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Economic Commentaries

Measures of core inflation in Sweden

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In addition to the CPIF target variable, the Riksbank regularly analyses different measures of core inflation. Such measures can provide a pointer to how high the more persistent or permanent component of the measured inflation rate is. This Economic Commentary describes and evaluates these measures based on a few common evaluation criteria. The evaluation shows that there is no single measure that is unequivocally better than the others, and the conclusion is therefore that it is reasonable to follow different measures of core inflation. This is also common practice among other central banks.

The Riksbank has had an inflation target of 2 per cent since the mid-1990s. From the beginning, the target was expressed in terms of the Consumer Price Index (CPI), but since September 2017, it has been expressed in terms of the CPI with a fixed interest rate (CPIF). Unlike the CPI, this measure is not directly affected by changes in household mortgage rates. In addition to the target variable, the Riksbank continually analyses different measures of core inflation. The main aim of analysing such measures is to provide an indication of the level of the more persistent or permanent 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 this concept and there are many different ways of calculating it. A common way is to exclude certain predetermined components from CPIF inflation, that is to say those that are considered to reflect more temporary and short-term fluctuations in the measured inflation rate than the other components do. 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 products in the CPIF whose prices fluctuate sharply. Examples of such measures published by the Riksbank include TRIM85, UND24, CPIFPV and CPIFPC.

The aim of this Economic Commentary is to describe the Riksbank's measures of core inflation and to examine their properties using a few common evaluation criteria. The properties examined include the predictive power of the measures as regards future CPIF inflation and their covariation with macroeconomic drivers of inflation. The evaluation shows that there is no single measure that is unequivocally better than the others, which leads to the conclusion that it is reasonable to follow different measures of core inflation. This is also common practice among other central banks.

What is core inflation?

There are different ways of measuring inflation. The Riksbank's target is expressed in terms of the CPI with a fixed interest rate (CPIF), the aim of which is to measure the development of an average Swedish household's cost of living, where the direct effects of changes in mortgage rates have been excluded.[3] The CPI and CPIF are calculated each month by Statistics Sweden and are a weighted average of the prices of a basket of different goods and services (see Appendix 1). The weighting is based on how large the proportion of each good or service is of an average household's

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[3] See for example Johansson (2015) for a more detailed description of the CPI and CPIF measures

total consumption costs. The CPIF, for example, measures the development of prices of food, accommodation, cars, clothes, etc. The weight for each sub-group is updated at the end of each year and is constant during the year.

The measured inflation rate is sometimes affected by price changes that are deemed more temporary. The Riksbank and many other central banks therefore use measures of core inflation in their communication. There is no uniform definition of the concept of core inflation.[4] The following description of the concept of inflation can be found on the Riksbank's website: "If prices of some individual goods or services rise, this is not inflation. Prices of individual goods and services can rise because, for instance, it is more difficult to get hold of them. For instance, the price of oil may rise as oil reserves diminish. Such price increases are usually called relative price increases and are thus not inflation. For inflation to exist there should be an increase in the general price level, that is, prices in general should rise. And if one is to call it inflation, the price increase should be lasting. If, for instance, the government raises VAT, this has a one-off effect on the general price level, but does not lead to prices continuing to rise."[5]

Based on this description, it appears reasonable to try to calculate measures that differentiate between temporary changes in the prices of individual products and more permanent price changes that are of a general character and apply to a wider group of products. For example, it is not always appropriate for a central bank to react to a change in oil prices, at least not if it depends on factors that only temporarily affect the supply of or demand for oil. If, on the other hand, the price change has more permanent causes, or if it is deemed to affect inflation and resource utilisation in the slightly longer term, there is normally more reason for monetary policy to react. Regardless of the reasons for it, however, an increase in oil prices will impact the CPIF and affect the measured inflation rate.

