The Riksbank's inflation target – target variable and interval

S V E R I G E S R I K S B A N K

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Foreword

The Riksbank's inflation target was introduced more than 20 years ago. Since inflation targeting was introduced in 1995, the Riksbank has defined it in terms of the annual change in the consumer price index (CPI). Up until 2010, the Riksbank also used a tolerance band around the inflation target.

From the very start, but especially more recently, it has been discussed whether the CPI is the most appropriate target variable. The reason for this is that changes in the repo rate – via household mortgage rates – have a direct effect on inflation which has nothing to do with the underlying inflationary pressure. The effect is in "the opposite direction" in that rate cuts aimed at pushing up inflation instead lead to a further fall in CPI inflation in the near term. This makes monetary policy communication more difficult and may lead to inflation expectations being affected in a negative way. Due to this direct interest rate effect, monetary policy decisions have, in practice, been guided by the measure CPIF (CPI with a fixed interest rate), which does not have this effect.

Following Goodfriend and King's review of monetary policy last spring, the Riksdag (the Swedish parliament) in June urged the Government to appoint a parliamentary commission of inquiry into the Swedish monetary policy framework and the Sveriges Riksbank Act.[1] The target variable will probably be included in this inquiry. In conjunction with a discussion of the target variable, there may also be reason to consider whether a tolerance band around the target should be reintroduced. The choice of target variable and a possible tolerance band are issues of significant socioeconomic interest. This Riksbank study is to be seen as a basis for a broad and open discussion of these issues. The study discusses the advantages and disadvantages of various possible target variables and of a tolerance band around the target. Changing target variable to CPIF or HICP or reintroducing a tolerance band could have consequences for how the Riksbank communicates monetary policy and builds confidence in the inflation target, but it would not change the basic features of the monetary policy being implemented.

In the following discussion, three questions are particularly important:
- Is there a price index that is preferable to other options or an index that has greater disadvantages?
- What possible problems are there with a change of target variable for the inflation target?
- What are the possible advantages and disadvantages of reintroducing an interval around the inflation target? Would a tolerance band or target range be preferable?

The Riksbank's role as an independent authority means that the members of the Executive Board may not seek or receive instructions when carrying out their monetary policy tasks (known as the prohibition against instructions). These tasks include specifying the price stability objective introduced into the Sveriges Riksbank Act in 1999. On the other hand, both the members of the Executive Board and the Riksbank's experts may engage in discussions with external authorities and organisations on how the target should be specified to create an appropriate and comprehensible monetary policy.

The Executive Board of the Riksbank

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1 See Evaluation of the Riksbank's monetary policy 2010–2015, Committee on Finance Report 2015/16:FiU41.

Summary

Since inflation targeting was introduced in 1995, the Riksbank has defined the target in terms of the consumer price index (CPI). It is now being discussed whether the inflation target should instead be expressed using a different index than the CPI and whether an interval around the target should be reintroduced.[1] One of the reasons is that the CPI is somewhat problematic as a target variable as changes to the policy rate have major direct effects on the CPI, pushing it in the "wrong direction". This creates difficulties in the communication of monetary policy and may make target fulfilment difficult if expectations of future inflation are affected.

The aim of the inflation-targeting policy is to anchor the long-term inflation expectations of households and companies. This suggests that the inflation target should refer to a relevant, broad and well-known index. The broad CPI with a fixed interest rate (CPIF) measure and the EU-harmonised index for consumer prices (HICP) are the most natural alternatives to the CPI as target variables, if a change is to be made.

Present monetary policy is already based on the CPIF, which, like HICP, does not include the direct effects of policy rate adjustments. The CPIF and HICP differ in their coverage and calculation methods, but the outcomes are very similar in practice. In the long term, the differences between the CPIF and the HICP will most probably be small. In the shorter term, over the next ten years, the annual rate of increase in the CPIF is expected to marginally exceed the rate of increase in the HICP. One argument for switching to the CPIF as target variable is that it is probably better known in Sweden than HICP, while international comparability might speak in favour of HICP. The practical consequences for monetary policy of a switch to the CPIF or HICP can be expected to be minor. Regardless of whether a change of target index takes place, the Riksbank will also have to continue to monitor and analyse several measures to obtain the best possible understanding of inflation.

A tolerance band is a way of illustrating uncertainty and showing that the Riksbank is unable to fine-tune inflation around the target. It can also provide a concrete expression of the variation in inflation that can reasonably be expected over time. Historical outcomes indicate that a tolerance band has to be very broad if CPI inflation, with reasonable probability, is to be expected to fall within it. With the CPIF or HICP, the interval can be narrower.

A target range means that the inflation target itself is defined in terms of an interval, and not just a specific value, such as the current point target of 2 per cent. It therefore provides greater scope for choosing the level of inflation which monetary policy is to aim for. At the same time, this can make it more difficult to anchor long-term inflation expectations than it would be with a point target.

Reintroducing a tolerance band could facilitate the communication of monetary policy, but would have limited consequences on the monetary policy

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1 See, for example, Jansson (2015).

being conducted. Introducing a target range could have more widespread consequences, as the freedom allowed monetary policy could expand so far as to allow the Riksbank to aim for any inflation rate at all within the interval.

In this Riksbank study, we discuss some aspects regarding the choice of target variable for the inflation target and the interval around the target.

1   Wording of the inflation target

On 15 January 1993, the General Council of the Riksbank announced that monetary policy was to be guided by an explicit inflation target from then on. The target was specified as the annual change in the consumer price index, the CPI, as from 1995, being limited to 2 per cent, with a tolerance band of ±1 percentage points.[2] When the new Sveriges Riksbank Act came into force in 1999 and an independent Executive Board was tasked with deciding on monetary policy issues, the original wording of the target was retained.[3] For the entire period, the inflation target has been expressed in terms of the CPI. The interval around the target was removed in 2010, however.

1.1   The CPI target variable has certain disadvantages

From the very beginning, it was clear that the choice of the CPI as target variable would pose a number of challenges. One reason for this is that changes in the Riksbank's policy rate have direct short-term effects on inflation. When, for example, the Riksbank cuts the repo rate to buoy inflation, mortgage rates will decline. Mortgage rates are included in the owner-occupied housing costs item in the CPI and the rate cut will therefore exert downward pressure on the index. This direct effect on the CPI thus goes in the "wrong direction"; in other words, the policy rate cut leads to a drop in near-term inflation.

For this and other reasons, the Riksbank has regularly allowed the progression of price indices other than the CPI to influence interest rate decisions, recently mainly the CPIF (CPI with a fixed interest rate). CPIF inflation has served as an intermediate target variable insofar as the Riksbank has usually aimed for CPIF inflation being close to 2 per cent within around two years. The idea is that even if rates sometimes go up and down, CPI and CPIF inflation will eventually coincide when the interest rate stabilises.

However, in the past few years, the deviations between the CPI and CPIF have been substantial – both upwards and downwards. For example, the period of rate cuts that commenced in December 2011 has contributed to CPI inflation being on average 0.6 percentage points below CPIF inflation. Conversely, CPI inflation will rise quickly and exceed CPIF inflation when the repo rate is raised in the period ahead.

Large and protracted differences between CPI and CPIF inflation can cause a number of problems. Perhaps the most serious one is that participants in the economy might start to question whether the Riksbank is actually stabilising CPI inflation around the target by stabilising CPIF inflation around 2 per cent. This can lead to confidence in the inflation target decreasing, and long-term inflation expectations starting to drift away.

Another problem is that evaluations of monetary policy are made more difficult if there are major differences between the progression of the variable that guides the Riksbank and the formal target variable.

A third problem is that both domestic and overseas analysts often do not take how the CPI is constructed into account when describing the situation in Sweden. This can, for

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2 Press release no. 5:1993.
3 Heikensten (1999).

instance, lead to misleading international comparisons. For example, in the past few years media reports have emerged from time to time describing how Sweden is in a state of deflation. This can give the impression of the situation in Sweden being worse, and inflation much lower than in other countries, despite the main difference being that the Swedish CPI is more sensitive to changes in the policy rate than corresponding price indices in other countries. Ultimately, this could also impact inflation expectations.

Even if this does not necessarily mean that the CPI has to be replaced as the target variable for monetary policy, there is reason to deepen the discussion on alternative target variables.[4]

1.2   Is an interval around the target needed again?

The interval of ±1 percentage points, which complemented the inflation target when it was introduced in 1995, was primarily a pedagogical tool intended to illustrate that certain deviations from the inflation target of 2 per cent, while not being too large, had to be accepted. The size of the interval was determined by what intuitively appeared to be reasonable. It was not possible to rely on any past experience as the monetary policy regime was entirely new and inflation had varied enormously during the old regime which had a fixed exchange rate. It was estimated that inflation would now vary less, but it was unknown as to how much.

The interval remained a part of the monetary policy framework for a long time, but was abolished in 2010. This was because the Riksbank deemed that it no longer served any practical purpose. In the memorandum published in connection with the decision to abolish the interval, it was noted that: "There is considerable understanding for the fact that inflation commonly deviates from the target and that the deviations are sometimes larger than 1 percentage point. Inflation can thus be outside of the tolerance band without threatening the credibility of the inflation target. Such deviations have proved to be a natural part of monetary policy."[5]

The question of whether the inflation target should be surrounded by an interval has recently become relevant again in the Swedish debate. Both members of the Executive Board of the Riksbank and others outside the Bank have raised the issue of a possible reintroduction of an interval in some shape or form.

2   Which inflation index should the target refer to?

According to the Sveriges Riksbank Act, the objective for monetary policy is to maintain price stability. The Riksbank has specified this as a target for inflation, according to which the annual change in the consumer price index (CPI) is to be 2 per cent.

The purpose of inflation targeting is to create stable conditions in the economy, and reduce uncertainty. This makes it easier for households, companies and other participants in the economy to make well-founded economic decisions. In more concrete terms, inflation targeting shall anchor long-term inflation expectations among households and companies. The inflation target can then function as a nominal anchor in the economy and contribute towards stable and effective wage formation. This suggests that the central bank should stabilise a broad and well-known index.

Other arguments and more recent monetary policy theory may suggest that the inflation target should refer to a narrower index, such as one where sticky prices carry particularly heavy weight or where an attempt is made to screen out components that monetary policy

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4 A change of target variable to CPIF is proposed in Marvin Goodfriend and Mervyn King's review of the Riksbank's monetary policy 2010-2015 (Goodfriend and King, 2016).
5 Sveriges Riksbank (2010).

finds difficult to affect (see Annex 1). However, such indices can be difficult to devise. They can also be difficult to communicate because they do not necessarily capture the inflation that is most relevant to households and companies. Therefore, specifying the inflation target in terms of such an index does not currently seem like an alternative that is particularly close to hand.

Besides the CPI, there are two broad price indices that are natural alternatives as target variables: The CPI with a fixed interest rate, the CPIF, and the EU-harmonised index for consumer prices, the HICP. Both these are relatively well known. They are based on the same statistical data and have exhibited more or less the same numerical trend. There are, however, certain differences between them.

2.1 Key differences between the CPI, CPIF and HICP

Institutional differences

The CPI is produced by Statistics Sweden. The calculation rules for the CPI are determined by the Swedish Government and the Riksdag.[6] Until recently, the Consumer Price Index Board (CPI Board) settled issues of a principal nature based on the established grounds. The CPI Board normally had two meetings a year, for which Statistics Sweden drafted proposals for changes in the CPI.[7] The CPI has three principal areas of use. The index is used in calculations of compensation for price developments,[8] in fixed-price calculations[9] and as the target variable for the Riksbank's monetary policy.

