Owner-occupied housing in the consumer price index

An examination of
The CPI Investigation
Committee's proposal

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Introduction

In November 1999, the Committee set up to review the consumer price index (the CPI Committee) presented its report –Konsumentprisindex (The Consumer Price Index), SOU 1999:124 (in Swedish with English summary). The proposal which has attracted the greatest attention, and which has also received the most criticism, is the proposal involving the treatment of owner-occupied housing.

In April 2001, the government commissioned the Swedish National Institute of Economic Research to analyse the consequences of the proposed calculation of the owner-occupied housing item, and to suggest possibly changes to this proposal. The time allocated for this assignment was quite limited, and the result of the assignment reproduced in this report was presented in July 2001.

The work was carried out by Hans Lindberg, Director of Forecasting, and the economists Mikael Apel, Mårten Löf and Christina Nyman.

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Owner-occupied housing in the consumer price index – An examination of The CPI investigation Committee's proposal[1]

In November 1999, the Committee set up to review the consumer price index (the CPI Committee) presented its report – *Konsumentprisindex* (*The Consumer Price Index*), SOU 1999:124 (in Swedish with English summary). The report included a number of proposed changes both to the fundamental structure of the index, and to the calculation of the index in certain sub-areas. The proposal which attracted the greatest attention, and which also received the most criticism, is the proposal concerning the treatment of owner-occupied housing. It was this proposal which occasioned two of the members of the expert panel used by the Committee – Bengt Assarsson and Anders Klevmarken – to submit separate reports in which they dissented from the conclusions of the Committee on this point.

The government instructed the Swedish National Institute of Economic Research to analyse the consequences of the proposed calculation of the owner-occupied housing item, and to suggest possibly changes to this proposal. The time allocated to this assignment has been quite limited, and it has not been possible to carry out a complete and exhaustive analysis. A possible modification of the Committee's proposal is presented. This modification should, first and foremost, be seen as a starting point for an attempt to find a more practical solution, and it requires further analysis in appropriate areas. As to the rest, the report is largely intended to explain various concepts and systematise the arguments put forward in the debate.

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[1] Helpful comments have been provided by Mats Haglund, Statistics Sweden.

Starting point for the CPI Committee

To understand the considerations behind the CPI Committee's proposal, it may be appropriate to begin by looking at the starting point for the investigation. The fundamental views on what a consumer price index should measure vary considerably from country to country. Sweden, along with the USA and the Netherlands, has adopted an approach based on the cost of living concept. The aim that the consumer price index should measure the change in the cost of consumption required for a representative household, or group of households, to be able to maintain a certain standard of living, or consumption standard.[2] This approach – the cost of living approach – is sometimes also called the economic approach, since it is based on the assumption of an optimising behaviour among economic agents. In principle, this forms the basis for the formation of all theories applicable to the economy as a whole.

The most common alternative approach is that the consumer price index should simply measure the average price change for a predetermined "basket" of goods and services. Since the quantities in this basket are predetermined, changes in the index will only reflect price changes. Supporters of this outlook therefore maintain that this is the correct way to measure inflation. An index based on this principle is sometimes also called a "pure" price index. This approach has formed the basis of the European harmonised index, HICP, for example.[3]

For some time, a fairly intensive international debate has been under way regarding which is the preferable approach.[4] It would be taking matters too far to report on this debate in greater depth here, and to specify the differences between the approaches. The differences in the practical applications do not, however, seem particularly great in many cases, and the differences largely seem to consist of the fact that certain countries *expressly declare* that the aim of the

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[2] See, for example, Triplett (2000).
[3] See, for example, the EU Commission (2000), which expressly argues that the HICP is *not* a cost of living index.
For a more detailed description of the fundamental assumption of various approaches to what the consumer price index should measure, see Dalén (1999). Also see Hill (1999).
[4] Current examples of studies with different points of view include Triplett (2000) and Turvey (1999).

index is to approximate a cost of living index, while most countries have not made an explicit declaration in either direction. It is, however, worth emphasising that the approach which forms the basis of the Swedish consumer price index is not the only possible one, and that it has *expressly* been adopted by only a few countries. It is also worth remembering that the criticism aimed at the proposal to treat the owner-occupied housing item in line with what has been proposed by the CPI Committee seems based on the fundamental approach to the consumer price index, at least on an international level. This report is not, however, an attempt to evaluate these fundamental approaches, and the cost of living approach has been taken as given.

The owner-occupied housing item in the cost of living approach

Measuring changes over time in the cost of maintaining an unaltered consumption standard is far from straightforward. For goods which are consumed close to the time of acquisition, e.g. most types of food, this can be done fairly painlessly. The consumption cost is the same as the purchase price. The situation is rather more complicated for durable goods, i.e. goods acquired on a certain date which generate services that affect the living standard of households for a long period after this date, such as stereo equipment or a bicycle. This also applies to a single-family house owned by the household, since this can also be regarded as a durable commodity which generates services, e.g. housing services, every month. The treatment of owner-occupied housing is, however, particularly important, since the cost of housing usually represents a considerable part of the household budget and because a house generates services over a considerably longer period of time than most other durable goods.

Consequently, to measure the consumption of a household, you must first obtain an idea of the value of the services generated by a durable good on a monthly basis. For stereo equipment, it would therefore be necessary, in theory, to know the value of the "music services" delivered by the equipment to a household during one month. In practice, the Swedish consumer price index

only applies this type of periodization to the cost of owner-occupied housing. For other durable goods, the simplified assumption is made that the cost is the same as the purchase price and that it arises in the month in which the good is acquired.

There are two ways in which you can obtain an idea of the value of the monthly services generated by owner-occupied housing: the rental equivalence approach and the opportunity cost approach.5

Before discussing these, it is worth noting that it is sometimes hinted that the approach of regarding housing as a service flow is an implication of the cost-of-living approach. For example, Triplett (2000, p. 22) writes: "*Beyond the rhetoric, the issue that drives much statistical agency uneasiness over the concept of the COL [cost-of-living] is the treatment of owner-occupied housing. The COL index suggests pricing the flow of monthly housing services – the monthly cost of living in the house. It is perhaps an oversimplification to say that empirical problems in estimating the flow of services for owner-occupied housing have induced rejection of the COL index framework, but there is nevertheless considerable truth in the oversimplification.*"

We have not been able to determine how strong the link actually is on a deeper theoretical level between the cost-of-living approach and the approach that owner-occupied housing should be regarded as a "flow" of services. It is, however, clear that a large number of countries, most of which have not expressly declared that their consumer price index is intended to approximate a cost-of-living index, are attempting to calculate the monthly value of owner-occupied housing services, usually using a rental equivalence approach (see the CPI Committee report, p. 74).

The rental equivalence approach

When a household rents its home, the monthly cost of housing services is obvious – quite simply, it amounts to the rent paid by the household to the landlord. In this case, the household purchases a service which, in principle, is like any other service. If the household owns its home, there is, however, no equivalent monetary transaction. Consequently, there is no observable price which forms the basis for an index calculation.

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5 See, for example, Triplett (2000). See also Turvey (2000), for an overview of alternative approaches

One opportunity for estimating the cost of monthly owner-occupied housing services exists if, in parallel with the market for buying and selling owner-occupied housing, there is a rental market with the equivalent type of housing. The cost of owner-occupied housing would then be approximately the same as the monthly rent for a single-family house in this type of market. There are, however, a number of reasons why such an approach would pose problems.

One reason is that the rental market, unlike the ownership market, is strongly regulated. This means that the rent paid is not representative of the costs faced by owner-occupiers in general. Another reason is that the markets for owned and rented single-family houses respectively can fundamentally be regarded as completely separate markets, and that parallels between the two are misleading. This is, however, more probably the case if the first objection applies, i.e. if the rental market is regulated.

The Committee found that, as far as Sweden is concerned, the single most important problem of using the rental equivalence approach is that the market for rented single-family houses is simply too limited to produce reliable data. The report also dismisses the alternative of using the more extensive rental market for apartments to reach conclusions about the cost of owner-occupied housing, due to the regulated nature of the rental market, and to the fact that the rental apartment stock differs considerably from the owner-occupied housing stock with reference to cost structure, type, location and standard.