Hence, an ideal measure of core inflation should measure the more common and permanent components of the measured inflation rate and show how high inflation is when temporary effects have diminished. There are different ways of achieving this. One common method is to exclude certain predetermined components from CPI inflation, i.e. those that are considered to reflect more temporary and short-term disturbances. The CPIF excluding energy does not include the prices of fuel and electricity. Energy prices are often affected by temporary factors such as weather conditions or geopolitical unease, and many central banks therefore analyse inflation measures that exclude them. Another way of measuring core inflation is to use statistical methods to exclude or lessen the significance of products whose prices have historically been seen to vary sharply.

Desirable properties of measures of core inflation

It is common to list various properties that are desirable in a measure of core inflation.[6] The most common are probably as follows:

- The measure should not have **bias**, i.e. should have a mean value that is the same as the target variable's mean value across a longer time period.
- The measure should be **forward-looking**, i.e. contain information about future inflation as it should ideally measure the permanent component of inflation.
- The measure should be **correlated with macroeconomic drivers** of inflation, such as demand.

[4] See, for instance, Wynne (2008) for a detailed discussion of the concept

[5] See the Riksbank website
https://www.riksbank.se/en-gb/monetary-policy/the-inflation-target/what-is-inflation/

[6] See for instance Khan et al. (2015), Roger (1998), Rich et al. (2005) and Wynne (2008) for discussion on which properties a measure of core inflation should have.

- The measure should be **readily accessible and easy to explain** for non-central bankers.

For a measure that is to be used as a target variable for monetary policy, the property of being readily accessible and transparent is an important one. However, the Riksbank and other central banks use measures of core inflation primarily as indicators of current inflationary pressures and in order to obtain a pointer as to where inflation is heading in the slightly longer term. With these aims, it is important for the measure to be forward-looking and unbiased. In this context, it is also desirable for the measure to covary with macroeconomic drivers of inflation, such as the general demand situation in the economy. The more the measure succeeds in filtering out temporary factors and noise from the measured inflation rate, the better it should covary with drivers of inflation.

The three first properties can be evaluated using the statistical methods presented below. But first, the measures currently calculated and published by the Riksbank are described.

Measures of core inflation

A number of measures of core inflation are regularly published in the Riksbank's Monetary Policy Report. These are often presented as a band in which the measure showing the highest and lowest rate of increase for each month constitutes the band's upper and lower limit. The band includes both measures where certain predetermined components have been excluded (for example the CPIF excluding energy) and measures that use statistical methods to reduce the significance of those goods and services that have historically varied the most or that exhibit the most extreme price changes in a given month. The measures of inflation are also published on the Riksbank's website every month, normally on the same day as new outcomes for the CPI are published by Statistics Sweden.

The calculation of the measures is based on the CPIF.[7] The **CPIF excluding energy** excludes electricity and fuel from the CPIF.[8] In the **CPIF excluding energy and unprocessed food**, meat, fish, fruit and vegetables are also excluded in addition to energy.[9] The measures computed using statistical methods are based on the CPIF divided up into 70 sub-groups and calculated as annual percentage changes.[10]

One way of calculating core inflation is to adjust for prices that vary considerably in the measured month. In **Trim85**, 7.5 per cent of the highest and lowest annual rates of price change are discounted among the sub-groups included in the CPIF. Thus, 85 per cent of the total weighting in the CPIF remains in this measure. The **Trim1** measure (or weighted median inflation) is similar to Trim85, except that only the median price change is used, which means that only 1 per cent of the CPIF's total weighting remains.

Another way of calculating core inflation is to give higher weight to prices that only vary a little. In **UND24**, all of the sub-groups are retained but are given a different weight to the one they have in the CPIF. Goods and services whose annual percentage price change has varied relatively more over the past 24 months are given a lower weight and vice versa. **CPIFPV** is calculated by estimating autoregressive equations (of the first-order) for each of the group's annual percentage change. The estimated coefficients are then used as weights for each component respectively. The higher the estimated coefficient, i.e. the more prolonged a price change is, the higher the weight.