The CPIF (CPI with fixed interest rate) is produced by Statistics Sweden on behalf of the Riksbank. The only difference between the CPI and the CPIF is that the rate of increase in the CPIF is not directly affected by changes in household mortgage rates.[10] The CPIF has in recent years served as an intermediate target variable for monetary policy insofar as the Riksbank has usually aimed for a CPIF inflation rate of close to 2 per cent within around two years.

The HICP is also produced by Statistics Sweden. The calculation rules for the HICP are regulated in EU regulations and other complementary documents on EU level.[11] In many areas, the regulatory framework is made up of minimum rules, where member states may use different methods. The HICP is primarily used as a target value for the ECB's monetary policy, as a comparable inflation measure within the EU and as a basis for evaluations of EU convergence criteria regarding price stability.[12]

Differences in calculation method

The CPI (and in principle the CPIF) is what is known as a cost-of-living index. A cost-of-living index measures "the relationship between the monetary amounts required to maintain, in two price situations, the same consumption standard, or the same level of benefit".[13] This means that situations are compared in which not only the prices but also the consumption composition differ. The index therefore captures the fact that consumers tend to consume more of goods and services that relatively speaking have become cheaper. On average since 1996, this substitution (the "basket effect") has led to CPI inflation being 0.15 percentage points lower per year than it otherwise would have been.

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6 The most important calculation rules date from the 1952 Index Committee, the 1955 Housing Index Inquiry and the 1999 Index Inquiry, SOU 1999:124.

7 New instructions from the Government to Statistics Sweden (2016:822) do not include the stipulation that Statistics Sweden is to be linked to a consumer price index board. This means that the CPI Board will no longer be a decision-making body.

8 In the Government's latest CPI guidelines, Government Bill 2001/02, Annex 4, it is established that the CPI shall primarily form the basis for the most common compensation purposes in society.

9 A fixed-price calculation recalculates nominal values to volume or real values and is used, for example, to analyse households' purchasing power and the development of their real incomes.

10   The CPIF is indirectly affected in that the weight for the interest expenditure index can be affected, see Annex 2, which, among other things, summarises how housing costs can be calculated and how they are calculated in the CPIF and the HICP.

11   The foundations are established in Regulation (EU) No 2016/793 of the European Parliament and of the Council.

12   The Bank of England also uses HICP (named CPI in the UK) as a target variable.

13   CPI Inquiry, SOU 1999:124, page 27.

The HICP is a so-called inflation index, i.e. it measures the development in prices of basically the same basket of goods. A key difference between the Swedish CPI and the HICP is therefore that the rate of increase in the HICP is not affected in the same way as the CPI by changes in the consumption pattern.[14]

If the development is the same as the historical trend in the period ahead, this difference, in isolation, could therefore lead to CPIF inflation being about 0.15 percentage points lower than HICP inflation.

Difference in dealing with owner-occupied housing costs

An important difference between the CPI and the HICP is how owner-occupied housing costs are calculated. In the CPI and the CPIF, these expenses are measured as the sum of an estimated capital cost and depreciation as well as day-to-day costs for operation and maintenance (waste collection, insurance, property tax, etc.).[15] The HICP only includes a narrower definition of operating costs. In practice, this means that housing prices are included in the CPI/CPIF, but not in the HICP. However, this occurs with a substantial lag and therefore affects inflation measured in terms of the CPI/CPIF for a long time in the future. As housing prices have increased rapidly for a long time, the contribution of capital costs to CPI/CPIF inflation will rise in the years ahead, even if housing prices in the period ahead remain unchanged or fall slightly.

Since 1996, owner-occupied housing costs have caused CPIF inflation on average to be about 0.15 percentage points higher than HICP inflation.[16] The size of the difference in the period ahead depends, among other things, on how property prices develop. It will also depend on the development of mortgage rates as these affect the weight of the capital cost for owner-occupied housing in the CPI and the CPIF, see Annex 2.

For the CPI/CPIF, a new method is currently being investigated where the cost of living in tenant-owned homes is also to be measured using a cost approach. Currently, the costs for living in a tenant-owned home are equated with those for living in a rented home. No decision has been taken, but the aim is for the new method to start to apply from 2017.[17] These proposals mean that the difference in CPIF and HICP inflation that stems from housing costs will be slightly greater over the next ten years. This method change was included in the inflation forecast in the July 2016 Monetary Policy Report.

Other authorities such as the European statistics agency, Eurostat, are also working on developing an owner-occupied housing item in the HICP. However, this is not calculated the same way as in the CPI (see Annex 3). The issue has been examined and discussed for many years and a decision as to when to start using the item has still not been taken.

There are no simple answers for how owner-occupied housing costs should be included in the target index, and it is calculated differently in the CPI, CPIF and HICP. However, in numerical terms, there is no great difference between the CPIF and HICP. Differences from the CPI are more significant as the interest rate has a major effect on capital costs as they are measured in the CPI.

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14   Prior to 2005, the Swedish inflation rate was calculated excluding the effect of the updated weights, and reported in parallel with the annual percentage change in the CPI. The Swedish inflation rate was at that time calculated using approximately the same method as in the HICP. In connection with the introduction of a new index construction in 2005, a decision was taken in the Consumer Price Index Board to end this distinction between the inflation rate and the annual percentage change in the CPI. See the CPI Inquiry, SOU 1999:124, Section 9.2.2 and the Statistics Sweden memorandum "Improved CPI construction from January 2005: Technical description".

15   The capital cost is measured using a so-called "Interest expenditure index". This index is affected by how mortgage rates change, and also by how the value of the properties financed by the mortgages changes, in accordance with the following simplified formula: Interest expenditure index = Capital stock index × Interest rate index. The capital stock index measures the purchase price of the properties and improvements such as refurbishments and extensions. The interest rate index measures the development of the average mortgage rate. In the CPIF, the interest rate index is kept constant, but the weight for the interest expenditure index can change if mortgage rates change, see Annex 2 for details.

16   Contribution from changes in the capital stock index.

17   Statistics Sweden (2016).

Differences in rate of increase between the CPI, CPIF and HICP

As the CPI, CPIF and HICP differ as regards coverage and calculation methods, the rate of increase in the various indices also differs. Falling mortgage rates have pulled down the CPI in relation to both the CPIF and HICP. At the same time, rising property prices and capital costs have caused the CPIF to increase marginally more rapidly than the HICP (see Table 1).[18] Since 1996, the CPI has increased on average by 1.04 per cent per year, while the CPIF and HICP have risen by 1.48 and 1.42 per cent per year respectively.

Table 1. Average annual rate of increase in the CPI, CPIF and HICP, January 1996 to March 2016

CPI	1.04
CPIF	1.48
HICP	1.42

Note. Calculations start from 1996 as there were no data for the annual rate of increase in the HICP before then.
Source: Statistics Sweden

In the period ahead, the differences in rates of increase will depend on the development of mortgage rates and property prices, basket effects and any changes in the calculation methods and their implementation. Based on the calculations presented in Annex 3, we can draw the following conclusions:

In the long term, the differences between the CPIF and HICP will be small given reasonable assumptions about the basket effect, growth in property prices and the size of capital costs for owner-occupied housing as a proportion of consumption expenditure. Assuming that the repo rate will stabilise in the long term, the rate of increase in the CPI and CPIF will be the same.

Over *the next five years*, expected repo rate increases will cause the CPI to rise much more rapidly than the CPIF and HICP. At the same time, we can expect the rate of increase in the CPIF to be slightly higher than the rate of increase in the HICP. The high rate of increase in single-family and tenant-owned housing prices in recent years will lead to higher housing costs in the CPIF than in the HICP over the next five years.

In the medium term, in about ten years' time, the annual rate of increase in the CPIF may, however, exceed the rate of increase in the HICP by around 0.2 percentage points. This is due partly to the fact that the weight for capital costs will rise in the CPIF when the interest rate goes up and to the fact that the substantial rate of increase in the prices for single-family dwellings and tenant-owned homes in recent years will lead to rising housing costs in the CPI/CPIF for a long time to come. The isolated effect of this will be that the CPIF is expected to increase by 0.35 per cent more rapidly than the HICP per year. But the effect is counteracted to a certain extent by the basket effect in the CPIF. Assuming that the basket effect is 0.15 percentage points per year, the rate of increase in the CPIF, according to these calculations, will be 0.2 percentage points higher than in the HICP in total. Once repo rate increases stop and have remained unchanged for several years, the annual rate of increase in the CPI in ten years is expected to be about the same as the rate of increase in the CPIF.

If the HICP were to include owner-occupied housing costs using a "net acquisition approach" – in accordance with the proposal currently being analysed by Eurostat – it would probably lead to a slightly higher rate of increase in the HICP as construction costs normally increase more rapidly than other consumer prices.[19] The differences in the rate of increase between the CPI/CPIF and the HICP would therefore be smaller.

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18 See Annex 3 for details.
19 In a net acquisition approach, the price progression of new houses are monitored. According to the proposal currently being analysed by Eurostat, land prices are to be excluded.

As mentioned above, a discussion is underway on calculating the costs of living in tenant-owned homes using a cost approach similar to the one used for owner-occupied housing. In addition, it has been decided that tax relief on interest expenditure is to be included in the CPI as of 2017, so that household interest expenditure is measured after tax. Calculations indicate that the weight for interest expenditure in the CPI and CPIF would increase by just over 40 per cent if tenant-owned homes were included. Including the tax relief on interest expenditure in the CPI simultaneously reduces the interest weight (for owner-occupied and tenant-owned homes) by 30 per cent. Both these method changes are included in the inflation forecast as from the July 2016 Monetary Policy Report.

In a long-term equilibrium, when the interest rate is stable for a longer time, the CPI and CPIF will increase at the same rate. But across economic cycles, when the interest rate varies around a certain level, it is possible that the CPI will increase more rapidly than the CPIF, as the percentage change of a rate rise is greater than the percentage change of a rate cut.[20] Given reasonable assumptions, the average rate of increase in the CPI can be about 0.15 percentage points higher than the average rate of increase in the CPIF for long periods, see Annex 3.

2.2 Practical aspects that can be relevant to the choice of target index

If the Riksbank changes the target variable for monetary policy from the CPI to the CPIF or the HICP, Statistics Sweden will continue to produce and publish the CPI. As explained above, a possible consequence of any change in the target variable for monetary policy could, however, be that the CPI increases slightly more rapidly than the new target variable. This can have consequences that are not directly related to monetary policy.

Several taxes and public expenditure items have a direct connection to inflation measured as the CPI or indirectly via the price base amount.[21] This applies above all to social protection systems directed at households and certain specific taxes. About a quarter of the Government's total expenditure has a direct connection to the CPI or the price base amount. Any change in the target variable for monetary policy could therefore affect public finances unless the rate of increase in the CPI coincides with the new target variable. If, for example, the target variable for monetary policy were to be changed from the CPI to the CPIF, and the target was still set at 2 per cent, it is probable that the price base amount and the CPI would increase slightly more quickly than 2 per cent in the medium term. The net effect on public finances is difficult to assess, but is probably limited.

Financial markets are affected by the CPI mostly as a result of the Swedish National Debt Office issuing government bonds that are indexed to the CPI.[22] If a change in target variable leads to the CPI increasing more rapidly than is currently expected, investors currently holding index-linked bonds will make capital gains. This effect is short-lived, however, and market prices will soon adapt. Another aspect is that the survey on inflation expectations performed by TNS Sifo Prospera on behalf of the Riksbank has been based on the CPI up until now. The survey would therefore need to be supplemented with questions linked to the new measure. Time series breaks in the survey can to a certain extent be bridged over by taking parallel readings of both measures.