The opportunity cost approach

Instead, the Committee recommends the use of an opportunity cost approach. This approach uses an expression from capital theory which describes the relationship between the cost of housing services, the price of single-family houses and a yield requirement. This relationship appears as follows (for the sake of simplicity, taxes and maintenance costs are not included):

$$K_t = P_t \left[r_t - \boldsymbol{p}_t + d \right]. \tag{1}$$

K_t is the cost of capital of a household, P_t is the current market value of the house, r_t is the interest rate the household is borrowing at and which it would

receive from an alternative investment, $p_t = (P_{t+1} - P_t)/P_t$ is the percentage price change of the house betweent and t+1 (expressed as an annual rate) andd is the depreciation (which is assumed to be constant over a period of time).

The idea is that this expression should reflect the cost to the house owner of keeping the house compared with the alternative strategy of investing the capital represented by the house elsewhere for a period of time. The first term on the right, $P_t r_t$, is the alternative return the owner would receive if the house had been sold and the purchase sum invested at a return of r_t. The second term, which can be abbreviated to $P_{t+1} - P_t$ is the capital gain (or capital loss) onthe house during the period. If, for instance, the market value of the house increases during the period, this contributes to a reduction in the cost of capital. The cost of keeping the house during the period compared with the alternative of investing the money elsewhere falls since the cost of buying back the house has increased. If the capital gain is sufficiently high, the opportunity cost could even become negative. The third term, $P_t d$, represents the cost of depreciation. In general terms, the right side of (1) can be interp reted as P_t being the starting capital which is invested and the expression $[r_t - p_t + d]$ the yield requirement on the invested capital.

Equation (1) is, perhaps, rather more intuitive if you bear in mind that, in principle, it also describes the financial considerations which must be taken into account in a rental market for single-family houses. For letting to be an attractive alternative, the rent must (over and above the running cost) cover the yield the owner would have received if the capital had been invested elsewhere, as well as compensation for the physical deterioration of the house. If the owner expects the price of the house to drop during the rental period, the rent must cover this as well. If, on the other hand, an increase in value is expected, the rent does not have to be as high as it otherwise would.

Consequently, equation (1) can be seen as a parallel to the rental equivalence approach, which, instead of noting the rent, tries to calculate it indirectly. For a variety of reasons, the opportunity cost approach seems to be regarded as more controversial than the rental equivalence approach. The main reason is probably

that the step from theory to practical application is considerable, demanding fairly drastic simplifications. Another reason may be that, if a comparable market rent is readily available, no further thought is paid to the economic considerations this rent is in fact based on, or the fundamental consequences of a "translation" into the conditions of owner-occupied housing.

The sub-index for the cost of capital to households of owner-occupation (before tax) can be written as the ratio between the cost of identical housing over two consecutive periods:

$$I_{01} = \frac{K_1}{K_0} = \frac{P_1\left[r_1 - \boldsymbol{p}_1 + d\right]}{P_0\left[r_0 - \boldsymbol{p}_0 + d\right]} \qquad \textbf{(2)}$$

The Committee's proposal

In the practical application of the opportunity cost approach, an attempt is made to calculate a measurement for the cost of housing services by observing the different variables in (1) or by making assumptions about these. This is, however, associated with a number of problems.

One problem is determining which interest rate and which measure of house price changes should be used. The report argues for a long-term time perspective, since it is the cost expected by households to apply over a relatively long period of time which is relevant in household consumption choices. A time horizon of 15 years – the average period of home ownership – is recommended. The proposal which is perceived as the most controversial is that the difference between interest rates and expected house price changes, $r_t - \boldsymbol{p}_t$ in the above formula, hereinafter called the real rate of interest of housing, should be kept constant throughout an index link, i.e. one year. If, for example, the real rate of interest for housing is measured at 4 percent during the price base period, this is assumed to apply throughout the index link. As far as the expected house price inflation is concerned, it is assumed that this could be set equal to, or in a predetermined ratio to, general inflationary expectations. The Committee proposes that the general inflationary expectations should be determined preferably as implicit inflationary expectations, calculated as the

difference between long nominal and real interest rates, or alternatively through surveys.

The Committee's report justifies the assumption of constant real interest rates for housing by stating that interest rates and the rate of inflation, seen over long periods of time, usually keep pace with each other.

The Committee further feels that it is not an acceptable solution to "allow the changes in the index, from month to month and year to year, to be determined by measured or assessed inflationary expectations" (p. 80) and that "it is not possible to measure short-term changes in the real interest rate for housing in a reliable way [.]" (p. 256).

Using the assumptions in the report, (2) can be written as:

$$I_{01} = \frac{K_1}{K_0} = \frac{P_1\left[r_0 - \boldsymbol{p}_0^e + d\right]}{P_0\left[r_0 - \boldsymbol{p}_0^e + d\right]}, \tag{3}$$

where $\boldsymbol{p}_0^e$ is the expected house price inflation over the next 15 years. Since r_0 and $\boldsymbol{p}_0$ are constant, it is clear that the index changes during each link become dependent only on changes in the house price.

Differences compared with the current calculation method

The current method of calculating the cost of living in owner-occupied housing follows the guidelines presented in the 1955 housing index investigation. The method is aimed at measuring the user's cost of living in owner-occupied housing.[6] Appendix 1 describes in general terms the current calculation method and the differences between this and the Committee's proposal. In brief, the

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[6] The terminology used in the area does not appear to be completely unambiguous. Triplett (2000) used the concept of user cost function when describing equation (1), i.e. the basis for the CPI Committee's opportunity cost approach. Even though the aim of the current calculation method is regarded as measuring the user cost, it is unlikely that, when this method was developed, this theoretical starting point was used (the essential parts of the calculation method were developed before capital theory had been fully formalised). In all likelihood, a model was developed which was simply regarded as "reasonable".

most significant difference can be described using (4), which is a development of (1), and table 1. It should, however, be emphasised that it is not possible to make an exact comparison, since the methods are based on approaches which vary greatly in many respects.

$$K_t = P_t r_t - P_t \boldsymbol{p}_t + P_t d \qquad\qquad (4)$$

Table 1 A comparison between the Committee's proposal and the current calculation method

| The Committee's proposal *Term*:	Current calculation method *Nearest equivalent is*:
$P_t r_t$	$\left(K_s^t + K_N^t\right) * \sum_i w_i^{RS} \overline{R}_i^t$
$P_t \boldsymbol{p}_t$	-
$P_t d$	Index for repairs and maintenance

K_s^t is the amount the current owners have invested in owner-occupied housing (purchase amount plus amount spent on conversions and extensions) during period t, K_N^t is the purchase amount for all newly-built houses during period t, $\overline{R}_i^t$ is the average interest on loans with a repayment time i during the period t and w_i^{RS} is the weight for loans with repayment time i corresponding to its share of the total loan stock for housing.

One difference between the first term in (4) and the corresponding expression for interest costs in the current calculation method is that the cost of interest in (4) is calculated on the current market value of the owner-occupied housing stock, while in the current method, it is based on the capital laid out by the owners, i.e. the purchase amount and charges for conversions and extensions. Another difference is that r_t in (4) is a 15-year interest rate, while the interest in the current calculation method is a weighted average interest rate based on the consumers' choice of fixed and flexible interest periods.

The current method does not include any equivalent of the second term in (4), which reflects capital gains. Taken together, these two differences reflect that, contrary to the current method, the proposal in the report is based on real interest rates and not on nominal interest rates. In the third term, the difference is that the costs before depreciation in (4) represent a constant proportion of the market price, while an index for repairs and maintenance is used in the current method. In summary, compared to the current calculation method, the proposal is considerably closer to a refined theoretical application of the opportunity cost approach, with, in many respects, a lower level of detail.

The consequences of the Committee's proposal in terms of the CPI are shown in diagram 1, which illustrates the development over the period December 1997 to December 2000.