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[7] See Appendix 2 for a more detailed description of the measures

[8] Indices for gas, electricity and fuel are excluded, i.e. groups 450, 471, 472 and 623, from Statistics Sweden's so-called "Riksbank grouping".

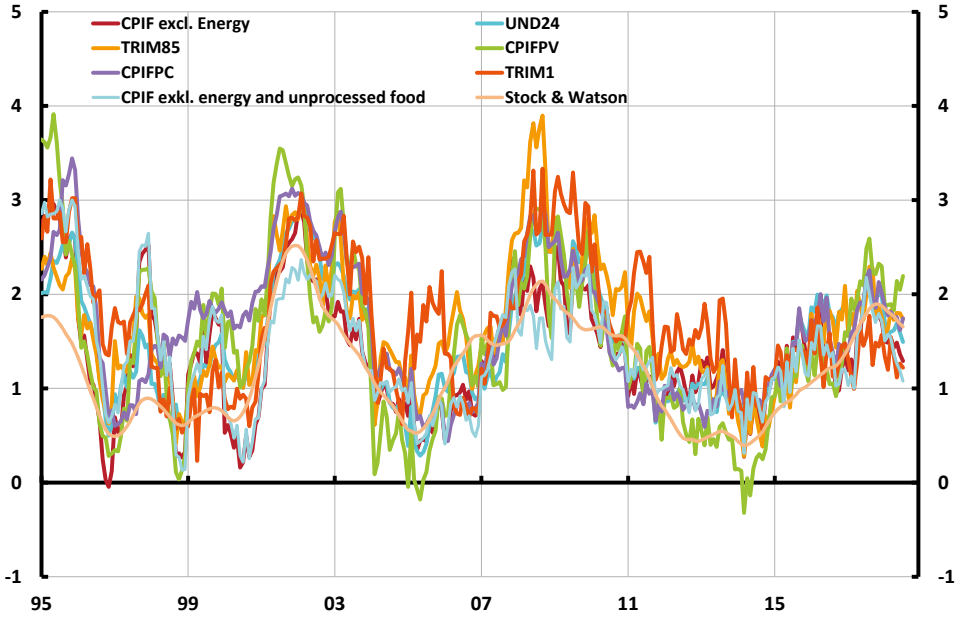
[9] In addition to energy (see Footnote 8), meat, fish, vegetables and fruit, i.e. groups 450, 471, 472, 623, 120, 130, 161, 162 and 163, are excluded from Statistics Sweden's so-called "Riksbank grouping".

[10] See Appendix for a list of the 70 sub-groups.

A third way of calculating core inflation is to estimate common trends in various sub-groups of the CPIF. **CPIFPC** is a so-called static factor estimated using principal component analysis aimed at capturing such common trends. All the sub-groups of the CPIF are included in the calculations (annual percentage changes). As a final step, the component is standardised so that it has the same mean value as the CPIF.

In addition to the measures presented above (and regularly published by the Riksbank), a statistical model presented by **Stock & Watson** (2016) has been estimated on Swedish data, where CPIF inflation is divided into a trend and a noise component. The trend component is modelled as a permanent process, while the noise component is allowed to vary more. The resulting measure of trend inflation is less volatile than the other measures of core inflation (see Figure 1 and Table 4). The annual percentage change in the CPIF broken down into 14 sub-groups is used in the estimations.[11] This method of calculating core inflation differs from the measures described above in at least two ways. Firstly, the Stock & Watson model uses information along the time dimension in a clearer way than other measures in order to calculate trend inflation. Secondly, Bayesian methods are used in the model estimations.

Figure 1. Measures of core inflation (annual percentage change)



Sources: Statistics Sweden and the Riksbank

An evaluation of the Riksbank's different measures of core inflation

The desirable properties of measures of core inflation were discussed earlier. In this section, we examine a few of these properties of the measures of core inflation described in the section above. The properties examined are:

[11]The CPIF is divided into the sub-groups capital stock, fruit and vegetables, alcohol, tobacco, other foods, heating, electricity, fuel, clothes and footwear, other goods, rents, property tax, foreign travel and other services. These are the same sub-groups that are usually analysed by the Riksbank.

