

## ARTICLE – Why measures of core inflation?

The measured rate of inflation is often affected by temporary price movements which have no significance for the development of inflation in the longer term. Like other central banks, the Riksbank therefore calculates and publishes various different measures of core inflation. The aim of analysing such measures is to provide an indication of how high the more persistent component of the inflation rate is by removing temporary price movements. CPIF inflation is currently at 2.5 per cent, while the measure of core inflation is lower. For inflation to remain close to the target in a lasting manner, measures of core inflation also need to be close to 2 per cent.

### Monetary policy is based on forecasts

Monetary policy normally focuses on bringing inflation close to the target of 2 per cent a couple of years ahead. This is why monetary policy is based on forecasts for inflation. From the beginning, the inflation target was expressed in terms of the CPI but, since September 2017, it has been expressed in terms of the CPI with a fixed interest rate, the CPIF.<sup>2</sup>

The measured inflation rate is often affected by price changes of a temporary nature. For example, this could be temporarily high electricity prices up or a change to tax deductions that temporarily affects the rate of increase in housing costs for households. One important part of the analysis of inflation is the attempt to assess how large a part of the measured inflation is temporary and how much is more persistent. In addition to CPIF inflation, the Riksbank therefore also regularly analyses measures of what is known as core inflation. The main aim of analysing such measures is to provide an indication of the level of the more persistent or persistent component of the measured inflation rate.

Even if many central banks use measures of core inflation in their communication, there is no uniform definition of what core inflation is and there are different ways of calculating it. One way is to exclude certain predetermined components of the CPIF whose prices are considered to reflect more temporary and short-term variations than those of the other components. The CPIF excluding energy is an example of such a measure. Another way of calculating core inflation is to use statistical methods to systematically exclude or lessen the significance of components in the CPIF whose prices fluctuate sharply. Examples of such measures calculated by the Riksbank include TRIM85, UND24, CPIFPV and CPIFPC.

### Measures of core inflation supplement the forecasts

As monetary policy affects inflation with a time lag, the inflation forecast is a basic part of the background material

for monetary policy decisions. The forecasts show how the Riksbank views the durability of the rate of inflation measured. Measures of core inflation supplement the forecast by illustrating in a non-judgemental way how much of the rate of inflation can be expected to be more persistent and how much may be temporary.

Energy prices have recently shown a rapid increase and contributed almost one percentage point to the measured rate of inflation of 2.5 per cent in September. As energy prices are not expected to continue to increase as rapidly in the period ahead, this is not deemed to be a persistent level but instead CPIF inflation can be expected to fall over the next year. The most recent outcomes in the measures of core inflation also indicate that the more persistent part of CPIF inflation is lower than 2.5 per cent.

When the Riksbank makes inflation forecasts, it uses different types of information. Measures of core inflation are used as a part of the analysis of the present level of the more persistent rate of inflation. In addition to this, detailed analyses and assessments of the economic situation, the exchange rate and company costs in the form of developments in wages and productivity are central factors behind the final inflation forecast.

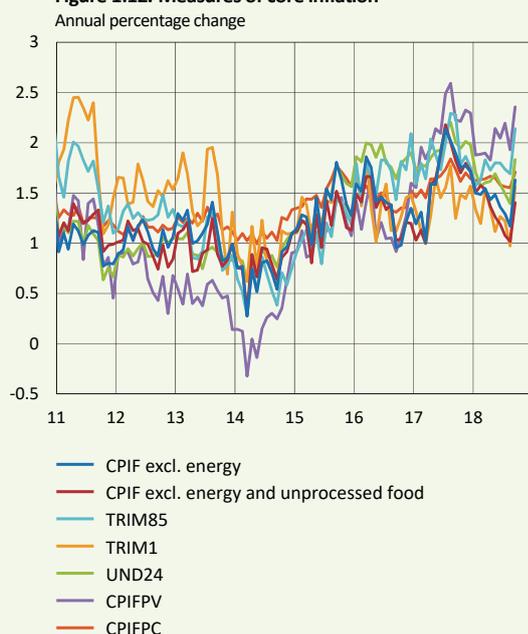
### Different ways of calculating core inflation

The Riksbank's Monetary Policy Reports often show the measures of core inflation as a band in which the measure showing the highest and lowest rate of increase respectively for each month constitutes the band's upper and lower limit (see Figure 3:2). The band includes both measures where components are excluded and measures that have been calculated using statistical methods. The measures included in the band are shown in Figure 1:12.<sup>3</sup>

<sup>2</sup> See "The CPIF as target variable for monetary policy", article in Monetary Policy Report September 2017.