Diagram 1. The Committee's proposal for a 15-year fixed real interest rate
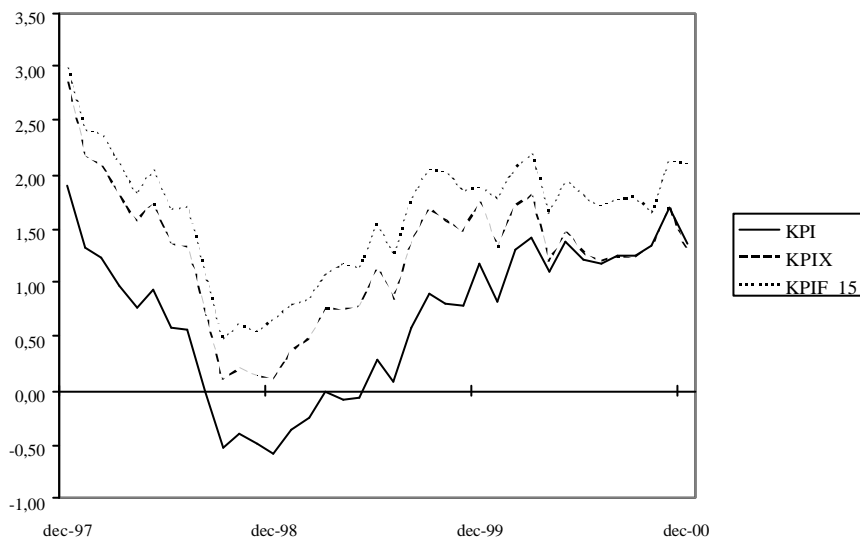
CPI (KPI) = rate of inflation according to CPI.

CPIX (KPIX) = CPI excl. the interest item.

CPIF_15 (KPIF_15) = CPI with the interest item replaced by an index relating to a constant 15-year real interest rate after tax.

Variations in the CPI inflation rate are slightly smaller if the cost of living is calculated on the basis of the Committee's proposal, since fluctuations in the interest rate level would not then have an impact on CPI inflation. The principal difference is, however, that measured inflation will be around 0.5-1 percentage units higher due to the Committee's proposal not including the reduction in interest rates at the end of the 1990s, and the fact that house price inflation was higher than the average CPI inflation during the period 1997-2000.

Criticisms of the proposal

As pointed out in the introduction, two members of the Committee's panel of experts – Bengt Assarsson and Anders Klevmarken – submitted separate reports in which they primarily objected to the proposed treatment of owner-occupied housing. In the consultative procedure several comments have, since then, wholly or partly agreed with this criticism.

One area of criticism referred to the adoption of a constant real interest rate for housing. Adopting this approach means that the owner-occupied housing index will mainly be determined by the changes in property prices. Assarsson writes (p. 151 of the CPI report):

"A consequence of this is that, if the CPI forms the basis for compensation, and if there is a substantial fall in property prices over a few years, property owners will suffer great capital losses and, in addition, will receive less compensation through the price index." Klevmarken writes (p. 159): *"The better off owner-occupiers are, the greater the compensation we have to pay to pensioners, people on income support and young families, many of whom are, in fact, owner-occupiers [.]"*

Both Assarsson and Klevmarken are of the opinion that changes in the interest rate should have an effect on the sub-index for owner-occupied housing.[7] It should, however, be stressed that the criticism of the adoption of a constant real interest rate is not solely aimed at the fact that this would create a clearly positive relationship between house prices and the index, but also that a varying

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[7] One difference between Assarsson's and Klevmarken's criticism is that while Assarsson states that both changes in the nominal interest rate and the expected property price trend should have an

interest rate is assumed to provide a better picture of cost trends. In this context, it should be noted that the mechanism through which lower property prices create a lower index value (and vice versa) remains as a partial effect even when the real interest rate on housing is allowed to vary over a period of time. The positive link between property price trends and the price index will probably, on average, become less noticeable with a variable real interest rate, but this does not automatically mean that lower (higher) property prices will no longer result in a lower (higher) index value. The criticism should, on this point, probably b e interpreted as being that property price trends would have *too great* an impact on the price index.

To put the question in perspective, it may also be worth considering what the actual consequences would be if the price of owner-occupied housing was not reflected by the index *at all.* A consumer price index is intended to measure the effect of price changes on the cost of living for the entire household sector collectively. This collective consists of a very large number of different types of households. So me of these are already owner-occupiers, while others are at the stage of life where they are about to become owner-occupiers. If, for example, a greater increase in the price of owner-occupied housing is not reflected by the index, it would raise the question of how well this reflects the situation for the latter type of household, for which the cost of purchasing owner-occupied housing has now become considerably higher. The example does not render the criticism void, but shows that one must remember that the consumer price index is an *aggregate* measurement, and that a certain calculation method in some situations will always favour some households and treat others unfavourably, just as there are identifiable "winners" and "losers" when the general allowan ce and taxation system is undergoing changes. If one imagines that equation (1) describes price formation for a rental market, the positive relationship between property prices and the index becomes more intuitive. A fall in the price of single-family hous es results in a presumptive landlord having a smaller capital to invest in an alternative way, and that he or she therefore charges a lower rent. An increase in the price of the rental object would instead result in a greater capital for alternative investment. This would also result in a higher rent.

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effect on the index, Klevmarken feels that the practical difficulties of measuring expected property inflation may be a reason for abandoning the real interest rate approach altogether.

Another criticism of the opportunity cost approach – but not by Assarsson or Klevmarken – has also been aimed at the fact that price changes affect the index, more precisely the inclusion of capital gains in the opportunity cost expression (1). As we have previously stated, a capital gain will reduce the opportunity cost and a capital loss will increase it. A representative view in this connection is that put forward by Goodhart (2000, p. 19-20): "*But this gives the absurd result that as house prices rise, so the opportunity cost falls; indeed the more virulent the inflation of housing asset prices, the more negative would this measure become. Although it has some academic aficionados, this flies in the face of common sense; I am glad to say that no country has adopted this method.*" In connection with this criticism, it is frequently argued that capital gains on housing do not belong in the consumer price index any more than capital gains on a share portfolio. This criticism is, in some ways, the opposite of the criticism voiced by Assarsson and Klevmarken: it is felt that it is unreasonable that price increases (in fact, expected house price inflation) should have a *negative* effect on the opportunity cost, while Assarsson's and Klevmarken's criticism is based on rising house prices having a *positive* effect on the opportunity cost. The difference is that Goodhart's criticism focuses on the yield requirement (i.e. in the expression in square brackets in (1)), while Assarsson's and Klevmarken's criticism is aimed at the basic capital itself (P_t in (1)).

Here also, the mechanism becomes more intuitive if (1) is assumed to apply to price formation on a rental market. For example, if the price of let single-family houses is expected to rise during the period, the person letting the single-family house would not, as we concluded above, have to charge as high a rent as he or she would otherwise do. Correspondingly, the rent would have to be higher if the price of the house was expected to fall during the period. It is, however, important to note that we are talking about an *expected* capital gain or capital loss during the letting period, and not the actual gain or loss, since this reasonably reflects how pricing is carried out in practice on the rental market.[8] The opportunity cost which can be calculated when expected house price change is included in (1) will then, at least in theory, correspond to the rent in a rental market. If one accepts the rental equivalence approach, one should, in principle, also accept a corresponding opportunity cost calculation. Even the above comparison with the capital gain on a share portfolio seems to become less

relevant, since the expected house price change would no longer be comparable with just any capital gain or capital loss (e.g. on a share portfolio), but indicates how much households' costs would change if they rented their accommodation rather than owned it.

When dealing with capital gains and capital losses on owner-occupied housing, it may be worth emphasising a relationship which, in our opinion, is not particularly clear in the CPI report. Once it has been decided to use the cost of living approach in the relatively theoretical way adopted by the Committee, it may be useful to calculate a price index which, as far as possible, attempts to reflect the cost of living for households and nothing else. This means that the imputed costs of living in owner-occupied housing should be included in the way implied in the Committee's proposal.

It is, however, also important to take into consideration that, in accordance with the approach used, owner-occupiers have implicit *income* from their accommodation. If one wishes to be consistent when calculating the compensation for various individuals, it is, therefore, necessary to attempt to assess and include such implicit income in the total income concept. [9]

In other words, the implicit income from owner-occupied housing should be added to an individual's monetary income when deciding whether he or she has the right to compensation in the event of a change in the prices of owner-occupied housing. If the consumer price index is based on the cost of living approach, and the implicit income from accommodation is not considered, a pensioner living in owner-occupied housing and receiving a pension adjusted on the basis of the CPI will obtain a higher standard of living when house prices increase above the rate of inflation in general. [10] The Committee's report certainly discusses this problem briefly (p. 70-71) (and includes some calculations in Appendix 5), but the presentation of the problem is not particularly lucid, and it is not obvious that a reader would clearly realise the implications. The extent to which one should try to assess this implicit income in practice when using the CPI for the purpose of compensation (which would probably prove extremely difficult) or if it should be regarded as an unwanted but acceptable consequence

[8] This is emphasised in, for example, the Economic and Social Council's comments.
[9] See for example Klevmarken's special report. This is also discussed in the Economic and Social Council's comments.
[10] See, for example, the discussion in Triplett (2000, p. 26).

of the theoretical application of the opportunity cost approach chosen is, of course, open to discussion. It is also possible to step away from the strict theory and calculate the cost of living in an alternative way. Klevmarken's suggestion not to allow imputed price changes on equity, but only changes in interest rate to affect the index may be seen as a way of handling the problem in accordance with the latter method. Whichever solution one chooses, one should be aware when making a decision that a strict application of the opportunity cost approach not only has implications for the households' costs, but also for their income.