- Predictive power as regards future CPIF inflation[12]
- Correlation with resource utilisation
- Bias in relation to the rate of increase in the CPIF

Based on earlier reasoning, a measure of core inflation should then be positively correlated with macroeconomic variables that normally explain future inflation developments. Similarly, the measure itself should be able to predict future inflation developments. Neither should the mean value of the measure deviate from the CPIF inflation mean value. Based on these criteria, the different measures of core inflation can be evaluated. Tables 1-2 and Figure 2 present the results of the properties of the various measures as a basis for such an evaluation.

A measure of predictive power is presented in Table 1 below. The calculation is performed for January 1995 to July 2018. The figures show how well the latest monthly outcome of the various measures tallies with the rate of increase in the CPIF 12, 18, 24, 30 and 36 months ahead. The exercise thus captures how well the various measures already reflect future developments in the CPIF. The figures presented on the first row are the average root-mean-squared errors (RMSE) when the current CPIF outcome is used as a forecast for the CPIF 12-36 months ahead.[13] The other rows show the relative predictive power of the other measures in relation to the predictive power of the CPIF. Figures below 1 indicate that the core measure is better at predicting future CPIF inflation than the rate of increase in the CPIF itself. Most measures of core inflation have better predictive power for future CPIF inflation than the current rate of increase in the CPIF on most time horizons. CPIFPC, UND24 and the Stock & Watson measure have the best predictive power.

Table 1. Predictive power (RMSE) of each measure respectively (as percentages)

	Months				
	12	18	24	30	36
CPIF (percentage points)	**0.96**	**0.95**	**1.05**	**1.25**	**1.40**
excl. energy	0.96	0.98	0.93	0.93	0.93
excl. energy and unprocessed food	0.96	1.00	0.97	0.96	0.95
CPIFPV	1.08	1.00	0.93	0.93	0.96
CPIFPC	0.77	0.79	0.78	0.72	0.68
TRIM1	0.99	1.08	1.07	0.98	0.97
UND24	0.84	0.84	0.82	0.89	0.89
TRIM85	0.90	0.95	0.96	0.97	0.98
Stock & Watson	0.89	0.87	0.87	0.84	0.82
Published forecast	*0.69*	*0.84*	*0.85*	*0.72*	*0.70*

Note. Forecast for the period January 1995 to July 2018 are evaluated. The row for published forecasts is there as a comparison. The Riksbank's forecast error does not,

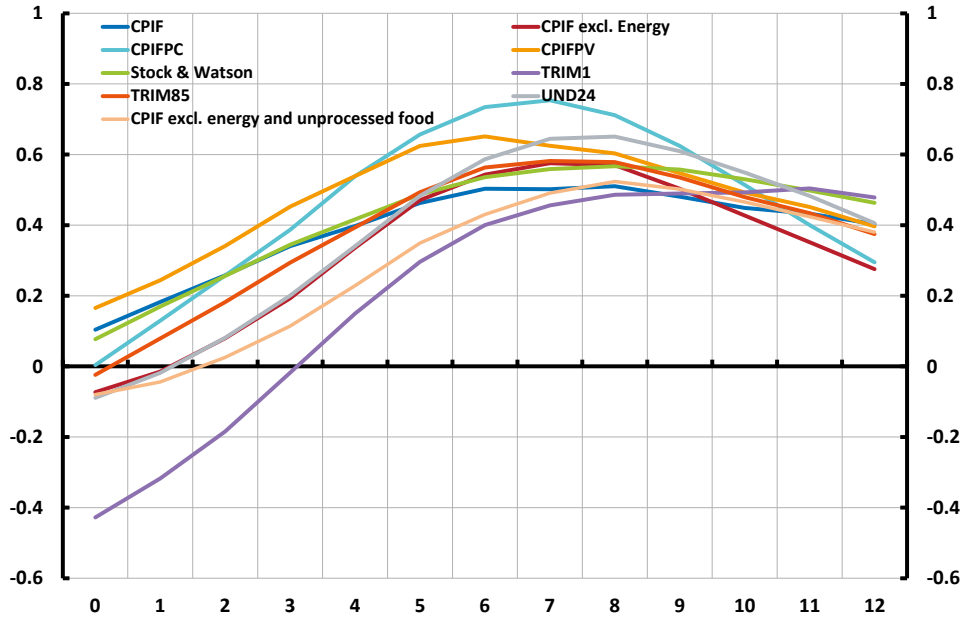
[12] This study evaluates the ability of each measure to explain future CPIF inflation. In other studies it is instead more common to evaluate the measure's ability to capture trend inflation, for example measured as a moving average of the measured CPI inflation. Such an approach does not change the ranking among the measures in any decisive way. The benefit of evaluating predictive power for a single month's outcome is that the forecast error can then be more clearly set in relation to the forecast errors in, for example, inflation forecasts published by the Riksbank.