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20 The percentage change in the average mortgage rate is greater when the interest rate goes up from, say, 6 to 6.5 per cent than when the interest rate falls from 6.5 to 6 per cent (even if the change in percentage points is the same). Over an economic cycle, where the repo rate is raised as much as it is cut, the average percentage change in mortgage rates will therefore be greater than zero.

21 Every year, the Government decides on the price base amount that is used, for example, in the social insurance and tax systems. In 2016, the price base amount was SEK 44 300. The price base amount is adjusted upwards with the help of the CPI inflation rate in June of the immediately preceding year. As the price base amount is rounded off to the nearest SEK 100, the annual changes in the CPI and the price base amount are not identical.

22 Inflation-indexed bonds are common in Sweden and their nominal yield is equal to the sum of a fixed real interest rate and a part that varies with inflation. The prices of these bonds can be used to estimate implicit inflation expectations.

The CPI is also used in other contexts, for example, for compensation purposes and to adjust prices in various agreements. For instance, the price amount guides the statutory minimum amount when it comes to distribution of an estate, inheritance or will. Insurance pay-outs are also often given in terms of a number of price base amounts. Most commercial rents and many leaseholds are annually recalculated using the CPI and business agreements containing index clauses often express these in CPI terms.

The CPI is also used to recalculate nominal amounts to fixed prices and volumes, i.e. deflate. When calculating real wages, it is common to deflate using the CPI. Any change in the target variable should, however, be unproblematic in this context.

The inflation target is to work as a benchmark for expectations in the economy and thereby lay the foundations for efficient price-setting and wage formation. Should a change be implemented, both the CPIF and the HICP could work as a good benchmark for expectations. Both are broad indices and capture the inflation that is relevant for consumers and wage earners. It is probable that both the CPIF and HICP could quickly become well-known inflation measures if either of them were to become the target variable for monetary policy.

2.3 Arguments for and against the CPI, CPIF and HICP

Any change in target variable may need to take the following pros and cons into consideration:

CPI

The Riksbank's reason for selecting the CPI as the target index was that it is a broad price index that represents ordinary purchases. Also, CPI statistics are of good quality, are published shortly after the end of the month and are not usually revised. The CPI is a well-known measure among the Swedish general public, and is used in a number of contexts. These reasons are naturally still valid.

Keeping the CPI as the target index signifies continuity. A change in target variable may lead to expectations that it may be replaced again. This can increase uncertainty about future monetary policy.

As discussed above, the CPI does have a number of disadvantages, primarily because changes in the Riksbank's policy rate have direct, short-term effects on inflation.

CPIF

The CPIF shares all the same properties as the CPI, apart from the disadvantage of being directly affected by interest rate adjustments via mortgage rates. One advantage of the CPIF in comparison with the HICP is that the Riksbank already uses the CPIF as a monetary policy rudder, and would continue to do so.

The possible disadvantages of the CPIF compared with the HICP are as follows:

- The CPIF includes housing prices with a significant lag and affects inflation measurements for a long time in the future. As housing prices have increased rapidly for a long time, capital stock will contribute positively to CPIF inflation in the years ahead even if housing prices were to remain unchanged or fall. Monetary policy may therefore react to a rise in housing prices that took place a long time ago. The HICP does not have this problem.

- The CPIF has been explicitly developed to work as a complement to the CPI. One can therefore claim that it is not a sufficiently independent measure.

- Statistics Sweden produces the CPIF at the request of the Riksbank. Having the inflation measure calculated by an institution other than the central bank makes it easier to maintain confidence in inflation targeting. However, the fact that the Riksbank itself has designed the index and decided how it should be calculated could be seen as a problem.

HICP

Neither is the HICP directly affected by interest rate adjustments as mortgage costs are not included in the measure. An advantage of the HICP in comparison with the CPIF is that it is used as a target index by Sweden's neighbouring central banks (the ECB and the Bank of England). In addition, it is often used for comparisons within the EU. If it is considered that monetary policy should stabilise the increase in a pure price index, rather than in a cost-of-living index, the HICP is preferable.

The possible disadvantages of the CPIF compared with the HICP are as follows:

- Currently, the HICP completely excludes the capital costs for owner-occupied housing.[23]

- The HICP does not take into account consumers' tendency to go over to cheaper goods and services as much as the CPIF does, which leads to households' living costs being overestimated. If it is considered important that the monetary policy target variable measures households' living costs, this can be seen as a disadvantage.

- The HICP is probably not as well-known as the CPI or CPIF. This would in all likelihood change if it became the new target variable for monetary policy in Sweden.

3   Should an interval around the target be reintroduced?

The question of whether the inflation target should be surrounded by an interval has once again become relevant in the Swedish debate. To facilitate the discussion, it is first necessary to define a few concepts.

3.1   Different types of targets and intervals

A *point target* is an inflation target where the target is defined in the form of a specific value for the rate of change in a target index, often in annual terms. For example, Sweden has a point target that says that the annual rate of change in the CPI should be 2 per cent.

Tolerance band

A point target can be supplemented with a *tolerance band*. The central bank then pursues a monetary policy in which inflation is to reach the point target, but the tolerance band shows which inflation outcomes can be "tolerated" or are counted as acceptable. If inflation ends up outside the interval – if the deviation is greater than what is acceptable – some form of sanction may be triggered in certain countries. In New Zealand and the United Kingdom, for instance, the central bank must present to the Government the reasons why inflation has ended up outside the interval when this happens. The interval then forms part of the agreement drawn up between the central bank and its governing body. The tolerance band can also indicate the central bank's own level of ambition with respect to stabilising inflation, without outcomes outside the interval giving rise to any kind of sanction. The interval used by the Riksbank prior to 2010 was of this type.

A tolerance band can also illustrate the fact that inflation is continually affected by different shocks and is difficult to control with any great degree of precision. The Riksbank's earlier interval also had this function.[24]

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23 This will change if/when Eurostat decides to introduce an owner-occupied housing item in the HICP.
24 The stated purpose of the interval was to illustrate that deviations from the inflation target are probable, and that the Riksbank's aim was to try to limit these deviations (see, for example, Heikensten, 1999).

Target range

A *target range* is an inflation target where the actual target is defined in the form of an interval for the percentage change in a target index. With a target range, there is no requirement for inflation to reach the exact midway point in the interval. The central bank can, in principle, pursue a monetary policy in which inflation is stabilised just before the boundary of the interval. Australia is an example of a country where the inflation target is defined as a target range.[25]

The differences between a tolerance band and a target range is illustrated in Chart 1. The tolerance band thus refers to outcome and monetary policy is always aimed at bringing inflation onto the point target. The target range is, on the other hand, also forward-looking insofar as monetary policy can be aimed at achieving any point within the interval.

Chart 1. Tolerance band vs target range
Per cent
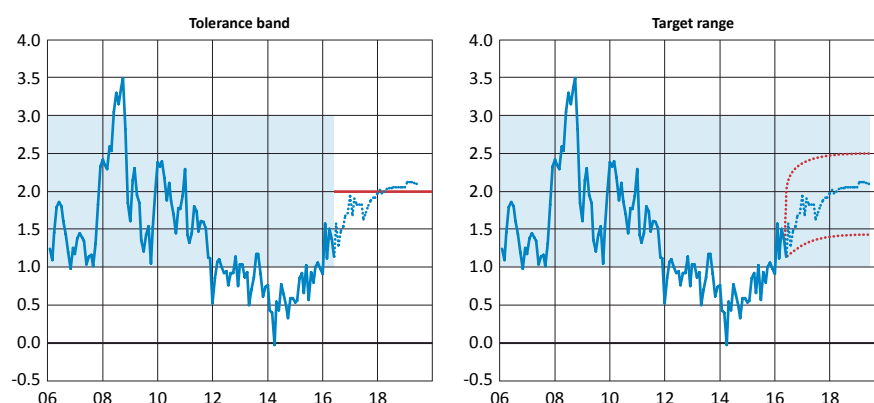
Note. The unbroken line denotes the outcome, i.e. the percentage annual rate of change in the CPIF. The broken blue lines in both left-hand and right-hand charts represent the forecast from the Monetary Policy Report, July 2016. The broken red lines in the right-hand chart represent fictitious forecasts.
Sources: Statistics Sweden and the Riksbank

3.2 Pros and cons of a tolerance band

A tolerance band could facilitate monetary policy communication. It would signal that the Riksbank has the ambition of limiting the variation in inflation and simultaneously provide a concrete benchmark for the variation that could be expected over time. Such an interval could thereby fulfil the same function as the interval that was abolished in 2010.

The Riksbank already has channels for communicating the fact that there is uncertainty concerning the development of inflation. One such channel is the Riksbank's forecasts. The inflation forecasts show that it can take time during certain periods before inflation gets back to the target and that inflation is not expected to be exactly on target all the time. Furthermore, uncertainty is illustrated in the forecasts with uncertainty bands. It is possible, however, that a tolerance band is a more pedagogical way of illustrating this uncertainty and that economic agents would perceive a tolerance band as a clearer alternative. It could therefore work as a complement to the existing communication.

It is also possible that a tolerance band would make deviations from the point target easier to accept and not give rise to criticism as long as inflation stayed within the interval. As such criticism can in itself reduce confidence in the inflation target, it cannot be ruled out that a tolerance band could, as a result, indirectly help to keep long-term inflation

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25 "In pursuing the goal of medium-term price stability, both the Reserve Bank and the Government agree on the objective of keeping consumer price inflation between 2 and 3 per cent, on average, over the cycle. This formulation allows for the natural short-run variation in inflation over the cycle while preserving a clearly identifiable performance benchmark over time." Reserve Bank of Australia (2013).

expectations better anchored to the target. A disadvantage may, however, be that if inflation does fall outside the interval, it could conversely be perceived as particularly serious.

A further complication is that the interval must also be well adapted. One reason for abolishing the previous tolerance band in 2010 was that CPI inflation had been outside the interval just as often as it had been within it. If the interval is to work as a useful benchmark for the variation in inflation that can be reasonably expected, the interval should be realistic insofar as a large proportion of inflation outcomes can be expected to fall within it.

The choice of target variable is therefore significant when it comes to setting a suitable interval range. A tolerance band of ±1 percentage points around the inflation target would work better for less volatile inflation measures such as the CPIF and HICP than it would for the CPI. An interval of that size would cover about 70 per cent of the outcomes for the CPIF since 1996 and about 60 per cent of HICP outcomes. To cover about 90 per cent of outcomes, the interval for the CPIF would need to be ±1.5 percentage points and almost ±2 percentage points for the HICP. The exact range of any new interval is therefore an issue that requires careful consideration. At the same time, it is appropriate, not least for pedagogical reasons, to choose a figure that is easy to remember.

A well-adapted range for the tolerance band would in itself make any new interval more meaningful than the previous one. There may also be reason to consider whether or not outcomes outside the interval should lead to any particular consequences and, if so, which. At one end of the scale, the interval would only illustrate that the development of inflation is uncertain and outcomes outside the interval would not lead to any particular consequences. At the other end, a possible option would be to oblige the Riksbank, in the same way as the Reserve Bank of New Zealand and the Bank of England, to explain to parliament why inflation had fallen outside the interval.