A slightly different type of criticism is that a new way of calculating the owner-occupied housing item may have a marked effect on the character of the resulting consumer price index series, compared with the current series. If this is the case, it could be maintained that, through an administrative decision, a significant structural change has taken place in the market and in the regulatory system, in which price trends play an important role as a standard of comparison. This could be particularly serious in the market for real interest rate bonds, since a rational investor would probably consider that such unexpected structural changes could happen in the future as well.[11] In the future, the investor would demand a higher risk premium, which increases the cost of borrowing for the state. The change in the calculation method may also in itself cause price effects in the market for real interest rate bonds, which, in turn, may cause an arbitrary redistribution of wealth among various owners of real interest rate bonds. This criticism does not fundamentally seem to apply to the use of the opportunity cost approach as such, but to the fact that the calculation method is being changed.

To sum up, the main criticisms of the proposal have been that the real interest rate on housing has been assumed to be constant, that the change in the price of owner-occupied housing (partly due to the constant real interest rate) is regarded as giving rise to consequences in respect of compensation which are difficult to justify, and that a change in the calculation method may have a negative effect on markets and regulatory systems where consumer price index trends play an important role as a standard of comparison.

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[11] Worries about such a reaction have been expressed in the National Debt Office's comments.

Problems with the alternative proposals

The criticism directed against the Committee's report does not include any finished proposals for alternative solutions. There are, however, some specific suggestions for modifications and improvements. Assarsson would particularly like to see the index reflect ing changes in the nominal interest rate and expected property price changes. Klevmarken, too, is of the opinion that nominal changes in interest rates should affect the index, and he also thinks that only changes in the interest on loans for owner-occupied housing should be taken into consideration.

In the above, we have established that an objection based on the Committee's position against Klevmarken's proposal not to allow imputed price changes on equity but only changes in interest on borrowed capital to affect the index, is that this can be interpreted as a departure from the theoretical application of the opportunity cost approach advocated by the investigation. Perhaps the most serious problem with letting the real interest rate for housing vary within the framework of the selected methodology is that it would normally lead to major fluctuations in the calculated index series. For example, Triplett (2000, p. 25) writes: *"Unfortunately, existing estimates of user cost for housing are often far more volatile than market rents suggest*[.]" The main reason is that most reasonable measurements of expected capital gains fluctuate relatively strongly. The substantial swings in the housing item in turn spill over into fluctuations in the consumer price index. This can be problematic in itself. In the past decade, the focus has been on low and stable inflation in Sweden and other countries, and this has been partly based on the assumption that the economy works better if households and businesses are reasonably confident as to what future inflation will be. Even though the argument fundamentally applies to inflation in a more basic sense, it should, to some extent, be possible to apply it to a situation where the consumer price index varies sharply as a result of the choice of calculation method. A sharply -fluctuating consumer price inflation rate could give rise to different types of risk premiums, which would not arise with a less volatile price trend.

However, the report put forward another problem with a flexible real interest rate for housing – the difficulty of finding a reliable measurement for the real interest rate for housing. Even though it has not been expressly stated by the

Committee, it is tempting to assume that another motive for the proposal has been that the character of the consumer price index would not differ substantially from the current index – more specifically that it would not fluctuate as much as if the real interest rate for housing was allowed to vary. In that case, it could be seen as an attempt, within the selected approach, to forestall the above type of criticism which focuses on the fact that a new calculation method may result in a consumer price index series, with a considerably different development than the current one. These problems are also illustrated in diagrams 2 and 3, which show the CPI inflation rate calculated on the basis of the Committee's proposal, but with a variable 15-year and 5-year real interest rate respectively. The conclusion drawn from the diagram is that the CPI inflation rate varies more sharply when the Committee's proposal is supplemented with a variable real interest rate. In addition, the variation in the CPI inflation tends to increase when the duration of the real interest rate is reduced.

As indicated in the quote by Triplett, there is another problem with allowing the real interest rate to vary: the resulting measurements tend to be considerably more volatile than market rents, where such are available. If one accepts the trend in market rents as a satisfactory measure of the housing cost trend in owner-occupied housing, attempts to calculate the cost using theoretical opportunity cost approaches will result in unrealistically high fluctuations. As shown in the modification we suggest below, we find it likely that at least some of the variations originate in an over-literal application of the theoretically-refined equation (1).

Diagram 2. The Committee's proposal with a 15-year variable real interest rate
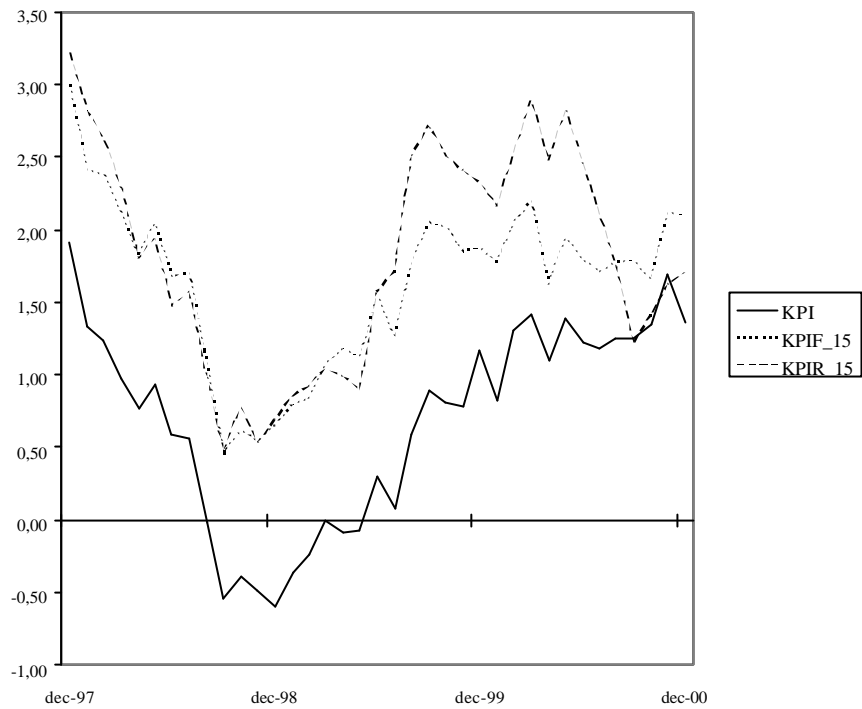
CPI (KPI) = rate of inflation according to the CPI.

CPIF_15 (KPIF_15) = CPI with the interest item replaced by an index relating to a constant 15-year real interest rate after tax.

CPIR_15 (KPIR_15) = CPI with the interest item replaced by an index relating to a constant 15-year real interest rate after tax.