<sup>3</sup> See Appendix 2 in Johansson, J. Löf, M. Sigrist, O. and Tysklind, O., "Measures of core inflation in Sweden", Economic Commentaries no. 11, 2018, for a technical description of the measures.

Figure 1:12. Measures of core inflation



Sources: Statistics Sweden and the Riksbank

Two of these measures exclude some predetermined components from CPIF inflation that has historically proved to be particularly volatile. The **CPIF excluding energy** excludes electricity and fuel from the CPIF. In the **CPIF excluding energy and unprocessed food**, meat, fish, fruit and vegetables have also been excluded in addition to energy.

The other measures are calculated with different statistical methods to systematically exclude or reduce the significance of those parts of the CPIF whose prices vary substantially. The idea behind these measures, which are also used in various forms by other central banks, is that unusually large (or small) price movements are temporary to a great degree. Different methods are used to make this adjustment, but the common factor is that they are based on the CPIF, divided into 70 components. In **Trim85** and **Trim1**, the components with the highest and lowest annual rates of price change are removed each month. In **UND24**, no components are excluded, but they are weighed together with other weights than in the CPIF. Components whose annual percentage price change varies to a relatively large degree are given a lower weighting and vice versa. All components are also kept in **KPIFPV**. The measure is calculated by giving the components weightings on the basis of how persistent their annual percentage rates of price change tend to be. The more persistent a component's price change is, the higher the weighting. **KPIFPC** is calculated by using statistical methods to estimate common trends among the components in the CPIF. The aim of the measure is thus to tone down major price movements in individual

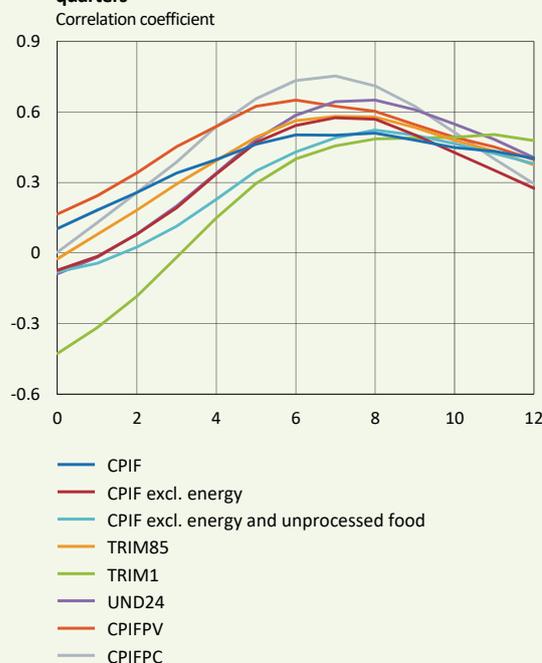
components and better identify the shared development of the majority of the components.

### An evaluation of the measures of core inflation

A common approach is to formulate assessable characteristics that measures of core inflation should have.<sup>4</sup> As the measure should ideally measure the more persistent parts of the measured rate of inflation, it should, for example, covary with macroeconomic variables that explain the development of inflation, for examples indicators of the level of economic activity. As the measure should ideally capture more persistent inflation, which tends to change relatively slowly, the measure should also be able to say more about the future development of inflation than current CPIF inflation does. It is also desirable that the measure has a mean value that is the same as the mean value of the target variable. In addition, given that temporary factors contribute towards increased variation in CPIF inflation, the measure of core inflation should also vary less than CPIF inflation.

One measure of economic activity is the Riksbank's indicator for resource utilisation (the RU indicator). Figure 1:13 shows the covariation (correlation) between the respective measure of inflation and the RU indicator with differing degrees of time lag.

Figure 1:13. Correlation between various inflation measures and the RU indicator with delay of a varying number of quarters



Note. The estimation period is Q1 1996 to Q2 2018. The figure shows the estimated correlation coefficient between respective inflation measures and the RU indicator with delays of a different number of quarters. The CPIFPC is revised every time a new observation is added. Measures of inflation calculated using real-time data are used in the estimations.

Source: The Riksbank

<sup>4</sup> See Johansson, J. Löf, M. Sigrist, O. and Tysklind, O. "Measures of core inflation in Sweden", Economic Commentaries No. 11, 2018, for a discussion of the desirable characteristics of measures.