3.3 Pros and cons of a target range

Introducing a target range would be a significantly greater step than introducing a tolerance band and the consequences could be much more sweeping. With a target range, the freedom allowed monetary policy could increase in such a way as to allow the Riksbank to aim for any inflation rate at all within the interval.

At the same time, it could also make it more difficult to keep long-term inflation expectations anchored if the target is set without a point target and where all levels of inflation within the interval of, say, 1-3 per cent, are deemed to fulfil the inflation target. The nominal anchor in the economy would then be more unclear. This could make wage formation more difficult, for example.

With a target range, it is also important to avoid inflation and inflation expectations permanently being in the lower half of the interval. It would then be more difficult to stimulate the economy in the future when economic activity is weak or inflation is below the target range. This is due, among other things, to the fact that policy rates are on average lower when inflation is on average low. This reduces scope for cutting the policy rate, as this cannot be decreased indefinitely and will hit its lower bound more frequently. When average inflation is low, it is more difficult to achieve the really low or even negative real interest rates that are sometimes needed to stimulate the economy. In the international debate following the financial crisis, proposals have therefore been put forward to raise the inflation targets of central banks, simply to increase monetary policy's scope for action.[26]

One way of both preventing inflation from being permanently close to its lower bound and reducing the risk of inflation falling outside the target range is to aim for the midway point of the interval. But then the target range basically becomes a point target.

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26 See, for example Blanchard et al. (2010).

4 Conclusion

In this Riksbank study, we have discussed various aspects regarding the choice of target variable for the inflation target and the interval around the target. No measure is entirely problem-free – the CPI, CPIF and HICP all have their advantages and disadvantages. In recent years, monetary policy has been based, in practice, on the CPIF which has tended to develop in a similar manner to the HICP, in numerical terms. Changing target variable to CPIF or HICP or reintroducing a tolerance band could have consequences for the Riksbank's communication of monetary policy and its ability to build confidence for the inflation target. However, the basic features of the monetary policy being conducted would not be affected appreciably. Our hope is that this Riksbank Study will contribute towards an increased understanding and discussion of the relevant issues.

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Annex 1 – Choice of target index. What does economic theory say?

This annex provides a brief summary of the more theoretical aspects regarding the choice of target index for the inflation target.[1]

Opinions are divided as to the characteristics a target index should have. The opinion that continues to dominate in practice is that the central bank is to stabilise a broad index with the aim of anchoring inflation expectations in the economy.

Traditional view – stabilising a broad index and anchoring inflation expectations

The purpose of inflation targeting is to create stable conditions in the economy, and reduce uncertainty. This makes it easier for households and companies to make well-founded financial decisions. In more concrete terms, inflation targeting should anchor the long-term inflation expectations of households and companies – the aim being to give the economy a "nominal anchor".

A nominal anchor is important because it is otherwise easy to end up in a price and wage spiral, in which economic policy makers find themselves obliged to conduct a policy that fulfils high inflation expectations – a self-perpetuating process. Although such a spiral does not last infinitely, inflation often ends up at an undesirable high level. The development in Sweden in the decades preceding the introduction of the inflation target in 1993 is an example of this. The economy was then stuck in a "devaluation cycle", in which recurring cost crises due to excessive wage increases were "addressed" by writing down the value of the Swedish krona.

When the inflation target was introduced, the primary problem was that inflation expectations were too high. It is, however, equally important to prevent expectations from starting to drift downwards, because a period of deflation can also have negative implications for the real economy.

What does this say about the choice of target index? If the inflation target is to constitute a nominal anchor, it says that the target should refer to a price index that is known and relevant to those who set wages and prices. If the central bank stabilises a price index that is not perceived as relevant, inflation expectations can start to deviate, even if the anchor remains in place. This suggests that the central bank should stabilise a broad and well-known index, such as the CPI.[2]

New view – stabilising sticky prices

The past few decades have seen the emergence of a new monetary policy theory – New Keynesian theory – with a partly different view of which target variables are appropriate. In this theory, macroeconomic relationships are built up from microeconomic theory about the behaviour of households and companies. Economic models devised according to this theory

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1 This annex is based on Apel, Armelius and Claussen (2016).
2 Even before inflation targeting became commonplace, it was argued that monetary policy should aim for broad indices, see, for example, Wynne (2008). There is also an older discussion indicating that asset prices should be included in the index, see, for example, Alchian and Klein (1973)) and Goodhart (2001).

have been considered well-suited to monetary policy analysis, and are widely used today by various central banks.[3]

New Keynesian theory is characterised by nominal prices and wages being sticky in the short term. In the more traditional view described above, it was also assumed that sticky prices and wages were sticky. The new element is that the stickiness is explicitly modelled.

When prices and wages are sticky, it takes time for these quantities to adapt to shocks and changing economic circumstances. Because of this, they deviate from their optimal level, which leads to inefficient resource allocation. This creates a role for monetary policy besides anchoring inflation expectations. By stabilising an appropriate measure of inflation, undesirable price adjustments can be avoided, while desirable price adjustments can be accelerated.

According to New Keynesian theory, monetary policy shall stabilise a price index in which prices are weighted according to their degree of stickiness. The more sticky, the greater the weight. Hence, flexible prices will be able to adapt "freely", while monetary policy can concentrate on the sticky prices that create inefficiency. The theory also indicates that other asymmetries can be of importance to the optimal inflation index. For example, a highly cyclical sector shall have a greater weight than a less cyclical sector.[4]

Devising a theoretically optimal index is, however, difficult in practice. No such indices currently exist for Sweden.[5] If the Riksbank's inflation target were to refer to an optimal index, the index must first be developed, then produced and updated by an authority external to the Riksbank, preferably Statistics Sweden.

Another point is that the theoretically optimal index perhaps does not capture inflation as it is perceived by, for example, households and companies. In the theoretical models, participants in the economy can simply compute what stabilisation of the optimal index means to the progression of the prices that are relevant to them. This is a fairly strong assumption and in reality it might be difficult for ordinary people to see the implications of stabilisation of the optimal index for the prices that they perceive to be relevant. The inflation expectations of households and companies can thus be more volatile with an optimal index than if the target refers to a better known and accepted measure.

It can also be difficult to explain how an optimal index fits into the Riksbank's mandate. According to the Riksbank's mandate, the Riksbank shall maintain price stability. Stabilising the theoretically optimal index probably means other broader inflation indices becoming more volatile, which can be problematic.

Arguments for stabilising "underlying inflation"

According to the traditional view, as it is presented above, the central bank shall stabilise the rate of increase in a broad price index, while New Keynesian theory advocates stabilising a narrower index. In the debate, arguments are also expressed in favour of the central bank stabilising an index that disregards price fluctuations that are more temporary in nature, or price changes that are less influenced by monetary policy, such as import prices and prices that are strongly weather-dependent.

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3 For more information about New Keynesian theory and models, see Gali (2015) and Woodford (2003).

4 See e.g. Mankiw and Reis (2003).

5 Two of the Riksbank's measures of underlying inflation, UND24 and persistence-weighted measures, could however be interpreted as a form of theoretically optimal index, even though they are rather devised to distinguish a general, trending price increase from a temporary one, see Annex 1. To our knowledge, Atlanta Fed's "Sticky-Price CPI" for the US is the only attempt to calculate an optimal index that is regularly updated and published, see https://www.frbatlanta.org/research/inflationproject/stickyprice/. Eusepi et al. (2011) also devise an optimal index for the US and find that there are welfare gains in stabilising the index compared with other indices for underlying inflation.

"Monetary policy shall disregard temporary price movements"

The usual reason for allowing the target to refer to "underlying" or trend inflation is the desire to focus on a general, trending price rise, and disregard temporary price increases.[6] If monetary policy reacts to temporary price fluctuations, this could give unnecessary volatility in interest rates and the real economy. However, this does not necessarily mean that the central bank' target variable has to be an inflation measure that only measures trend inflation.

Monetary policy acts with a lag and cannot influence current inflation. It must therefore be forward-looking and based on forecasts for e.g. inflation. When monetary policy is forward-looking, it therefore automatically disregards current temporary price fluctuations. It only reacts to effects that will also remain in the future. Thus, it does not matter if the central bank focuses on stabilising a broad inflation measure or measures that exclude temporary price fluctuations. The forecasts for all of these measures will be similar in the longer run. For example, an increase in the oil price today will give a temporary increase in the rate of inflation for 12 months ahead (because inflation is measured as 12-month changes). But that in itself will not affect monetary policy as long as the latter focuses on inflation longer than 12 months ahead. This is the reason why central banks mainly use measures that purge temporary price changes for describing outcomes, not for guiding monetary policy.[7] Rising oil prices can also have more long-term effects if they lead producers of goods and services to increase their prices as a result of the rise in the oil price. These more long-term effects of oil price increases will affect the forecasts for inflation measured using a broad index, and measures that exclude temporary price changes beyond the first year, and can therefore affect forward-looking monetary policy.

It is a different situation if monetary policy is not forward-looking, but based on current inflation, for example through a policy rule in which monetary policy today is set as a function of current inflation (through, for example, a "Taylor rule"). In that case, it might be better to focus on a measure purged of temporary price fluctuations.[8]

However, temporary price changes can also occur in the future. If these are unexpected, forward-looking monetary policy automatically disregards these too. But, they can also be expected. Assume, for example, that it is known that in a year's time, a VAT or tax increase will emerge that will directly increase inflation for a certain period of time, but which will not subsequently have any direct effects. In that case, there would be an expected temporary price increase. However, it seems reasonable that the VAT increase does not only have direct price effects but also could subdue aggregate demand and output, which may have more direct effects on inflation. But with flexible inflation targeting, in which the horizon for when the inflation target is to reached is allowed to vary, the central bank can choose to allow the forecast for inflation to overshoot the target in those periods in which the price increase is expected to have direct effects on inflation, and to focus on stabilising any long-term effects of the temporary price increase independently of whether the target is defined in terms of a broad index or a measure that excludes temporary price fluctuations.

Rationale similar to that in the example above regarding a VAT or tax hike could be expressed for other one-off changes too, such as an increase in energy prices as a result of a rise in the oil price. The rationale will of course be entirely parallel for VAT cuts or other one-off changes that drive down inflation during a limited period.

It might be difficult to devise an index that excludes all temporary price changes robustly. Usually, such indexes are devised by purging prices that have previously exhibited great volatility. This method presents two potential problems. First, temporary index movements can be perceived as permanent: if the index rises due to a temporary increase in a historically

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6 See e.g. Bryan and Cecchetti (1993), Mishkin (2007a) and Blinder (1997).
7 See e.g. Nessén and Söderström (2001) for a formal analysis.
8 Bryan and Cecchetti (1993), Mishkin (2007b) and Eusepi et al. (2011).

stable price, the index will rise, even though the price movement is temporary. Second, permanent index movements can be perceived as temporary: if a price that has historically exhibited many temporary price movements now starts to change more towards a trend, the index will not capture this because the price is not included in the index or has a low weight in the index. These measures are therefore not used mechanically. Rather, as described above, the Riksbank uses the forecast for broad inflation measures to manage temporary movements.

An alternative to indices from which certain goods and services are permanently excluded are "trimmed" inflation measures. Here, the CPI is "trimmed" by excluding the prices that have changed the most since the last date(s) of observation. Such measures can also be associated with the problems described above; temporary price changes can be perceived as permanent, and permanent price changes can be perceived as temporary.

In the same way as communication is difficult if the target refers to a theoretically optimal index, it can also be difficult if the target refers to an index that is purged of non-permanent price changes. It can be complicated to explain what the underlying index measures, and why it is the relevant target variable. Similarly, it can be difficult to explain how an inflation target defined in terms of an underlying index fits into the Riksbank's mandate.