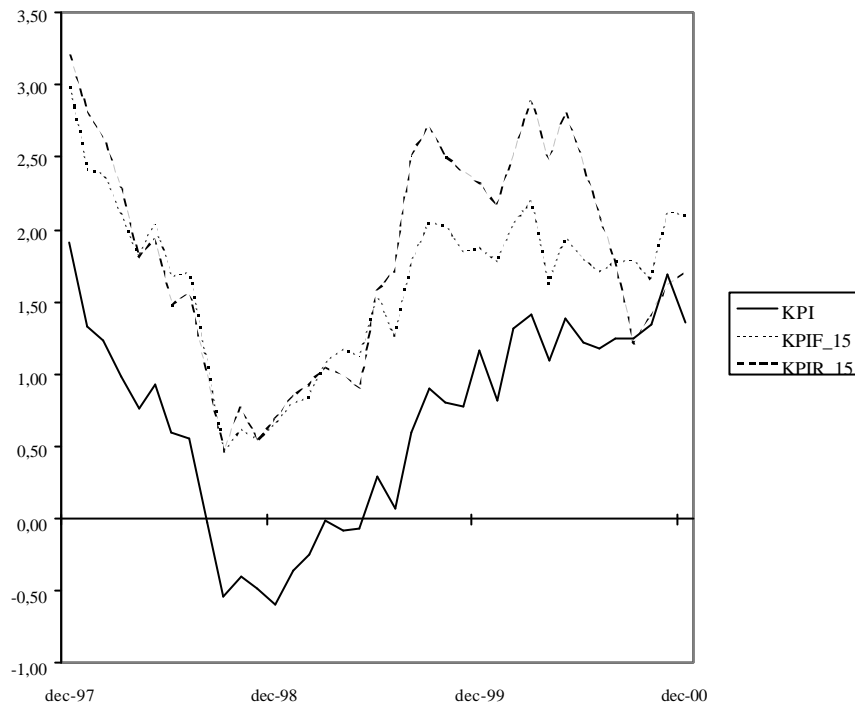**Diagram 3. The Committee's proposal with a 5-year variable real interest rate**

CPI (KPI) = rate of inflation according to CPI.

CPIF_5 (KPIF_5) = CPI with the interest item replaced by an index relating to a constant 5-year real interest rate after tax.

CPIR_5 (KPIR_5) = CPI with the interest item replaced by an index relating to a variable 5-year real interest rate after tax.

Some lack of clarity in the application of the formula

One aspect of the Committee's proposal which is not covered in detail in the separate reports, but which may benefit from discussion, is the specific economic considerations assumed to form the background to the opportunity cost approach. The Committee is, in our opinion, not completely clear on this point. As established above, it argues in favour of a long-term perspective, more

specifically a 15-year time horizon. As shown in (3), the index will, at the same time, change as the price of the housing stock, P_t, changes every month.

If the above approach is adopted in attempting to translate this relationship to the considerations which should be made in a rental market for single-family houses – which should be possible since (1) in principle also should apply to a rental market – it would have the following approximate implications. Presumptive landlords would ask themselves what return they would receive on their capital (i.e. the current value of the house) during the coming fifteen-year period.

As we have argued, this yield requirement would include the yield they could receive from an alternative investment, and the expected capital gain (or capital loss) and compensation for the physical deterioration of the house. A tenancy contract could then reasonably be drawn up for the next fifteen-year period. At the same time as the landlord has a fifteen-year perspective of the yield requirement at the time when the tenancy contract is drawn up, he or she would, if we have interpreted the proposal correctly, be able to set a new rent every month as the market value of the invested capital changes. This would, as far as we have understood, apply to the whole housing stock. It is not clear how such a thought experiment should be interpreted.

A modification of the Committee's proposal

A possible alternative– which in our opinion would seem more intuitive – would be to retain the basic approach of the proposal, but to start from how a rental market for single-family houses would work if such a market existed. On the basis of observations from other types of rental market, it is reasonable to assume that a rental market for single-family houses would be characterised by the following:

- Landlords and tenants would draw up contracts where the rent is fixed for a certain period of time.

- Such contracts would not be drawn up on one and the same occasion, but be distributed over time.

- Since the rent is fixed for a certain period, it would include an *expected* capital gain (or capital loss) which the landlord could expect to make on the single‑family house during this period.

The last point has been discussed above, and also seems to be in line with the reasoning of the Committee. The first two points would, however, mean that the index would change in accordance with a slightly different process than that proposed by the Committee. In accordance with the Committee's proposal, the sub‑index for owner‑occupied housing would change as a result of monthly changes to the market value of the total owner‑occupied housing stock. The cost of all houses in the stock would, consequently, change at the same time. Under such circumstances, it is natural that a real interest rate for housing which varied over time would have a significant effect and provide an expression for the opportunity cost (and a consumer price index) which fluctuates substantially.

However, it seems doubtful whether such a strong and direct effect will provide a realistic picture of the actual circumstances in the sense that they would reflect price formation on a rental market for single‑family houses. Even on markets for more ordinary goods and services, price inertia is a common phenomenon due to the fact that there are different types of costs associated with changes to a price. Such costs ought to be relatively high in a rental market. As a result, longer contracts would probably become a common occurrence in a rental market for single‑family houses in the same way as for apartments. Similarly, all contracts would not be signed at one and the same time, but distributed over a period of time. The modified version of the Committee's proposal for calculation of the sub‑index for households' cost of capital for owner‑occupied housing (before tax) can then be written as:

$$I_{t-1,t} = \frac{K_t}{K_{t-1}} = \frac{\sum_{i=o}^{j} P_{t-i}\left[r_{t-i} - \boldsymbol{p}_{t-i}^{e} + d\right]}{\sum_{i=1}^{j+1} P_{t-i}\left[r_{t-i} - \boldsymbol{p}_{t-i}^{e} + d\right]} \qquad (5)$$

where j is the duration of the tenancy contract, r_{t-i} is the nominal interest rate with the same duration as the tenancy contract and p_{t-i}^{e} is the expected rate of house price inflation during the same period of time.

All in all, the modified version of the Committee's proposal would mean a change to the sub-index in such a way that changes in house prices or real rates of interest for housing would only affect the cost (the rent) of that part of the owner-occupied housing stock where "contracts" are coming to an end and are to be renewed in a certain month. All other "contracts" would remain valid until the end date. The following month, yet another proportion of the owner-occupied housing stock would sign "contracts" and so on. Expressed in more technical terms, the above assumption will introduce a certain inertia, which means, for example, that a change in interest rates would not have as significant and direct an impact as in the Committee's proposal. Even with a certain time variation in the real interest rate for housing, variations in the resulting CPI series would, consequently, be limited.

Advantages and disadvantages of the modified proposal

The main advantage of this modification is that the calculation method, in our opinion, is more intuitive and provides a more realistic picture of how price formation would take place in a rental market, if such a market existed. The proposed modification can be seen as an attempt, within the fundamental framework of the opportunity cost approach, to narrow the step from the purely theoretical expression (1) to a practical application under actual conditions. Since the rental equivalence approach is often regarded as less controversial than the opportunity cost approach, it would be desirable to attempt a more explicit imitation of the conditions on the rental market

One consequence of the outlined proposal for modification is that the sub-index generated would be considerably less volatile in the event of a real interest rate for housing which varied over time than would be the case in the Committee's proposal, which is also shown in diagram 4 (CPIM_2 in comparison with CPIR_5).

The modified proposal has, however, certain drawbacks, and its practical application is not without complications. For example, the choice of the duration of the rental contract would largely be arbitrary. One starting point could be the length of actual rental contracts on the market for multi-family housing, which indicate a rental review interval of one to two years. Another important question is which definition of the real interest rate for housing should be used. To start with, it is not obvious that the term of the real interest rate for housing should be the same as that of the imagined rental contracts. Owner-occupied housing can perhaps, for good reasons, be seen as a more long-term investment, resulting in r_{t-i} and p_{t-i}^{e} in expression (5) tending to have a longer duration than the imagined rental contracts.

Diagram 4. Modified proposal
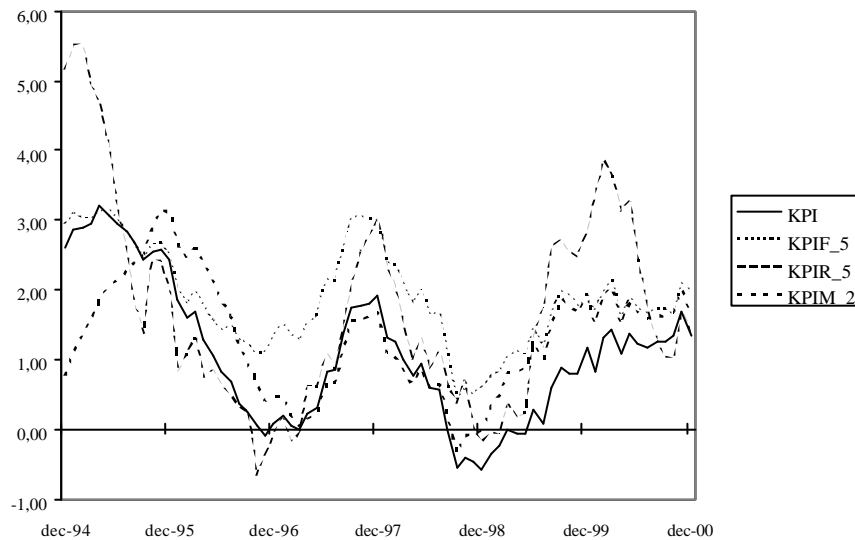
CPI (KPI) = rate of inflation according to the CPI.