[13] One of the simplest ways of evaluating forecasts is to calculate the average forecast error, which is sometimes called "bias". It shows whether the forecast on average has been over or under the outcomes and hence captures the degree of systematics in the forecast errors. RMSE (Root-Mean-Squared-Error) summarises the dispersion, standard deviation and bias for the forecast errors. The lower the RMSE, the better the predictive power. A forecast that is always correct has an RMSE that is equal to zero.

however, refer to the same periods and forecasting months as the other measures. The Riksbank's forecasts are published less often and forecast errors for up to a 24-month horizon are available from 1998 onwards while forecast errors for horizons longer than 24 months are only available from 2005 onwards. Before 2008, the Riksbank's published forecast errors refers to forecasts for the CPIX. The CPIFPC and Stock & Watson measures are revised upwards every time a new observation is added. Measures calculated using real-time data are used in the estimations.
Source: The Riksbank

Figure 2 below shows how the various core measures co-vary with the Riksbank's measure of resource utilisation (the RU indicator).[14] The curves refer to estimated correlation coefficients calculated for the period 1995Q1 to 2018Q2. The lines furthest to the left in the figure show the degree of contemporaneous correlation, that is when the core measures in a given quarter, t, are matched with resource utilisation in the same quarter, t (see period 0 in the figure). Thereafter, the correlation between the core measures and resource utilisation in the previous quarter, t-1 (1), is shown against the resource utilisation two quarters ago, t-2 (2), and so on. If the correlation is highest in, for example, t-6 (6), it means that the correlation between the core measure and resource utilisation is highest if the RU indicator is delayed for six quarters. Most measures of core inflation are more correlated with the RU indicator than the CPIF. The highest correlation is found between the RU indicator and CPIFPC is with a 7-8 quarter delay (see Figure 2).

Figure 2. Correlation between various inflation measures and the RU indicator with different delays



Note. The estimation period is 1995Q1 to 2018Q2. The figure shows the estimated correlation coefficient between respective inflation measures and the RU indicator with different delays. The CPIFPC and Stock & Watson measures are revised upwards every time a new observation is added. Inflation measures calculated using the data that had been available in real time are used in the estimations.
Source: The Riksbank

Table 2 presents a measure of bias in relation to CPIF inflation and the degree of variation over time. The average annual percentage change in the CPIF is 1.56 per cent during the period January 1995 to July 2018. The rows in Column 1 show the deviation of the various

[14] See Nyman (2010)

measures from this average rate of increase (in percentage points). During this period, UND24 and CPIFPC have the lowest bias, i.e. the average rate of increase for these measures deviates the least from the average rate of increase in the CPIF. CPIPC also has the lowest variability.