"Monetary policy shall disregard prices it cannot influence"

The global market price for petrol, diesel, food and several other products included in the CPI are not affected by Swedish monetary policy. The same largely applies to the price of electricity and some other goods and services that are strongly weather-dependent. Does that mean that the price index that monetary policy attempts to stabilise should exclude such prices?[9] The question on which we mainly focus is whether monetary policy should concentrate on only stabilising domestic inflation.

There are no simple answers to this. Different effects and arguments diverge.[10] This is also reflected in the research-based literature, in which the answer depends on the analytical methods employed and the assumptions made.[11] In practice, it has also proven difficult to distinguish between domestic and imported inflation, and hence also difficult to devise an index for domestic inflation in practice. One problem is that certain goods during the year are produced domestically in certain periods, and imported in others. Another problem is that all goods and services, irrespective of the degree of their imported content, are sold on the Swedish market and are hence affected by Swedish salaries, transport costs, etc. A large part of the final consumer price can thereby be determined by circumstances other than the import price of the product. In addition, the prices of many domestic products are set on the global market, despite them being produced in Sweden; i.e. also domestically produced goods are determined by factors abroad.

The Riksbank used to analyse sub-indexes for primarily domestically produced products (UNDINHX) and in mainly imported goods (UNDIMPX). Production of these series was terminated in 2007, however, when problems relating to the domestic/imported breakdown became increasingly evident.[12]

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9 Alan Blinder (1997) writes the following, for example: "As a central banker, I always preferred to view the inflation rate with its food and energy components removed as our basic goal. But not because these components are extremely volatile. (…) The real reason was that the prices of food (really, food at home) and energy are, for the most part, beyond the control of the central bank. The Fed cannot do much about food and energy prices – except, of course, to cause a recession deep enough to ensure that increases in these prices do not lead to overall inflation."

10 See, for example, Svensson (2005).

11 For example, Galí and Monacelli (2005) and Benigno and Benigno (2006) assume that the exchange rate reacts endogenously to shocks and corrects for "errors" in the relative price between domestic production and imports. Hence, the central bank shall stabilise domestic inflation. However, the conclusion depends on the exchange rate reacting in such a way that exchange rate fluctuations take full effect on import prices in domestic currency, and that salaries are fully flexible (Campolmi, 2014). See also Adolfson (2007) and also Bean (2006).

12 See Hansson and Johansson (2007).

An alternative measure of domestic inflation is the GDP deflator. This measure prices of all domestically produced goods and services. A problem with this measure is that it is only produced on a quarterly basis and is also revised a lot retroactively. Also, export prices are included in the GDP deflator.

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Annex 2 – Price indices and housing costs

Principle issues and alternative calculations

In this annex, we look at 3 questions in more detail:[1]

1. How can/should owner-occupied housing costs be treated in the price index used as the target index for monetary policy?

2. How are owner-occupied housing costs treated in the CPI, CPIF and HICP?

3. What would the development in the CPIF and HICP look like using alternative calculation methods?

The owner-occupied housing item in the CPI is a controversial and difficult area that has been examined many times in Sweden and other countries. In this annex, we highlight more principle issues that are of relevance to the choice of index for the inflation target.

In the annex, the definition of "owner-occupied housing" will deviate slightly from its definition in the CPI/CPIF. In the CPI, owner-occupied housing is defined as single-family dwellings with right of ownership. Tenant-owned homes are not included in the definition of owner-occupied housing in the CPI, see below. In this annex, the term "owner-occupied housing" will refer to single-family dwellings with right of ownership <u>and</u> tenant-owned homes (houses and apartments). In the same way, we allow the term "housing prices" to refer to the prices of single-family dwellings with right of ownership <u>and</u> tenant-owned homes (houses and apartments).[2]

How can/should owner-occupied housing costs be treated in the target index?

Should housing costs be included in the target index?
The original theory behind inflation targeting may speak in favour of including owner-occupied housing costs in the target index. Two circumstances leads to this. First, this theory prescribes that the target index should be broad and relevant to households and companies (see Annex 1). Second, housing costs make up a substantial part of the budget of most households (around 25 per cent according to the weight in the CPI), and a large proportion of consumers in Sweden own their homes. If the index is to be broad and relevant, housing costs for owner-occupiers must be captured in the index. The question is which owner-occupied housing costs are to be included.

In a strict economic sense, the total housing costs for owner-occupiers include on the other hand the amounts from which they refrain in interest on equity. This expense depends both on the interest rate level and on housing prices (the market value of the capital invested). This can be an argument for including both interest and housing prices in the index.

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1 This annex is based on Annex 2 in Apel, Armelius and Claussen (2016).
2 The issues of principle discussed in this annex concern the costs for owner-occupied housing in general, and not just single-family dwellings with right of ownership.

Related to this, one can think of examples where monetary policy becomes unnecessarily volatile and contributes to housing price increases unless housing prices are included in the owner-occupied housing costs. Assume, for example, that a general productivity improvement takes place in the economy and/or the price of goods and services that are consumed domestically does not rise as quickly as the inflation target, while at the same time wages grow at an even rate. Consumers may then have a higher real income, and it is probable that part of the increased real income is spent on housing. The price of housing consumption might consequently rise because rents increase (if rents are freely set) and housing prices rise. Rising housing prices lead to an increase in owner-occupied housing costs. If owner-occupied housing costs are not included in the index, inflation will, however, be lower than the inflation target and the central bank may conduct more expansionary monetary policy. This can then lead to even greater pressure on the housing market.

It could, on the other hand, be claimed that capital expenses for owner-occupied housing are not particularly "relevant" to households and companies. If housing prices rise, it does not mean that day-to-day expenses increase for households who continue to live in their home. The households can continue to refrain from the alternative return and continue to consume to the same extent as before.

A relevant question in this context is also whether a central bank with an inflation target is to stabilise living costs or prices. For more on this discussion, see for example SOU (1999) and the National Institute of Economic Research (2002).

Based on New Keynesian theory (see Annex 1), it may be argued that capital-related housing costs could be excluded if these are very flexible. Other parts of owner-occupied housing costs, such as the cost of refuse collection, maintenance, etc. that can be more sticky, should be included in the index. This is also in line with how the HICP is currently calculated, with only day-to-day operating expenses being included. However, capital-related expenses are also included in the CPI/CPIF and housing prices play a certain part. The effect of housing prices on the measure is discussed in more depth in section 2.

How can owner-occupied housing costs be measured?

Measuring owner-occupied housing costs is difficult. While the price of a home might be known, the price of housing services generated by the home are difficult to measure. The problems are the same as for all durable goods, i.e. goods acquired at a certain point in time, but which generate services for a lengthy subsequent period, e.g. a tablet computer or bicycle. A substantial difference, however, is that the value of a home often appreciates over time, while a tablet computer or bicycle commonly depreciates in value.

There are primarily four different ways of measuring owner-occupied housing costs. All of them have their limitations.

Equivalent rent

When a household rents its home, the price of a month's housing services is clear – it amounts, quite simply, to the rent paid by the household to the landlord. In this case, the household purchases a service like basically any other. If the household owns its home, however, there is no equivalent money transaction and therefore no observable price that can form the basis of an index calculation.

One possibility to estimate the price of one month's housing service in an owner-occupied home is if, parallel to the market on which such homes are bought and sold, there is also a rental market for the equivalent type of home. An approximation of owner-occupied housing costs could then be obtained using the monthly rent for a comparable home. However, there are certain reasons for why such a procedure might prove problematic.

One reason is that the rental market, unlike the market for owner-occupied and tenant-owned homes, can be strictly regulated. The rents paid are not representative of the owner-

occupier's expenses in general. Another reason is that the market for owner-occupied homes and the rental markets can fundamentally be perceived to be two entirely different markets, and parallels between them will therefore be misleading.

In Sweden, the rental market is strictly regulated. For single-family dwellings, the conclusion has previously been that the rental market is too small to obtain reliable data.[3]

Alternative cost approach

Instead of the equivalent rent approach, an alternative cost approach is perceivable, which takes account of the financial considerations that would be made on a rental market for owner-occupied and tenant-owned homes.

In order for letting a home to be an attractive alternative, the rent must cover the return that the owner could have obtained if the capital had been invested elsewhere, as well as compensation for operating costs and wear and tear on the home. If the owner also expects the home, over the rental period, to decline in price, this must also be covered by the rent. If instead an increase in value is expected, the rent does not need to be as high as would otherwise be the case. The following equation can thus be seen as a parallel to the equivalent rent approach, whereby instead of observing the rent, an attempt is made to indirectly calculate it.

$$K_t = P_t [r_t - p_t + q_t]$$

K_t K_t = Capital cost in period t

P_t = Price of the home in period t

r_t = Interest in period t

p_t = The (expected) price change of the home as a percentage, i.e. $(P_{t+1} - P_t) / P_t$

q_t = Expenses for wear and tear, taxes, insurance and charges (water, electricity, refuse, etc.) in period t as a proportion of housing price P_t

The approach is called the alternative cost approach[4] as the expression above reflects the (alternative) cost for the homeowner to live in the home him/herself compared with the alternative strategy of investing the capital represented by the home elsewhere.

A challenge in this approach is determining which interest rate and housing price change should be used. In the Swedish CPI, a partial version of this approach is used, where $p_t = 0$. In the CPIF, r_t is also set equal to a constant. We come back to the CPI and CPIF below.

Net acquisition approach

In a net acquisition approach, expenses are measured in the same way as for a litre of milk, i.e. by monitoring the development of housing prices. Often only the price of newly constructed homes is covered, and land prices are often excluded. The coverage is limited by definition.

Operating costs only

Capital costs can also be omitted, and only operating costs, such as costs for water and sanitation, are measured. If we look at the equation above, this will be as if only $P_t q_t$, was included, i.e. a small part of the capital costs. Substantial parts of the capital costs are thus left out. This is how it is now done in the HICP.

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3 The subject has been raised several times in the CPI Board. The subject was recently brought up in connection with the discussion on tenant-owned homes at Meeting 251.

4 The approach is also called the user cost approach or cost calculation.

Table A1 shows how a selection of inflation-targeting countries have opted to measure owner-occupied housing costs in their inflation measures.

Table A1. Methods for measuring owner-occupied housing costs in each country's main inflation measure

Country/region	Method
Sweden (single-family dwelling), Canada	Alternative cost approach
Sweden (tenant-owner homes), US, Japan, Norway	Equivalent rent approach
Australia, New Zealand	Net acquisition approach
Euro area (HICP), UK	Operating costs only

Source: Johansson (2015)

The CPI/CPIF and HICP treat owner-occupied housing costs in different ways

In the main group "Housing" in the Swedish CPI, there are three types of housing: rented home main (with right of tenancy), tenant-owned home and owner-occupied home (single-family dwelling).

The monthly cost for rented homes is measured as existing rents. For tenant-owned homes, an equivalent rent approach is used in which the monthly cost is measured by the monthly cost for rented homes. For owner-occupied housing (single-family dwellings with right of ownership – according to the CPI definition of owner-occupied housing), a so-called partial (alternative) cost approach is used: The index is a weighted average of a number of sub-indices, including the interest expenditure index and various indexes for depreciation, electricity and heating, water and housing-related services, municipal property charge, insurance, repairs and site leasehold fees. The method is "partial" because capital gains and capital losses (p_t in the equation above) are not included. In the CPIF, r_t is also set equal to a constant.