CPIF_5 (KPI_5) = CPI with the interest item replaced by an index relating to a constant 5-year real interest rate after tax.

CPIR_5 (KPIR_5) = CPI with the interest item replaced by an index relating to a variable 5-year real interest rate after tax.

CPIM_2 (KPIM_2) = CPI in accordance with the modified proposal, 2-year "contract period".

The measure selected for the expected rate of house price inflation is not uncontroversial either. The expected rate of house price inflation can either be calculated on the basis of historical house prices or approximated by the general inflation rate as measured by various types of surveys. The results presented in Appendix 2 show that the general price level and house prices track each other well over a longer period of time (they are co-integrated).

This suggests that long-term real rates of interest for housing can be approximated on the basis of general inflationary expectations. To the extent that p_{t-i}^e refers to the expected rate of house price inflation over a shorter period of time, for example one year, this is no longer the case. The actual trend in house prices frequently deviates from the general inflation rate, and it is necessary to use the information to design a more reasonable measure for the expected rate of house price inflation. One drawback in this connection is, however, that the real rate of interest for housing, $r_{t-i} - p_{t-i}^e$, tends to vary considerably over time.

Parallels between the modified proposal and the current calculation method

The modified version of the Committee's proposal implies, in practice, a move closer to the current method for calculating the cost of capital of owner-occupied housing. This is also reflected in diagram 4, which shows that the modified version of the Committee's proposal (CPIM_2) deviates less from the current CPI inflation than the measure based on the Committee's proposal with fixed (CPIF_5) as well as variable real interest rate (CPI_R5). There are several reasons for this. In the modified version, interest rate costs are calculated on the basis of a rolling historical average of the market value of the owner-occupied housing stock instead of the current market value, which is a measure that deviates less from the capital laid out by the owners, i.e. the purchase price and expenses of conversion and extension work, which is used in the current construction of the owner-occupied housing item. Moreover, in the modified version the nominal interest rate is flexible as in the current method. One important difference is, however, that the current method does not take

account of expected capital gains. On the other hand, this tends to be counteracted by the fact that the capital laid out by the owner is not updated with the trend in house prices. To the extent that the expected rate of house price inflation is realised and agrees with the actual trend in house prices, the difference between the modified version of the Committee's proposal and the current method for calculating cost of capital is likely to be limited.

Conclusions

The principal criticism of the Committee's proposal has been the assumption that the real rate of interest for housing is constant, that price changes for owner-occupied housing (partly due to the constant real interest rate) are regarded as resulting in consequences which are difficult to justify from a compensation point of view, and that a change in the calculation method risks having a negative impact on markets and regulatory systems where the consumer price index plays an important part as a standard of comparison. Neither does the Committee's proposal seem to be clearly and directly transferable to a hypothetical rental market.

From a theoretical point of view, it may be desirable to complement the Committee's proposal with a variable real interest rate. This would, however, result in a pronounced change in the character of the CPI. The modification of the Committee's proposals that, due to this among other things, is outlined in this report has greater similarity with the "rental equivalence approach". It also involves, in practice, a certain move towards the current construction of the owner-occupied housing item in the CPI. In addition, the modified proposal tends to provide a more stable CPI inflation rate than the Committee's original proposal with a fixed real interest rate.

It is, however, nevertheless reasonable to stay with the current measure of owner-occupied housing costs until the question has been investigated further. One reason is that there is considerable disagreement over which calculation method would be preferable. Another reason is that both the committee's proposal and the modification outlined in this report are relatively strictly

designed on the basis of simplistic economic theory, and represent hitherto untried methods of calculating the cost of owner-occupied housing for the CPI.

Summary

The report and its implications can be summed up in the following points:

- The principal criticism against the committee's proposal – which is a variant of the "opportunity cost approach" – has been the assumption that the real rate of interest for housing is constant, that price changes for owner-occupied housing (partly due to the constant real interest rate) are regarded as resulting in consequences which are difficult to justify from a compensation point of view, and that a change of the calculation method risks having a negative impact on markets and regulatory systems where the consumer price index plays an important part as a standard of comparison.

- The report points out that it is not clear which type of thought experiment forms the basis for the committee's application of the opportunity cost approach.

- The principal problem with allowing the real rate of interest for housing to vary is that the calculated cost will fluctuate strongly. A strongly-fluctuating sub-index (and consumer price index) can be problematic in itself. It is also doubtful whether it gives a particularly realistic picture of price formation in a single-family house rental market (which, according to the rental equivalence approach would have been the alternative way of estimating the trend in living costs for owner-occupied housing).

- The report suggests a modification of the Committee's proposal, the aim of which is to retain its fundamental approach, but instead start from how a rental market for single-family housing would work if such a market existed. This would have the advantage of providing a more realistic picture of actual conditions in the sense that they would reflect price formation in a single-family housing rental market. The parallels between the opportunity cost and the "rental equivalence" approaches

would become clearer, which may be an advantage since, for example, the rental equivalence approach frequently appears to be seen as less controversial than the opportunity cost approach. A further consequence would be that a variable real interest rate for housing would result in less fluctuation in the sub-index than would be the case with the Committee's proposal.

- Even though, in our opinion, the outlined modification has certain advantages compared with the Committee's proposal, it also has certain disadvantages. The problem of which real rate of interest should be used remains, at the same time as it is necessary to make an assumption on the "contract duration" and the distribution over time of the signing of these "contracts". This underlines the fact that there is no altogether satisfactory approach for calculating the cost of owner-occupied housing.

- All in all, there are a number of reasons why it may be reasonable to retain the current measure of the cost of owner-occupied housing until the matter has been investigated further. One reason is that there is considerable disagreement on which calculation method is preferable. Another reason is that the Committee's proposal and the modification outlined in this report are both relatively strictly designed on the basis of simplistic economic theory, and represent hitherto untried methods for calculating the cost of owner-occupied housing for the CPI.

Appendix 1

A comparison between the current method and the Committee's proposal

Current method

The current calculation method for the cost of owner-occupied housing follows guidelines adopted in the 1955 housing index investigation.[12] Some changes have been made over the year, as the result of decisions by the Consumer Price Index Board. The intention is to measure the user cost of owner-occupied housing. The components included in the calculation are mortgage interest, depreciation, repairs, insurance, water and sewage, and property tax. The weighting is determined by direct estimates of the various cost components. Power and heating costs are reported separately.

The most complex calculation is cost of capital, which is, in fact, the mortgage interest. This is calculated using two indices; one which measures changes in the average nominal interest on borrowed capital (RS_{01}) and one which measures changes in the total capital invested in owner-occupied houses (KS_{01}). Capital gains are not included in the index of cost of capital. The index for mortgage interest is calculated as follows:

$$I_{01} = RS_{01} * KS_{01}$$

where KS_{01} is calculated in accordance with:

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[12] The description is based on SCB (2001).

$$KS_{01} = \frac{K_s^1 + K_N^1}{K_s^0 + K_N^1 / BPI} \; \cdot$$

K_s^0 is the total amount the current owners have invested in owner-occupied housing (the purchase price plus the amount laid out on conversion and extension) in period 0, K_s^1 is the total capital invetsed in period 1 with reference to the housing stock in period 0 (the purchase price is updated for sales between period 0 and 1), K_N^1 is the purchase price for all newly-built houses in period 1 and BPI is a new -construction price index which is used to backdate K_N^1 to the price level of the previous year. Changes in property prices do, consequently, affect the index for that part of the housing sto ck which is sold between the periods 0 and 1 with the price change which occurs between the purchase date and sales date.Changes in new construction prices have an immediate impact on the index.

The average rate interest RS_{01} is calculated by weighting different types of housing loans (in accordance with the banks' and housing finance institutions' distribution of loans with fixed rates of different lengths and loans with flexible rates for lending for housing). In RS_{01}, mortgages with a 2 -year fixed interest period are calculated as 24 months' moving average. In the same way, mortgages with a fixed interest period of five years or more are calculated as 60 months' moving average. More specifically, the formula

$$RS_{01} = \frac{\sum_i w_i^{RS} \overline{R}_i^1}{\sum_i w_i^{RS} \overline{R}_i^0}$$

is used, where $\overline{R}_i^0$ and $\overline{R}_i^1$ is the average interest on a loan of type i in period 0 and 1, respectively, w_i^{RS} is the weighting for mortgages of type i equivalent to their share of the total housing loan stock. The consequences of this index are that changes in variable interest rates have a direct impact on the index, while

changes in interest rates on mortgages with a longer fixed interest period have a gradual impact on the index.