Table 2. Mean value, bias in relation to the rate of increase in the CPIF and standard deviation

	Mean value	Bias[15]	Standard deviation
CPIF	1.56	-	0.72
excl. energy	1.38	- 0.18	0.65
excl. energy and unprocessed food	1.39	- 0.16	0.62
CPIFPV	1.48	- 0.08	0.90
CPIFPC	1.62	0.06	0.36
TRIM1	1.70	0.14	0.70
UND24	1.50	- 0.06	0.64
TRIM85	1.66	0.10	0.68
Stock & Watson	1.24	- 0.32	0.64

Note. The CPIFPC and Stock & Watson measures are revised upwards every time a new observation is added. Measures calculated using real-time data are used in the estimations. The standard deviation is calculated for the annual percentage change in each inflation measure respectively (percentage points).
Source: The Riksbank

Conclusions and discussion

Central banks often use different measures of core inflation as part of the basis for their monetary policy decisions. The main aim of using such measures is to provide an indication of how high the more persistent or permanent component of the measured inflation rate is. In this Economic Commentary, different measures of core inflation have been described, several of them often being published by the Riksbank. Some commonly desirable properties of measures of core inflation have been discussed. Based on these, the various measures have then been evaluated. One finding from the evaluation is that CPIFPC is the measure that best explains future CPIF inflation and covaries the most with resource utilisation.

Overall, however, no single measure is deemed to be more relevant than the others if the aim is to continuously reflect developments in core inflation. Different measures can be useful on different occasions or in different periods. For example, CPIF inflation may be affected by large, temporary and supply-related changes in energy prices, which will probably make those measures of core inflation that exclude energy prices the most useful. Similarly, other types of shocks that affect CPIF inflation will make different measures more or less useful. To obtain as good an indication as possible of current inflationary pressures and where inflation is heading in the slightly longer term, it is therefore reasonable for the Riksbank to continue to analyse several different measures of core inflation. This is also common practice among other central banks.[16]

[15] Some of the bias for the measures UND24, TRIM85, CPIPV, TRIM1 and Stock & Watson depends on the fact that the sub-groups are aggregated in a simpler way in measures of core inflation than they are when Statistics Sweden calculates the CPIF. When calculating measures of core inflation, the percentage changes in each sub-group are aggregated to a total figure. A more complicated formula is used to calculate the CPIF. The average difference since 1995 between the CPIF aggregated in this way and the published rate of increase in the CPIF is 0.09 percentage points, i.e. the aggregate rate of increase calculated using the simpler method is 0.09 percentage points higher.

[16] See, for instance, Khan et al. and Ehrmann et al. 2018.

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Appendix 1

Table A1: Sub-groups in the CPI and their weights 2018

Sub-group	Weight in parts per thousand 2018
FLOUR, GRAIN AND BREAD	20.3
MEAT PRODUCTS	24
FISH AND TINNED FISH	7.7
MILK, CHEESE AND EGGS	21.1
COOKING FAT	3.5
COFFEE, TEA AND COCOA	4.3
OTHER FOODSTUFFS	22.4
SOFT DRINKS AND NON-ALCOHOLIC BEER	8
BEER,CLASS II	1.3
VEGETABLES, SWEDISH	3
VEGETABLES AND FRUIT, IMPORTED	7.2
VEGETABLES AND FRUIT, MIXED	16.8
SPIRITS, SYSTEMBOLAGET	4.4
WINE, SYSTEMBOLAGET	11.1
BEER, SYSTEMBOLAGET	5.9
TOBACCO PRODUCTS	16.2
WOMEN'S WEAR	19.9
MENSWEAR	16.5
CHILDREN'S WEAR, SPORTSWEAR	8.8
TEXTILE FABRICS, YARNS AND HABERDASHERY	0.7
FOOTWEAR, EXCLUDING HEELING	7.7
OWNER-OCCUPIED HOUSING: REPAIRS, GOODS	5
FURNITURE, CARPETING AND LIGHTING	19.2
HOUSEHOLD TEXTILES, OTHER FURNISHING	10.5
HOUSEHOLD APPLIANCES EXCLUDING REPAIRS	4.6
HOUSEHOLD UTENSILS	11.9
HOUSEHOLD ITEMS	7
VEHICLE PURCHASES	48.1
AUTO SPARE PARTS ETC.	9.1
RADIO, TELEVISION, VIDEO ETC.	20.1
CAMERAS INCLUDING COLOUR FILM	0.6
MUSICAL INSTRUMENTS, CD, DVD	3.9
FLOWERS ETC.	6.5