The significance of the three housing items in the CPI is indicated by Table A2, which shows their weighting figures in the CPI. As can be seen, the housing item makes up more than 25 per cent of the CPI in total. Owner-occupied housing according to our definition (tenant-owner homes and single-family dwellings) makes up almost 15 per cent of the CPI.

Table A2. The importance of the housing items in the CPI. Weighting figure as a percentage of the CPI.

	2000	2005	2010	2014	2016
Housing item	32.0	29.5	27.9	26.4	25.1
Rents	15.0	14.1	12.8	11.4	11.7
Of which tenant-owned homes	4.1	4.0	4.0	4.6	4.7
Owner-occupied housing item	11.8	9.2	9.7	9.2	8.0
Of which interest expenditure	6.9	5.6	6.2	5.7	4.2

Note. The owner-occupied housing item is defined here according to Statistics Sweden's definition and consists of single-family dwellings with right of ownership.
Source: Statistics Sweden

When we measure *inflation*, it is the *change* in housing costs that is of importance. Looking at the capital cost equation above, we obtain the following expression for the percentage change in the capital cost:

$$\frac{dK_t}{K_t} = \frac{dP_t}{P_t} + \frac{1}{[r_t - p_t + q_t]}[dr_t - dp_t + dq_t]$$

All elements are included in the CPI apart from dp_t which we can see as the change in the expected rate of price increase for housing. As already mentioned, however, there are at least two disadvantages of using the CPI as the target variable for monetary policy.

First, because interest rate adjustments (dr_t) are included, the CPI is very sensitive to changes in the interest rate as a large percentage of mortgages are taken out at flexible interest rates. This can be a problem from a monetary policy perspective even if it is theoretically correct to include interest expenditure in the index for housing costs. For monetary policy reasons, it may be better if interest expenditure does not have as great a direct effect on the CPI as it poses challenges in terms of communication, see Apel, Armelius and Claussen (2016).

Second, changes in housing prices (dP_t / P_t) are measured as changes in the so-called capital stock index. The capital stock index can be approximated to a 25-year moving average of the property price index.[5] Recent changes in housing prices thus have little significance for the CPI (and the CPIF) today. In the same way, expected changes in housing prices in, for example, two years' time are of little significance to the forecast for the CPI (and CPIF) two years ahead, and thereby are of little significance to a forward-looking monetary policy.

A third problem with the CPI (and the CPIF), which we have not discussed previously, could be that housing costs in tenant-owner homes are measured using the equivalent rent approach. Tenant-owner homes make up a substantial part of the stock of owner-occupied homes (according to our definition) and are bought and sold on a free market in the same way as single-family dwellings with right of ownership. In principle, it is difficult to see why these two types of housing are not treated in more or less the same way in the CPI. Whether a change would give clear differences in the index is an empirical question that is beyond the scope of this discussion.

Including dp_t, i.e. the change in the expected rate of price increase for housing, in the CPI could lead to the same monetary policy problems as with the interest rate: When the interest rate is cut and housing prices rise more than previously, homeowners obtain an (expected) capital gain which brings down the capital costs and hence inflation, i.e. an initial effect that "goes in the wrong direction".

A new approach for tenant-owned homes, similar to the one employed for single-family dwellings, is under consideration. No decision has been taken, but the aim is to implement the new method in 2017.[6] As far as we know, no discussions are taking place as regards changing the method to include housing price changes in the CPI.

In HICP, owner-occupied housing costs are omitted, except for day-to-day operating expenses. Therefore, neither interest rates nor housing prices are included in HICP. However, development work is in progress at, for instance, the European statistics agency, Eurostat, regarding an owner-occupied housing item in the HICP according to the "net acquisition

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5 The capital stock index shall measure the development of the housing stock valued at purchase price. The index is calculated as a weighted property price index, where the weighting consists of the number of housing units sold in different periods. A period of high turnover on the market gives a greater weight in the index. Changes in property prices affect the capital stock index with a significant time-lag and the development can be approximated rather well using a 25-year moving average of Statistics Sweden's property price index for single-family dwellings.
6 Statistics Sweden (2016).

approach". According to the method, the price progression of the capital component of owner-occupied homes shall largely track prices of new owner-occupied homes. The term "new" owner-occupied homes refers to homes that are new to the household sector, and not just newly constructed ones, and "net" in this context refers to the fact that any owner-occupied homes exiting the household sector are to be excluded.[7] Tenant-owner homes shall be included together with owner-occupied homes. In addition, certain other costs are added that relate to the purchase of the home such as estate agent fees, stamp duty and mortgage deeds, as well as costs for major repairs, maintenance and insurance.

Whether the net acquisition approach (HICP) or an improved cost calculation (CPI/CPIF) is preferable when selecting the index to which the inflation target should refer is an open-ended question. Where Sweden is concerned, it might however be relevant to take a closer look at whether this gives substantial differences in the figures.

The CPI/CPIF and HICP using alternative calculation methods

To illustrate how alternative ways of measuring owner-occupied housing costs might impact existing indices, we have produced a few example calculations in Table A3.

The example calculations indicate that CPIF inflation would have been higher if the cost of living in a tenant-owned apartment was calculated in accordance with the definition of an owner-occupied home used in this annex (seventh row in Table A3). This is also the definition that is now under consideration (Statistics Sweden, 2016).

Furthermore, the example calculations indicate that CPIF inflation would have been higher if the current property price development had had a greater impact on the capital stock in the CPI. For example, CPIF inflation in March 2016 would have been 2 per cent if the existing capital stock for owner-occupied housing had been replaced with the current property price development and tenant-owned homes had been treated the same as single-family dwellings (last row in Table 3).

Table A4 shows the development in important variables included in Table A3.

Conclusions

There are no simple answers for how owner-occupied housing costs should be included in the target index. However, in numerical terms, there is no great difference betwen the CPIF and HICP. Differences from the CPI are greater as the interest rate has a major effect on capital costs as they are measured in the CPI.

The changes in the definitions that are currently under consideration may lead to the differences between the CPIF and HICP becoming marginally greater.

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7 Rented apartments converted to tenant-owned apartments form an example of "new" owner-occupied homes that are not newly constructed.

Table A3. Example calculations using alternative ways of measuring owner-occupied housing* costs

Inflation according to different related measures	1996-2015	2015	Mar 2016
CPI excl. housing (owner-occupied & rents)	1.17	0.53	1.05
CPI excl. owner-occupied	1.29	0.64	1.17
HICP	1.43	0.70	1.21
CPI with rent equivalence[1]	1.36	0.70	1.15
CPIF	1.48	0.86	1.50
CPIF with cost approach for tenant-owned[2]	1.54	0.95	1.63
CPI with net acquisition approach[3]	1.66	0.75	1.58
CPIF, FPI[4] for owner-occupied[5]	1.62	1.12	1.82
CPIF, FPI for owner-occupied and tenant-owned[6]	1.71	1.34	1.99

* Existing CPI definition of "owner-occupied housing", that is single-family dwellings with right of ownership.

1. It is not possible to apply an accurate equivalent rent approach in Sweden as the rental market is regulated. In this measure, both the rent and owner-occupied housing items are approximated using the rent change in the CPI.

2. Calculated values. Currently, tenant-owned homes are approximated using the rent change in the CPI and CPIF, with a proposal for calculating tenant-owned homes in the same way as owner-occupied housing (using a cost approach) being under consideration (Statistics Sweden, 2016).

3. Calculated values. A net acquisition approach for owner-occupied housing has been discussed by Eurostat for several years with the aim of implementing the approach in the HICP.

4. Property price index.

5. In this calculation, the capital stock for owner-occupied housing has been replaced with the current property price development.

6. In this calculation, the capital stock for owner-occupied housing and tenant-owned homes has been replaced with the current property price development.

Table A4. Price development for related variables

Price development for related variables	1996–2015	2015	Mar 2016
Rent	2.01	1.48	0.91
Interest expenditure owner-occupied	-1.49	-16.65	-13.70
Interest rates owner-occupied	-5.62	-20.87	-18.34
Capital stock owner-occupied	4.31	5.39	5.68
Capital stock tenant-owned	6.41	8.56	9.71
Property price index owner-occupied	6.64	10.73	13.06
Property price index tenant-owned	8.70	18.28	13.84

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Annex 3 – Long-term differences between the rate of increase in the CPI, CPIF and HICP

The differences between the CPI/CPIF and the EU-harmonised price index, the HICP are described below. First, how the measures differ as regards calculation method and coverage are described. And then we look at how the rates of increase in the measures have differed historically and how they can be expected to differ in the future.

Summary

- There are differences between the HICP and the CPI/CPIF as regards both calculation method and coverage.
  - The calculation method differs in that the CPI/CPIF is affected by weight changes to a greater extent than the HICP.
  - The most important difference in coverage is that the HICP does not include owner-occupied housing costs.
- All in all, the rate of increase in the CPI and CPIF exceeds the rate of increase in the HICP by just under 0.1 percentage points in the long term.
- In addition, the rate of increase in the CPI will exceed the rate of increase in the CPIF by just over 0.1 percentage points, calculated as an average over long periods. Across economic cycles, when the interest rate varies around a certain level, the CPI will increase more rapidly than the CPIF on average, as the percentage change of a rate rise will be greater than the percentage change of a rate cut.

Differences in calculation method and coverage between the CPI, CPIF and HICP

Theoretical basis and index formula

The theoretical basis of the CPI (and implicitly the CPIF) and the HICP differs. The CPI is linked to the economic theory for the **cost-of-living index**. The CPI intends to measure the impact of price changes on household expenditure in order to maintain a constant consumption standard. The CPI and CPIF are therefore calculated using an index construction that tries to approximate consumers' adaptability to relative price changes (see Appendix for a description). The CPI is calculated and published by Statistics Sweden. The CPIF is calculated and published by Statistics Sweden on behalf of the Riksbank.

The HICP is calculated using a **fixed basket** during the year. The starting-point is that the index should measure "pure" price changes for current transactions. The rate of increase in the HICP should not be affected by consumers changing their behaviour when adapting their consumption to relative price changes. This means that the HICP aims instead to follow the price development for a constant consumption structure during the year.[1] On the most detailed index level in the HICP, however, an index formula is used that approximates the behaviour of consumers when they substitute relatively more expensive goods for cheaper versions. It is the same index formula that is used in the CPI and CPIF. The HICP is also

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1 Constant (or fixed) basket means that the basket does not change during the year. The consumption basket is updated in January every year. New goods can be added some years and outdated ones removed. Furthermore, the weights of existing goods are updated.

calculated by Statistics Sweden but the calculation methods are regulated in EU regulations that apply to all member states' HICP calculations.

The fact that the CPI is based on the cost-of-living index theory and the HICP on the fixed basket index can be justified based on the objectives and purposes formulated for the measures. The different starting-points have implications both for the choice of index construction and for which products are to be included in the measure.

The difference in the index constructions is clarified in connection with Statistics Sweden's annual report on the "basket effect" in January. On average, this difference has been just over –0.15 percentage points per year since 1996, i.e. the basket effect has, on average, contributed to lower inflation since consumers tend to consume less of the goods and services that have become relatively more expensive, and that therefore can be given a smaller weight, and more of the goods and services that have become relatively cheaper, and that can hence be given a greater weight (see Chart A1).