The sub-index for depreciation is equal to the index for repairs and maintenance. The weighting is calculated as 1.4 percent of the actual market value of the owner-occupied housing stock.

The Committee's proposal

The Committee's proposal for the calculation of the cost of owner-occupied housing is based on an opportunity cost approach. The cost at time t, without taking tax effects into account, can be written as:

$$K_t = P_t \left[r_t - \boldsymbol{p}_t + d \right]$$

where Pt is the current market value of the house, rt is the current interest rate at which the household can borrowe and which it would receive from an alternative investment of the capital (the same for own and borrowed capital), πt is a relative capital gain – property inflation– relating to an unchanged property capital and d is that share of the property's value which, due to wear and tear, is lost in the course of a period.

The Committee proposes that the real rate of interest should be regarded as constant over an index link. The consequences of this would be that only changes in property prices would have an impact on the index. Disregarding tax effects, the index for cost of capital in period 1 would then be:

$$I_{01} = \frac{K_1}{K_0} = \frac{P_1 \left[r_0 - \boldsymbol{p}_0 + d \right]}{P_0 \left[r_0 - \boldsymbol{p}_0 + d \right]}$$

Weighting

The real rate of interest will, of course, be adjusted annually, but this would only affect the weighting, and, through this, the impact of property changes on the CPI. The weighting comprises the share of cost of capital of the whole consumer basket.

The cost of capital is estimated as follows:

$$\hat{K}_0 = \hat{P}_0 \left[R_0 - \Pi_0^e + D \right]$$

where $\hat{P}_0$ is the estimated market value during the price base period of the owner-occupied housing stock for the weighting period, R_0 is the average long interest rate on new investment during the price base period, Π_0^e is the long-term expectations for general inflation, assumed to be the same as the expectations for house price inflation, and D is depreciation.

Comparison between the Committee's proposal and the current method

$$K_t = P_t r_t - P_t \boldsymbol{p}_t + P_t d \qquad \text{(the Committee's proposal)}$$

The first term in the above expression can be compared with the current mortgage interest expression:

$$RK_t = \left(K_s^t + K_N^t \right) * \sum_i w_i^{RS} \overline{R}_i^t \qquad \text{(current calculation)}$$

The main difference between the expressions $P_t r_t$ and RKt is the calculation of the value of the owner-occupied housing stock and the choice of interest rate. In the proposal, the interest expense of the current market value of owner-occupied housing stock is calculated, while the current calculation method uses the capital laid out by the owners, the purchase price and the amount laid out on conversion and extension.

In both cases, borrowed and own capital have been included. Furthermore, only a 15-year interest rate has been used in the proposal, while the current method is based on a weighted average interest rate based on the consumers' choice of flexible and fixed interest periods.

The second term in the Committee's proposal, $P p_t$ which refers to capital gain, has no equivalent in the current index.

As far as we have been able to determine, the weighting for depreciation is calculated in the same way in the current index as in the Committee's proposal.

However, the equivalent to $P_t d$ is calculated differently. In the current method, an index for repairs and maintenance is used. In the proposal, the index is made up of a constant share of the market value of the owner-occupied housing stock, which means that depreciation tracks changes in the property price index.

Appendix 2

A statistical evaluation of the trend in house prices and the general inflation rate

Expected house price changes

The simplest assumption is that households take a wholly retrospective view when predicting future price changes. The best guess for future price changes is often that the historical average will, on average, apply in the future as well.

One such measure of house price expectations can be calculated by taking the average of historical values for each time period. The result from and including the 4th quarter of 1976 is shown in diagram A2.1 (FHP1).13 If one believes that this year's price changes can, in a more complicated way, be explained by historical price changes, another measure for expected house price changes can be generated via the following type of autoregressive equation:14

$$H_t = a_0 + \sum_{i=1}^{p} b_i H_{t-i} + e_t,$$

where p is the number of time lags for the explanatory variable, a_0 is a constant and e_t is a random variable (unexplained part of the variation in H).

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13 This measure of expected house price expectations may seem rather trivial. It should, however, be remembered that econometric or time series analytically-generated forecasts fairly rapidly converge on the average applicable for the time series at the time the forecast is made, and in this case, the perspective is as long as 15 years.

14 Previous studies have shown that such models can be extremely useful when creating models for house price trends. Hort (2000) writes regarding the ability of such models to reflect a relatively large number of the variations in house price changes over time: "This systematic time serie s pattern means that the appreciation of the housing capital is relatively predictable, which gives rise to a large amount of literature on whether housing markets are efficient or not."

The above equation has been estimated from and including the 4th quarter of 1976.[15] The forecast has been made for the next 15 years. An average of these forecasts has then been calculated, since the expectations describe what households believe will happen on average over the next 15 years. After this, another time period has been included in the estimating period. The equation has been re-estimated, the forecast has been made using the same time frame, and a new average value has been calculated. This procedure has been repeated up to and including 2000:4, and the result is shown in A2.1 (FHP2).

It should be emphasised that measures of house price expectations which are, to some extent, retrospective are supported in literature. Using surveys, Case and Shiller (1988) investigated what house price expectations are based on. They studied three very different housing markets (regions) in the USA, and the result indicated that price expectations on houses were based almost exclusively on historical price changes.

Expectations of future inflation rates and house price changes

The proposal by the CPI Committee (p. 84) states that the expected changes in house prices can be set as equivalent to, or in a predetermined relationship with, general inflation rate expectations. It should, therefore, be possible to use inflationary expectations as a proxy variable for expected house price changes when calculating the real interest rate for housing.

Diagram A2.2 shows the annual percentage changes in consumer prices and house prices (noted quarterly) from 1966 to 2000.[16] It can be noted that house prices fluctuate considerably more than inflation during the period, and also that the covariance between the two variables seems to have changed over time. Table A2.1 describes the linear relationship between the variables with the correlation coefficient, for the whole period as well as for three sub-periods.

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[15] In the equation specification used, $p=5$ throughout the estimating period.
[16] Sources: Statistics Sweden and The Swedish National Institute of Economic Research.

Table A2.1. Correlation between inflation rates and house price changes

Annual changes in percent, quarterly data

Period	1966:3–2000:4	1966:3–1977:4	1978:1–1989:2	1989:3–2000:4
Correlation	0.17*	0.63*	-0.47*	0.13

Note. Significance at 5% level has been indicated by *. The number of quarters for the whole period is 138. The number of quarters in sub-periods is 46.

The correlation between the variables is slightly positive, but significantly different from zero, when looking at the period as a whole. The linear connection between the variables is, however, completely different if divided over the three sub-periods. Table A2.2 shows the average value and variance for general inflation and house price changes.

Table A2.2. Average value and variance for inflation (I) and house price changes (H)

Annual changes in percentage, quarterly data.

Period	1966:3–2000:4		1966:3–1977:4		1978:1–1989:2		1989:3–2000:4	
Variable	I	H	I	H	I	H	I	H
Average value	6.10	6.66	6.96	8.68	8.13	7.04	3.22	4.25
Variance	14.74	48.32	3.10	25.67	3.01	6.81	3.57	8.05

As shown in the table, the variance in house price changes has been greater than the variance in the inflation rate over all sub-periods.

A reasonable assumption is that a high variance in actual price changes should lead to a high variance in expected house price changes. If this assumption is correct, it would be possible, on the basis of the results in table A2.2, to assume that the variance in the expected changes in prices on houses is considerably greater than the variance in the expectations of future general price changes.

