Riksbank's measure of resource utilisation (the RU indicator).[11] The curves refer to estimated correlation coefficients calculated for the period from the first quarter of 2000 to the third quarter of 2023. The leftmost lines in the chart show the degree of contemporaneous correlation, i.e. when the core measures in a given quarter, t, are matched with resource utilisation in the same quarter, t (see period 0 in the chart). They then show the correlation between the core measures and resource utilisation in the previous quarter, t-1 (1), against resource utilisation two quarters ago, t-2 (2) and so on. If the correlation is highest in, for example, t-6 (6), this means that the correlation between the core measure and resource utilisation is highest if the RU indicator is lagged by six quarters.

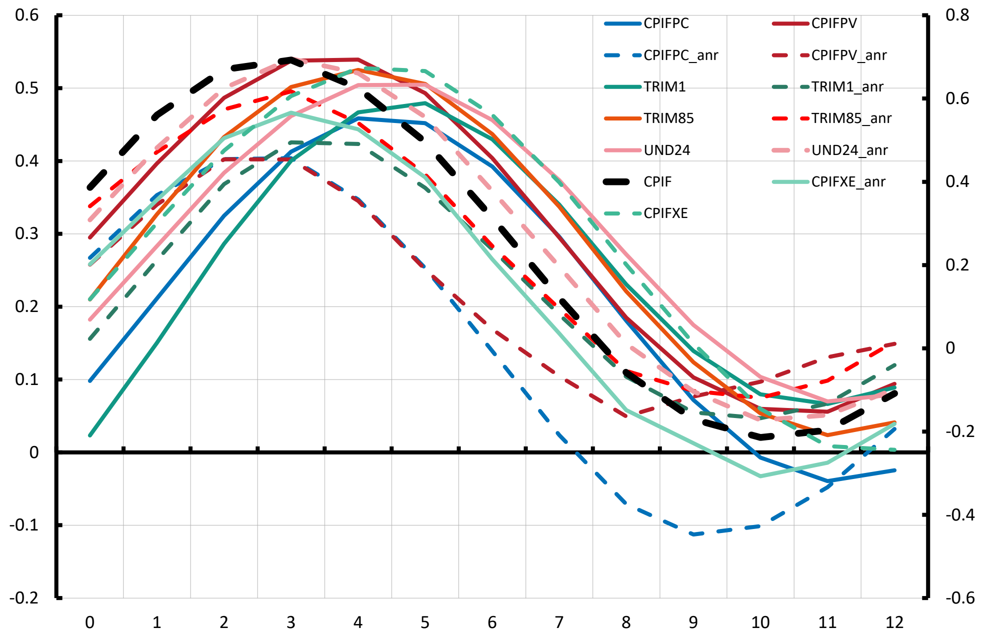
No measure stands out and is more correlated with the RU indicator than the CPIF. The highest correlation between the RU indicator and inflation measures is found after 3-5 quarters (see Figure 2). The correlation between the RU indicator and measures based on monthly percentage changes generally appears to be slightly lower compared to measures based on annual rates of change.[12]

[11] See Lovéus (2023).

[12] If the correlations are calculated using data only up to 2021, before inflation started to rise, roughly the same ranking between the measures is maintained. But the time lag for maximum correlation will be a few quarters later.

Diagram 2. Correlation between different measures of inflation and the RU indicator with different lags

Percentage points



Note. The estimation period is the first quarter of 2000 and the third quarter of 2023. The figure shows the estimated correlation coefficient between each inflation measure and the RU indicator with different lags. The calculations are not made on real-time data.

Source: Statistics Sweden and the Riksbank

Summary and conclusions

One conclusion is that measures of price changes over periods shorter than one year are usually not very good at forecasting future inflation measured as an annual percentage change in the CPIF. However, over the past five years, which includes the period of rapidly rising and then rapidly falling inflation, measures calculated over shorter periods have been better, relatively speaking. It may therefore be worthwhile to analyse this type of measure during periods of large changes in the inflation rate. But under normal circumstances they are too volatile and contain too much 'noise' to be useful.

In this Economic Commentary, the forecasting ability of CPIF inflation for a number of measures of core inflation and their correlation with resource utilisation has been evaluated. One of the aims of this has been to investigate how measures based on more high-frequency changes, which have started to be used since the pandemic, compare with the usual measures based on annual percentage changes, which the Riksbank has used for a long time.

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APPENDIX - The new measures

The new measures are calculated in the same way as the old ones, but instead of weighting together annual percentage changes, seasonally adjusted monthly changes are weighted together, annualised. The seasonal adjustment is based on data from 1980 onwards. An implication of this is that the seasonal adjustment is re-estimated for the entire history each time new data are added and that the history of the measures changes for each new month of data added.

TRIM1 and TRIM85 are calculated by assigning the subgroups with the highest and lowest seasonally adjusted monthly percentage change in a given month a weight of 0 for that month, while the other subgroups are weighted up so that the weight sums to 1. Thus, different subgroups will be excluded in different months. In TRIM85, subgroups are given a weight of 0 when they correspond to a weight sum of 7.5 per cent and have the highest annual percentage change. The same applies to the subgroups that correspond to a weight sum of 7.5 per cent and have the lowest annual percentage change. However, there will always be subgroups that are right on the edge. Instead, the weight for that group is adjusted depending on how much of the weight total needs to be excluded to reach a total of 7.5 per cent. Then all remaining weights are weighted up so that the weight sum is 1. These weights are then used to arithmetically weight the annual percentage changes for the different subgroups. For TRIM1, the procedure is the same but now all but the middle 1 per cent are removed.

The UND24 measure retains all subgroups but gives them a different weight than in the CPIF. The weights are calculated by first calculating the difference between the monthly percentage change in each subgroup and the change in the overall CPIF. The weight for each subgroup is then calculated each month based on the historical standard deviation of the deviation. More specifically, the weights are calculated by first calculating the inverse of the 24-month moving standard deviations of the deviation for the different groups. These are then normalised so that the sum of the weights is 1 in each time period. These weights are then used to arithmetically weight the annual percentage changes for the different subgroups. The weights thus vary from month to month and the weight is larger for the groups where the variation has been small compared with total CPIF inflation, while it is smaller for the groups where the variation has been large compared with total CPIF inflation over the past 24 months.

A similar approach is used for the CPIFPV measure. Again, all subgroups are retained. But here the weights are determined by the persistence of the monthly percentage changes for each subgroup. This is done by estimating a simple first-order autoregressive model on each subgroup. The weights are then obtained by normalising the coefficients for each subgroup so that the total weight sums to 1. These weights are then used to arithmetically weight the annual percentage changes for the different subgroups. The estimates are based on a rolling window corresponding to the last 60 months, i.e. a new estimate is made every month, which means that the weights change continuously. The weight for an individual subgroup will thus be greater the higher the estimated autoregressive coefficient for the monthly percentage change rates has been for the subgroup over the last 60 months.

The CPIFPC has been produced using what is known as principal component analysis. Again, all subgroups are included in the calculations. First, the subgroups are standardised so that all have a mean of zero and a standard deviation of 1 for the given period. Static factors for the subgroups are then estimated using principal component analysis. This is a method of trying to reduce the data set to a few components that can explain much of the overall variation in the data. We weight the first three components, which together explain about 15 per cent of the variation in all subgroups. The weight they are given in the weighting is based on how much of the total variation in all subgroups each component can explain of the total variation. Finally, a simple regression on the CPIF is estimated with the factor as the only explanatory variable; the CPIFPC is the fitted values from that regression.

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