Chart A1. Basket effect
Percentage points
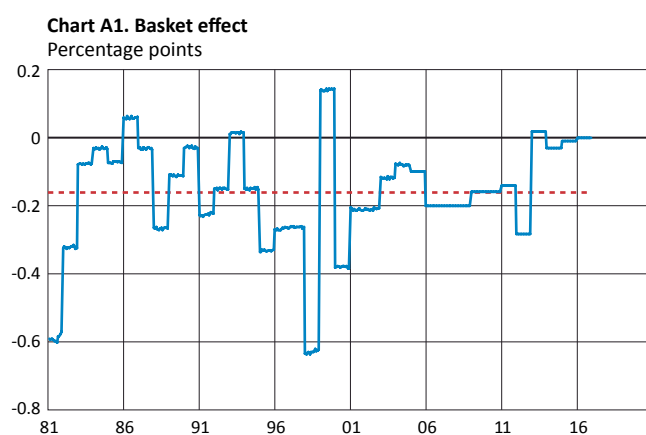
Note. Broken lines show averages since 1981.
Source: Statistics Sweden

Prior to 2005, Swedish inflation was calculated excluding the basket effect. Statistics Sweden then presented two different measures of the annual percentage change in the CPI, one of which was called the inflation rate and excluded the effect of updated composition of the goods basket. The Swedish inflation rate was at that time calculated using approximately the same method as in the HICP. In connection with the introduction of a new index construction in 2005, a decision was taken in the Consumer Price Index Board to end this distinction between the inflation rate and the annual percentage change in the CPI.[2] The difference between the annual percentage change in the CPI and what was called the inflation rate amounted on average to –0.18 percentage points between 1981 and 2004 and to an average of –0.23 percentage points between 1995 and 2014. Riksbank forecasts were made as from the second inflation report in 2004 (May) on the CPI according to the new calculation methods. The change had no decisive impact on the monetary policy decision made in conjunction with the publication of this report.[3]

Coverage

The coverage of products differs between the HICP and the CPI/CPIF. The most important differences are that households' owner-occupied housing costs are included in the CPI but not in the HICP. The reason why the coverage differs is an interpretation of the guiding

2 See the article "Changes in the methods for calculating the inflation rate" in Inflation Report 2004:2. See also the CPI Inquiry, SOU 1999:124, Section 9.2.2 and the Statistics Sweden memorandum "Improved CPI construction from January 2005: Technical description".
3 See the press release from the Riksbank "Repo rate unchanged at 2 per cent", 28 May 2004.

principle for the HICP; to only follow the price progression in current transactions.[4] This means that historical prices and calculated/imputed items of various kinds are not included in the HICP. The consequence of this view is above all a significantly smaller housing item in the HICP compared with the CPI/CPIF.

The following items are included in the CPI/CPIF but not in the HICP (weights in the CPI/CPIF 2016 in brackets):

- Interest expenditure (4.2 per cent)
- Depreciation (2.2 per cent)
- Property tax (0.7 per cent)
- House insurance (0.4 per cent)
- Tenant-owned homes (4.7 per cent)[5]
- Lotteries, etc. (1.2 per cent)

The following items are included in the HICP but not in the CPI/CPIF (weights in the HICP 2016 in brackets):

- Elderly care (0.8 per cent)
- Hospital care (0.1 per cent)
- Fund services (1.4 per cent)

Interest expenditure index and difference between the CPI and CPIF

The interest expenditure index in the CPI is affected by how mortgage rates change, and also by how the value of the properties financed by the mortgages changes, in accordance with the following simplified formula:

*Interest expenditure index = Capital stock index × Interest rate index*

The difference between the CPI and CPIF is that the interest rate index is kept constant in the CPIF when calculating the interest expenditure index. The weight for interest expenditure is the same in the CPI and the CPIF but the interest expenditure in the CPIF is only affected by how the capital stock index develops. **The capital stock index** shall measure the development of the housing stock valued at purchase price. The index is calculated as a weighted property price index, where the weighting consists of the number of housing units sold in different periods. A period of high turnover on the market gives a greater weight in the index. Changes in property prices affect the capital stock index with a significant time-lag and the development can be approximated rather well using a 25-year moving average of Statistics Sweden's property price index for single-family dwellings. *The **interest rate index** measures the progression of the average interest rate for mortgages with the floating rate and interest rates with fixation periods of one, two, three, five and eight years.

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4 When the basis of the HICP was determined, it was established that "It should encompass only market transactions; i.e., imputations such as user costs or imputed rental prices for owner occupied housing would not be included", "It should not include interest rates or interest costs since such costs are neither a good or a service but the instrument for balancing the supply and demand of money" and "The index should treat owner occupied housing in one of two ways: either exclude owner occupied housing from the index or to include new purchases of dwelling units, essentially treating purchases of new dwelling units like any other purchase of a consumer durable." See p. 39 ff in Diewert, Erwin (2002), Harmonized Indexes of Consumer Prices: Their Conceptual Foundations, ECB Working Paper No. 130.

5 Living in a tenant-owned home does not have its own price measurement in the CPI but is instead calculated as imputed rent, in accordance with an "equivalent rent approach".

Historical differences in the rate of increase between the various inflation measures

Table A5 and Chart A2 show how the rates of increase in the measures have related to each other since 1996. The average rate of increase in the CPI is lowest since mortgage rates have on average fallen during this period. Rising housing prices have caused the capital stock to rise relatively quickly, by 4.3 per cent on average over the period 1996-March 2016. This has maintained the rate of increase in the CPIF in relation to the rate of increase in the HICP and more than countered the effect of the annual revision of weights, which has kept down the rate of increase in the CPIF in relation to the rate of increase in the HICP. The difference in rate of increase between the CPIF and the HICP is therefore very small.

Chart A2. CPI, CPIF och HICP
Annual percentage change
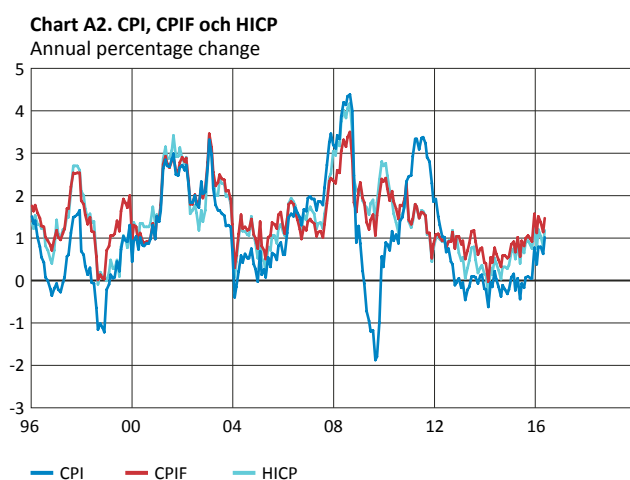
CPI   CPIF   HICP

Source: Statistics Sweden

Table A5. Average annual rate of increase in the CPI, CPIF and HICP, January 1996 to March 2016

|	
CPI	1.04
- of which the interest rate index	-5.79
- of which the capital stock index	4.33
CPIF	1.48
HICP	1.42

Source: Statistics Sweden

What differences in the rate of increase can we expect in the short and long term?

Assumptions

As a result of differences in calculation formulae and coverage, we should expect the rate of increase in the various inflation measures to continue to differ even in the future. This can be illustrated using a few example calculations. However, the size of the long-term differences between the rate of increase in the CPI, CPIF and HICP is sensitive to the various assumptions, for example about how mortgage rates and housing prices will develop.

First, it is assumed that the weight for interest expenditure in the CPI will increase from its current 4.2 per cent to about 10 per cent in the long term. As a major difference between the various inflation measures is how interest expenditure for owner-occupiers is treated, this assumption will govern the result. If the weight is greater, the difference between the measures will also be greater. The weight has, on average, been 6.8 per cent since 1980,

6 per cent since 1995 and 5.2 per cent since 2000 (see Chart A3). Given that housing prices and lending to households has gradually increased over the past twenty years, we can expect that the weight in the CPI will be higher than its average when interest rate levels rise. If we assume that a long-term mortgage rate is 6 per cent, the interest expenditure weight in the CPI is expected to increase to around 10 per cent in the long term.[6] The assumption of a long-term mortgage rate of 6 per cent is consistent with a repo rate of 4 per cent in the long term. If households change their behaviour and reduce their debts, the weight for interest expenditure will be lower and the difference between the rate of increase in the measures will be less. On the other hand, if household debt continued to rise more rapidly than household income, the weight and difference would be greater. There is, however, a discussion about the fall in the level of the "natural interest rate" and the interest rate level could therefore be lower than this long-term assumption for a long time to come. Then as well, would the weight for interest expenditure be lower.

Chart A3. Weight for interest expenditure in the CPI
Per cent
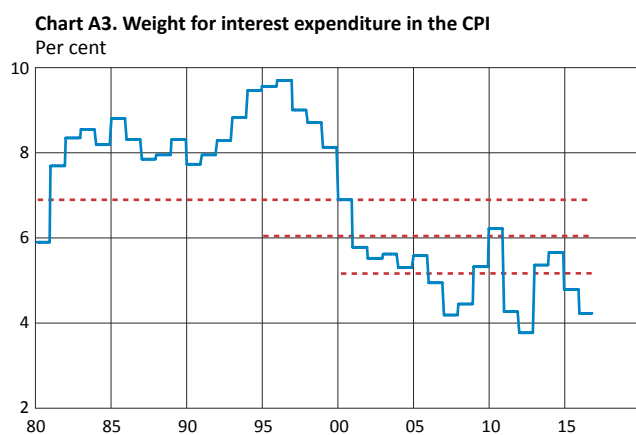
Note. Broken lines show averages since 1980, 1995 and 2000 respectively.
Source: Statistics Sweden

Second, **housing prices** are assumed to increase by 4 per cent in the long term. Behind this assessment is the assumption that housing prices increase at the same rate as household income in the long term. This is a common assumption in the models used at the Riksbank and other places. This is assumed to lead to the capital stock index also increasing by 4 per cent in the long term, which is probably an underestimation. The capital stock index is to measure the purchase price of the stock of single-family dwellings. In addition to the price development of existing dwellings, the stock is also affected by the addition of new ones and the removal of old ones. Given that the population and construction increase and that the price development is higher for new builds compared with condemned houses in the stock, we can expect the value of the capital stock to increase somewhat more quickly than housing prices in the long term. A higher rate of increase in housing prices and the capital stock would increase the rate of increase in the CPI/CPIF in relation to the rate of increase in the HICP. This would happen both as a result of a higher rate of increase in the capital stock index and as a result of a higher weight for interest expenditure in the CPI/CPIF.

The last important assumption is that **the basket effect** will continue in the period ahead to hold back the rate of increase in the CPI/CPIF by 0.15 percentage points per year.[7]

6 Given the current level of household indebtedness and the current value of the housing stock in relation to total private consumption, the weight in the CPI can be estimated at about 9.4 per cent (0.0424 x 0.06 / 0.027), where 0.042 is the weight for interest expenditure in 2016, 0.06 is an assumed long-term mortgage rate of 6 per cent and 0.027 is the average mortgage rate that forms the basis of the weight calculations in 2016. The capital stock is assumed to increase more rapidly than nominal consumption in the coming years, which means a certain further increase in the interest expenditure weight.

7 Some of the basket effect depends on the interest expenditure weight. And, as a result, some of it depends on a substitution effect between mortgage rates with different maturities. This effect has an impact on the CPI, but not the CPIF. On average over a longer period of time, the difference in the basket effect between the CPI and CPIF seems to be small.