SPORTING ARTICLES AND LEISURE GOODS	5.6
TOYS, GAMES AND HOBBY ITEMS	7.8
VARIOUS LEISURE GOODS EXCLUDING REPAIRS	9.4
BOOKS	3.5
NEWSPAPERS AND MAGAZINES	5.6
PHARMACEUTICALS	12
HEALTH AND MEDICAL CARE ITEMS	5.2
PERSONAL HYGIENE, GOODS	13.2
DIVERSE GOOD EXCLUDING REPAIRS AND GOLD	6.2
GOLD ITEMS	2.2
GAS AND ELECTRICITY, RENTED FLAT AND TENANT–OWNED APARTMENT	10.9
OWNER-OCCUPIED HOUSING: ELECTRICITY	28.4
FUELS	25.5
OWNER-OCCUPIED HOUSING: HEAT EXCLUDING ELECTRICITY	5.4
RENTED FLATS, TENANT-OWNED APARTMENTS, BASIC RENT	96
GARAGE COSTS	1.5
OWNER-OCCUPIED HOUSING: SITE LEASEHOLD, PROPERTY TAX	7.5
OWNER-OCCUPIED HOUSING: WRITE-OFFS	28.3
OWNER-OCCUPIED HOUSING: INSURANCE FEES	4.1
OWNER-OCCUPIED HOUSING: WATER, SEWAGE, REFUSE COLLECTION, CHIMNEY SWEEPING	9.4
AUTO REPAIRS AND MAINTENANCE	16.7
VEHICLE TESTING, DRIVING LESSONS, AUTO INSURANCE	15.3
DOMESTIC TRAVEL EXCLUDING BOAT TRIPS AND REMOVALS	24.7
FOREIGN TRAVEL	19.9
POSTAL SERVICES	1.4
TELECOMMUNICATIONS	23.9
ENTRERTAINMENT AND RECREATION EXCLUDING TELEVISION LICENCE AND GAMBLING	34.6
TELEVISION LICENCE	4.5
LOTTERIES, POOLS AND TOTE BETTING	11.7
MEDICAL CARE	18.5
DENTAL CHARGES	9.4
PERSONAL HYGIENE, SERVICES	15.5
WINES, SPIRITS, BEER: RESTAURANTS	9.9

EATING OUTSIDE THE HOME	53
ACCOMMODATION	9.1
FUNERALS, HOME INSURANCE, BANKING, EDUCATION	28.7
REPAIRS, HOUSEHOLD SERVICES	5.4
Interest rate index/Capital stock	33.5
CPI/CPIF, TOTAL	**1000**

Appendix 2

In this appendix, we describe in more detail how the various measures presented in this commentary are calculated.

The measures that exclude certain specific sub-groups, i.e. the **CPIF excluding energy and the CPIF excluding energy and unprocessed food**, are calculated by constructing new indices according to the same calculation methods used when the CPIF is aggregated, but where certain product groups are now excluded. The weights for the remaining sub-groups are increased proportionally based on the size of the total weighting of the excluded sub-groups.