This would, in turn, mean that the variance in a real interest rate for housing based on house price expectations is greater than the variance in a real interest rate for housing based on expectations on general price changes. This assumption is, however, difficult to test formally, since data on expected inflation does not exist for the time horizon proposed by the Committee (approx. 15 years), and data for expected house price changes does not exist at all.[17] One can also ask oneself whether house prices and the general price level rise at the same rate over time. If this is not the case, it would be in appropriate to use inflationary expectations rather than house price expectations when calculating the real rate of interest for housing, since the trends would not correspond even in the long term. Just like most time series, the price series tends to follow a positive trend over time. Economic variables often demonstrate a similar trend over time. They tend to follow a common, stochastic trend, and are described as co-integrated. If inflationary expectations are to be used as a proxy variable for expectations of house price changes, the actual time series should be co-integrated, i.e. their stochastic trends, if any, should not be independent of each other so that they drift off in different directions. If the test indicates that the actual historic development of the price series follows a common trend, it should be safe to assume – if the agents are reasonably rational – that expectations on house prices and consumer prices would also track each other over time. Diagram A2.3 shows logarithmic consumer prices and house prices for the same time period as in diagram A2.2. The price series seem to follow a common long-term trend, even if the house prices fluctuate considerably more over time. To investigate initially whether the two price series follow stochastic trends (are non-stationary), two versions of an augmented Dickey-Fuller test (ADF-test) are used.[18] These are designated c and ct in table A2.3 below.[19] The number of lags of the dependent variable in the test regression is indicated by p.

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[17] The hypothesis receives some support if the variance in actual and expected inflation (one year into the future) is compared over different time periods. Source: HIP.

[18] The test is augmented by lags of the dependent variable (Augmented Dickey-Fuller test).

[19] The versions have different non-null hypotheses but the same null hypothesis. If the null hypothesis is rejected in favour of the non-null hypothesis when version c is used, the test result indicates stationary fluctuations around a constant average value. If the null hypothesis is rejected in favour of the non-null hypothesis when ct is used, the test indicates stationary fluctuations around a deterministic linear trend. When the variables are expressed in differential form, no tests

Table A2.3. ADF test for levels and first differentials (D) in consumer prices (KP) and house prices (HP), quarterly data from 1965:3 to 2000:4.

Variable :	KP	DKP	HP	DHP
C	-1.97	-2.57	-0.99	-3.46*
P	(1,3-4,7-8)	(1-2,4,7)	(1-4,6)	(1-2,4-5,7)
Ct	-1.97	-	-2.70	-
P	(1-5)		(1-4,6)	

Kommentar: Är det här kommatecken för decimaler eller är det bara skiljetecken? Om det är decimaltecken ska de bytas ut mot punkter.

Note. Significance at 5% level is indicated by *. During tests, normal t-ratios have been used, but the underlying distribution is non-standard. Critical values are taken from MacKinnon (1991).

The test results imply that both consumer prices and house prices are non-stationary, when the price series are expressed in level form. Quarterly changes in house prices (DHP) seem to be a stationary time series. The result does, however, indicate that the differential consumer price series (DCP) is non-stationary. If the test is carried out at a 10% level, the conclusion is, however, the opposite. A more in-depth analysis of DCP results in it being viewed as stationary in two different time periods, one prior to the period around 1993, and one after.[20] The conclusion is that both price series can be regarded as non-stationary at levels but stationary in differential form.

To test the co-integration between variables, Engle and Granger's two-step procedure is used. In the first step, the co-integration regression (the long-term relationship) is estimated using the following equation:

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are carried out with *ct*. In this case, the more reasonable non-null hypothesis is stationarity around a constant average value.

[20] If dummy variables are introduced into the ADF test, to catch a shift in level around 1993, the null hypothesis at the 5% level is rejected. The version of the ADF test which is used to

$$KP_t = a_0 + b_1 HP_t + e_t,$$

while in the second step an ADF test is used to find out whether the residuals, from step one, are stationary. The result of this procedure for consumer prices and house prices is reported in table A2.4. Two different specifications of the co-integration regression are used. Firstly, a version with a constant (a_0) included in the long-term relationship above (c). Secondly, a version which does not include the constant (-). The number of lags of the dependent variable, which has been included in the residual regression (step two), is designated p.

Table A2.4. Test for co-integration between consumer prices and house prices, quarterly data 1965:3 – 2000:4. Estimated parameters from step 1 are designated $_0a$ and $_1b$ respectively.

	Step 1			Step 2	
	a_0	b_0	R^2	ADF-test	p
-	-	1.005	0.97	-4.16*	(1-4,6,8)
c	-0.21	1.050	0.97	-4.63*	(1-4,6,8)

Note. Significance at the 5% level is indicated by *. Critical values are taken from MacKinnon (1991).

As shown by the result, the null hypothesis, which implies non co-integration, is rejected if the whole period is taken into account. This applies to both test versions. The conclusion is that there is no clear tendency for consumer prices and house prices to drift away from each other over time.

Assume that expectations on, or forecasts for, future price changes are, to some extent, retrospective, i.e. that the historical trend in house prices plays a part in the development of expectations on future house price changes. If this assumption is reasonably accurate, an effective proxy variable for price changes

compensate for the shift in level in this study was originally presented by Perron and Vogelsang (1992). The critical values are taken from Franses (1998).

on houses should incorporate all relevant information which is important in the development of expectations on future changes in house prices. In this case, the historical values of general price changes (*I*) should be all that is necessary to generate acceptable forecasts for future house price changes *(H)*.

Expressed in equation form, the specification looks as follows:

$$H_t = a_0 + \sum_{i=1}^{k} a_i I_{t-i} + e_t,$$

To test whether lags of *H* give additional explanatory values (forecasting ability), over and above lagged inflation values, for the development of house prices, *p* lags are added in the equation above. The equation then appears as follows:

$$H_t = a_0 + \sum_{i=1}^{k} a_i I_{t-i} + \sum_{j=1}^{p} b_j H_{t-j} + e_t.$$

If a test indicates that $b_1 = 0 = ... = b_p = 0$ in the above equation, this supports the hypothesis that expectations on future house price changes are formed on the basis of the historical trend in general inflation. If this is the case, inflationary expectations should be an acceptable proxy variable for house price expectations, since all information on future house price changes would be incorporated in expectations on the general price trend.

The hypothesis is, however, clearly rejected if $k = p = 5$ in the above equation, and if the years 1966 to 2000 are studied.[21]

A possible explanation for why lagged values on house price changes seem to be necessary in a model for contemporaneous house price trends is based on

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[21] 21 F-test = 320.32, p-value = 0.000.

the theory of speculative bubbles. According to this theory, the strongly cyclical variation in house price changes over time would depend on self-fulfilling expectations on the future prices of houses. The expectations are primarily based on information on the historical house price trend and, to a lesser extent, on fundamentals such as the relationship between supply and demand in the housing market. If prices are rising, households will believe in a continued future rise in prices, irrespective of simultaneous developments in fundamental factors. Expectations on future increases in house prices stimulate demand, and the expectations become self-fulfilling in the form of rising prices. A similar argument can be used to explain falling house prices.[22] If expectations on future house prices are, at least to some extent, formed in this way, i.e. there is a grain of truth in the theory of speculative bubbles, it would, of course, be completely misleading to use general inflationary expectations as a proxy variable for expected house price changes. A moving average of the actual house price trend (e.g. over 5 years) would, in this case, be preferable as a measure of house price expectations.

Diagram A2.3. Consumer prices and house prices (logarithmic).
1965:3 - 2000:4

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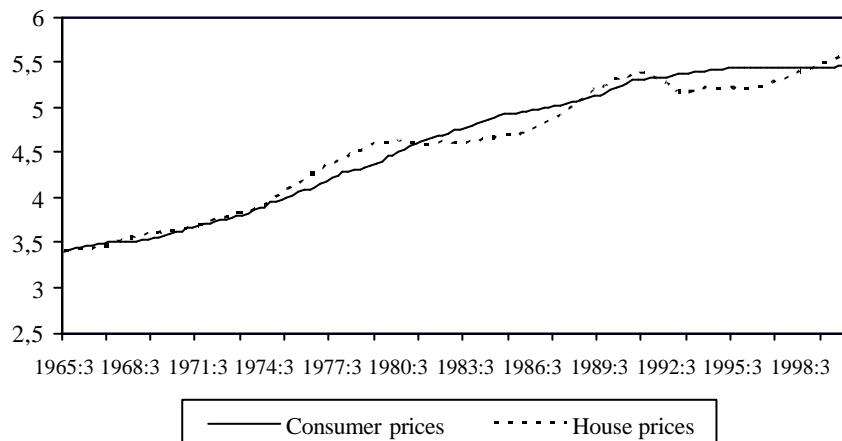
[22] See Hort (2000) for a more detailed discussion.

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