All measures show the highest correlation with the RU indicator with a delay of 5–8 quarters, meaning that there is relatively high correlation between the RU indicator in one quarter and measures of core inflation 5–8 quarters later. Most measures of core inflation are more correlated with the RU indicator than the rate of increase in the CPIF. The highest correlation is found between the RU indicator and CPIFPC with a 7 quarter delay.

Table 1:3 describes one way of measuring predictive power. The figures show how well outcomes in the various measures tally with CPIF inflation 12 to 24 months ahead. The tables thus illustrate how well the various measures are already reflecting the development of CPIF inflation up to two years ahead. The figures show the so-called root-mean-squared errors (RMSE) when the current outcome of each inflation measure is used as a forecast for future CPIF inflation 12–24 months ahead. RMSE is a common measure of forecasting ability. The lower the value of the RMSE, the more accurate the forecast. The RMSE values that fall below the RMSE of the CPIF are marked in bold in the table. Most measures of core inflation have better predictive power for future CPIF inflation than the CPIF itself has, both one and two years ahead. The best forecasting ability among these measures is that of the CPIFPC, where the current level of the CPIFPC implies a better prediction of CPIF inflation in, for example, two years than the current level of CPIF inflation does. In practice, like other forecasters, the Riksbank uses more sophisticated methods and more information in its forecasting work than only the current level of core inflation. However, the figures in Table 1:3 can give an indication of how well the measures of core inflation capture the more persistent parts of the current rate of inflation.

**Table 1:3. Predictive power for respective measure of inflation for different forecast horizons**

RMSE, percentage points

	12	24
CPIF	0.95	1.05
CPIF excl. energy	<b>0.92</b>	<b>0.98</b>
CPIF excl. energy and unprocessed food	<b>0.91</b>	<b>1.02</b>
TRIM85	<b>0.86</b>	<b>1.01</b>
TRIM1	0.95	1.12
UND24	<b>0.80</b>	<b>0.86</b>
CPIFPV	1.02	<b>0.98</b>
CPIFPC	<b>0.74</b>	<b>0.81</b>

Note. The CPIFPC measure is revised every time a new observation is added. Measures calculated using real-time data are used in the estimations. However, the first 5 years (1995–1999) the CPIFPC is calculated with data within the sample. Forecasts for the period January 1995 to July 2018 are included in the evaluation. Sources: Statistics Sweden and the Riksbank

Table 1:4 presents mean values and standard deviations for the various measures of core inflation and the CPIF. The average annual percentage change in the CPIF has been 1.56 per cent since 1995. The average rate of inflation according to the different measures is relatively close to CPIF inflation and most measures vary less than CPIF inflation. During this period, UND24 and CPIFPC deviate the least from the average rate of increase in the CPIF. The CPIFPC also has the lowest standard deviation.

**Table 1:4. Mean value, bias in relation to the rate of increase in the CPIF and standard deviation 1995–2018**

Annual percentage change and percentage points respectively

	Mean value	Bias	Standard deviation
CPIF	1.56	–	0.72
CPIF excl. energy	1.38	–0.18	0.65
CPIF excl. energy and unprocessed food	1.39	–0.17	0.62
TRIM85	1.66	0.10	0.68
TRIM1	1.70	0.14	0.70
UND24	1.50	–0.06	0.64
CPIFPV	1.48	–0.08	0.90
CPIFPC	1.62	0.06	0.36

Note. The CPIFPC measure is revised every time a new observation is added. Measures calculated using real-time data are used in the estimations. However, the first 5 years (1995–1999) the CPIFPC is calculated with data within the sample. The standard deviation is calculated for the annual percentage change in each inflation measure respectively (percentage points).

Sources: Statistics Sweden and the Riksbank

#### Other measures relevant at different points in time

When the properties of various measures of core inflation are compared over time, the measures CPIFPC and UND24 appear to be the most useful. These measures are, for instance, best at explaining future CPIF inflation at the same time as they covary the most with resource utilisation.

However, no individual measure of core inflation is assessed to provide the most correct picture of inflationary pressures in all situations, and various measures of core inflation can be useful at different times or over different periods. To obtain as good an indication as possible of current inflationary pressures, and where inflation is heading in the slightly longer term, the Riksbank will continue to analyse several different measures of core inflation. This is also common practice among other central banks.

CPIF inflation is currently at 2.5 per cent, while the measure of core inflation is lower. For inflation to remain close to the target in a lasting manner, measures of core inflation also need to be close to 2 per cent.