The TRIM measure is instead calculated by the sub-groups with the highest and lowest annual percentage changes in a given month being given a weight of 0 for that month while the weights for other sub-groups are increased so that the total weighting is 1. Consequently, different sub-groups will be excluded for different months. As a first step, the 70 CPIF sub-groups are ranked together with their weights in ascending order from those showing the lowest rate of price increase to those showing the highest in a given month. For **TRIM85**, those sub-groups equivalent to a total weighting of 7.5 per cent that have the highest annual percentage change are given a weight of 0. The same thing applies to those sub-groups equivalent to a total weighting of 7.5 per cent that have the lowest annual percentage change. However, there will always be sub-groups that are just on the borderline. In such cases, the weight is instead adjusted for the group depending on how much of the total weighting needs to be excluded to reach a total weighting of 7.5 per cent. Thereafter, all remaining weights are increased so that the total weighting is 1. These weights are then used to arithmetically aggregate the annual percentage changes for the various sub-groups. For **TRIM1**, the procedure is the same although everything apart from the middle 1 per cent is removed.

In **UND24**, all of the sub-groups are retained but are given a different weight to the one they have in the CPIF. The weights are calculated by first working out the difference between the annual percentage change in each sub-groups and total CPIF inflation. The weight for each sub-group is then calculated each month based on the historical standard deviation for the deviation. More specifically, the weights are calculated by first working out the inverse for 24-month moving standard deviations for the deviation for the various sub-groups. These are then normalised so that the weights total 1 in each time period. These weights are then used to arithmetically aggregate the annual percentage changes for the various sub-groups. The weights therefore vary from month to month and the weight is greater for those groups in which the variation relative to total CPIF inflation has been small while it is less for those groups in which the variation relative to total CPIF inflation has been considerable over the last 24 months.

A similar approach is used for the **CPIFPV** measure. Here, too, all of the sub-groups are retained but are given a different weight to the one they have in the CPIF. The weights are determined based on how persistent the annual percentage changes are for each sub-group

respectively. This is done by estimating a simple autoregressive model of the first order for each respective sub-group. The weights are then obtained by normalising the coefficients for each respective sub-group so that the total weighting is 1. These weights are then used to arithmetically aggregate the annual percentage changes for the various sub-groups. A rolling window corresponding to the last 60 months is used in the estimations. In other words, a new estimation is done each month which means that the weights constantly change. The weight for a single sub-group will therefore be greater the higher the estimated autoregressive coefficient for the annual percentage rate of change has been for the sub-group over the past 60 months.

CPIFPC has been produced with the aid of what is known as a principal component analysis. Here, too, all sub-groups are included in the calculations. First, all sub-groups are standardised so that they all have a mean value of zero and a standard deviation of 1 for the given period. Then, static factors are estimated for the sub-groups with the aid of a so-called principal component analysis. This is a method to try to reduce the data volume to a small number of components that can explain much of the total variation in the data. We aggregate the three first components that together explain just over 30 per cent of the variation in all sub-groups. The weight they receive in the aggregation is based on how much of the total variation in all sub-groups and component respectively can be explained by the total variation. Finally, a simple regression on the CPIF is estimated with the factor as the only explanatory variable, CPIFPC is the adjusted values from this regression. As the factors are re-estimated for the whole of history each time there are new data, the history for this measure will change for each new month with newly added data.

The **Stock & Watson** method is more technically sophisticated than previously described methods. The model is estimated for sub-groups of the CPIF and tries, for each group, to differentiate between more persistent trend components and a noise component that are assumed to be temporary deviations from the trend. In this case, the CPIF is divided into 14 sub-groups: capital stock, fruit and vegetables, alcohol, tobacco, other foods, heating, electricity, fuel, clothes and footwear, other goods, rents, property tax, foreign travel and other services. The basis of the model is a dynamic factor model that is estimated for sub-groups of the CPIF. However, the model allows time variation in parameter estimations and the variance in the error terms. The measure is then generated by arithmetically aggregating the trend components for each sub-group with its weight in the CPIF. Similar to CPIFPC, the measure's entire history is re-estimated each time there are new data. The entire measure will therefore change for each month with newly added data. For more information on how the measure is calculated, see Stock & Watson (2016).