Modified calculation methods in the HICP and the CPI/CPIF can affect the rate of increase in the measures

Behind the calculations is also the assumption that the calculation methods and coverage in the CPI and HICP look the same in the future as they do now. There is a discussion in the EU about starting to measure owner-occupied housing costs in the HICP using a net acquisition approach. The method involves the inclusion of the price progression for newly-built housing in the index. This would probably lead to a higher rate of increase in the HICP since property prices normal rise more quickly than other consumer prices. The differences in rate of increase would therefore be smaller between the CPI/CPIF and the HICP.

At the same time, there are two changes imminent in Sweden that will change how housing costs are measures in the CPI and CPIF. Firstly, a discussion is underway on calculating the costs of living in tenant-owned homes using a cost approach similar to the one used for owner-occupied housing. Secondly, it has been decided that tax relief on interest expenditure is to be included in the CPI as of 2017, so that household interest expenditure is measured after tax. Calculations indicate that the weight for interest expenditure in the CPI and CPIF would increase by just over 40 per cent if tenant-owned homes were included. Including the tax relief on interest expenditure in the CPI simultaneously reduces the interest weight (for owner-occupied and tenant-owned homes) by 30 per cent. Both these method changes are included in the inflation forecast as from the July 2016 Monetary Policy Report.

Differences in the short term (within the next 5 years)

In May 2016, the inflation rate measured by the CPIF was just over 0.3 percentage points higher than measured by the HICP. The principal reason for this was that the basket effect was close to zero this year and that lower tax deductions for ROT services (repairs, conversions and extensions in private homes) pushed up the CPIF but not the HICP. Over *the next five years*, repo rate increases are expected to cause the CPI to rise much more rapidly than the CPIF and HICP. At the same time, the sticky capital stock index will continue to increase by just over 6 per cent a year. If the annual weight effect is as normal and the general price development excluding owner-occupied housing costs increases by about 2 per cent, we can expect the rate of increase in the CPIF to be slightly higher than the rate of increase in the HICP.

Differences in the medium term (in about 10 years)

Given that repo rate increases have stopped and have remained unchanged at 4 per cent for five years, the annual rate of increase in the CPI in ten years is expected to be about the same as the rate of increase in the CPIF. If the rate of increase in property prices slows down and stabilises at 4 per cent as early as from today, the capital stock index will still continue to increase by about 5.5 per cent in 10 years' time. The rate of increase in the CPI and CPIF will then exceed the rate of increase in the HICP by about 0.2 percentage points.[8]

Differences in the long term (in about 25 years)

Assuming that the repo rate has stabilised in the long term, the rate of increase in the CPI and CPIF will be exactly the same. Property prices increase by 4 per cent and the capital stock index will rise by 4 per cent. The rate of increase in the CPI and CPIF will then exceed the rate of increase in the HICP by about 0.05 percentage points.[9]

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8 If the weight for interest expenditure in the CPI is 0.1 and the basket effect is −0.15 percentage points, an HICP inflation rate of 2 per cent will mean a CPIF inflation rate of $(1 − 0.1) \times 2 + 0.1 \times 5.5 − 0.15 = 2.2$ per cent.

9 If the weight for interest expenditure in the CPI is 0.1 and the basket effect is −0.15 percentage points, an HICP inflation rate of 2 per cent will mean a CPIF inflation rate of $(1 − 0.1) \times 2 + 0.1 \times 4 − 0.15 = 2.05$ per cent, i.e. about the same as HICP inflation.

Differences as well in the average rate of increase between the CPI and CPIF over long periods

A difference may also occur between the CPI and CPIF in the average reported rate of increase over long periods. In a long-term equilibrium, when the interest rate is stable for a longer time, the CPI and the CPIF will increase at exactly the same rate. Across economic cycles, however, when the interest rate varies around a certain level, the CPI will increase more rapidly than the CPIF, as the percentage change of a rate rise will be greater than the percentage change of a rate cut. In an example calculation where the repo rate over economic cycles varies around 4 per cent, between 2 per cent and 6 per cent, the annual rate of increase in the interest rate index will on average be about 1.5 per cent.[10] If we assume a weight in the CPI for interest expenditure of 10 per cent in the long term, the rate expenditure in the CPI will then be about 0.15 percentage points (1.5 × 0.10) higher than the rate of increase in the CPIF on average over long periods.[11]

Overall assessment of long-term differences between the measures

As a result of different calculation methods and differences in coverage, a rate of increase in the HICP of 2 per cent in a long-term equilibrium, when the repo rate level has stabilised, corresponds to a rate of increase in the CPI and CPIF of about 2.05 per cent, given the assumptions described above (see Table A6). On average over long periods and economic cycles, the CPI will, however, increase slightly more quickly at an average rate of increase in the CPIF of 2.05 per cent, as the percentage change in a rate rise is higher than the percentage change in a rate cut.

Table A6. Assessment of the rate of increase in a long-term equilibrium and on average over long periods at a rate of increase in the HICP of 2 per cent.

	In a long-term equilibrium	Average rate of increase over long periods
HICP	2.00	2.00
CPI	2.05	2.20
CPIF	2.05	2.05

Source: The Riksbank

Sensitivity for the assumptions

Table A7 shows how sensitive the calculation of the long-term difference between the measures is for various assumptions about housing prices and the weight for interest expenditure. In all the calculation alternatives, the basket effect is assumed to be –0.15. The most likely outcome is considered to be an increase in housing prices of 4 per cent and a weight for interest expenditure of about 10 per cent. In this case, the rate of increase in the CPI and CPIF is 0.05 percentage points higher than the rate of increase in the HICP. The assumptions about both the rise in housing prices and the weight for interest expenditure are important for the result. If, for example, the weight and the rate of increase amount to 8 and 2 per cent respectively, the converse will be true, i.e. the CPI and CPIF will increase more slowly than the HICP.

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10 The percentage change in the average mortgage rate is greater when the interest rate goes up from, say, 6 to 6.5 per cent than when the interest rate falls from 6.5 to 6 per cent (even if the change in percentage points is the same). Over an economic cycle, where the repo rate is raised as much as it is cut, the average percentage change in mortgage rates will therefore be greater than zero.

11 This calculation is dependent on the level around which the repo rate varies and how much the rate varies around this level. The lower the level of the repo rate, the greater the percentage changes.

Table A7. Rate of increase in the CPI and CPIF in the long term given an increase in the HICP of 2 per cent (annual percentage change).

		Weight for interest expenditure				
		4 per cent	6 per cent	8 per cent	10 per cent	12 per cent
Rate of increase in capital stock	2 per cent	1.85	1.85	1.85	1.85	1.85
	4 per cent	1.93	1.97	2.01	2.05	2.09
	6 per cent	2.01	2.09	2.17	2.25	2.33

Source: The Riksbank

Appendix

The main calculation formulae for the HICP and CPI are shown below. For a more detailed description, see, for example, Memorandum on the CPI's index construction or other up-to-date documentation on the Statistics Sweden website, e.g. SCBDOK.

The CPI/CPIF is calculated using an index construction that tries to approximate consumers' actual adaptation to relative price changes. The calculations include several index links that are based on information for household consumption in different periods (see Formula 6) Within each link, many sub-indices are calculated using information updated during the year, which means that the CPI goes through an "internal audit" every year to capture the substitution effect (see Formula 8). Inflation figures calculated from such an index are usually lower compared with inflation figures calculated from a basket that has been fixed during the year, such as the HICP.

When an initial index is calculated based on the CPI/F and the HICP, the same fundamental index formula is used. Examples can include indices for apples, laptop computers or gym cards. At this level of aggregation, information is normally lacking on weights between different products and indices calculated as quotients of geometric means of prices in a current month and a base method, Jevon's index formula.

Jevon's index is deemed ideal for products with so-called unit elasticity, i.e. when the consumption quantity changes as much as the price change. The fundamental index formula used in both the CPI/F and HICP therefore approximates a "normal" substitution.

The index construction in the HICP

The HICP for November 2015 with base period 2005 = 100 is calculated by annual linking in accordance with:

(1) $I_{2005}^{2015,nov} = I_{2005}^{2005,dec} \cdot I_{2005,dec}^{2006,dec} \cdot \ldots \cdot I_{2014,dec}^{2015,nov} \cdot$

All index links apart from the first one are calculated in the same way, by weighing together the same index figures for sub-groups, g, as in:

(2) $I_{2014;dec}^{2015,nov} = \sum_{g} W_{2015;g} \cdot I_{2014;dec;g}^{2015,nov}$

The total runs over all g included in the HICP Weighting figures are in turn calculated thus:

(3) $W_{2015;g} = \dfrac{U_{2013;g} \cdot \dfrac{I_{2012;dec;g}^{2013,dec} \cdot I_{2013;dec;g}^{2014,dec}}{\dfrac{1}{12}\sum\limits_{m=1}^{12} I_{2012;dec;g}^{2013,m}}}{\sum\limits_{g'} U_{2013;g'} \cdot \dfrac{I_{2012;dec;g'}^{2013,dec} \cdot I_{2013;dec;g'}^{2014,dec}}{\dfrac{1}{12}\sum\limits_{m=1}^{12} I_{2012;dec;g'}^{2013,m}}}$

Here, $U_{2013;g}$ the consumption amount for the product group g during 2013 and the external total in the denominator runs over all product groups 'g' covered in the HICP.

The index construction in the CPI

The CPI for November 2015 with base period 1980 = 100 is calculated by annual linking in accordance with:

(4)
$$I_{1980}^{2015,nov} = I_{1980}^{1980,dec} \times I_{1980,dec}^{1981,dec} \times I_{1981,dec}^{1982,dec} \times \ldots$$
$$\ldots \times I_{2002,dec}^{2003,dec} \times I_{2003,dec}^{2004} \times I_{2004}^{2005} \times I_{2005}^{2006} \times \ldots I_{2012}^{2013} \times I_{2013}^{2015,nov}$$

Where the link I_{2012}^{2013} is calculated using an index formula according to Walsh and refers to the average price situation in 2012 to the average price situation in 2013 according to:

(5) $\quad I_{2012}^{2013} = W_g^{2013/2012} \sum_g I_{2012;g}^{2013}$

The total runs over all "g" that are included in the CPI and the weighting figures are calculated in accordance with:

(6) $\quad W_g^{2013/2012} = \dfrac{\sqrt{U_g^{2013} \cdot U_g^{2012} / I_{2012;g}^{2013}}}{\sum_{g'} \sqrt{U_{g'}^{2013} \cdot U_{g'}^{2012} / I_{2012;g'}^{2013}}}$

Where U_g is the consumption value in product group g in each year respectively. One can show mathematically that the aggregate (5) of these weighting figures gives Walsh index in the aggregation up to the CPI in total from the product group level. Correspondingly, the final link in the chain (4) is calculated as an aggregate of sub-indices for product groups as below;

(7) $\quad I_{2013}^{2015,nov} = W_g^{2013} \sum_g I_{2013;g}^{2015,nov}$

The weighting figures are calculated in a similar way to (6) but based on consumption values during 2013 and in accordance with Laspeyre's index formula. Calculation of the index $I_{2013;g}^{2015,nov}$ is made using the following formula where all index links are "revised" links apart from the last in the chain, $I_{2014,dec;g}^{2015,nov}$, which refers to the current period.

(8) $\quad I_{2013;g}^{2015,nov} = \dfrac{I_{2012,dec;g}^{2013,dec(rev)}}{\dfrac{1}{12} \sum_{m=1}^{12} I_{2012,dec;g}^{2013,m(rev)}} \cdot I_{2013,dec;g}^{2014,dec(rev)} \cdot I_{2014,dec;g}^{2015,nov}$