The new inflation target: the statistical perspective

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This article[1] sets out the statistical background to the Chancellor of the Exchequer's Pre-Budget Report 2003 announcement that the UK inflation target has changed from one based on the Retail Prices Index excluding mortgage interest payments (RPIX) to one based on the Harmonised Index of Consumer Prices (HICP), now known in the UK as the Consumer Prices Index (CPI). The article describes the historical background to the development of the CPI and RPIX indices, the differences between them, and their relative merits as indicators of UK inflation.

Executive summary

This article sets out the statistical background to the Chancellor of the Exchequer's Pre-Budget Report 2003 announcement that the UK inflation target has changed from one based on the Retail Prices Index excluding mortgage interest payments (RPIX) to one based on the Harmonised Index of Consumer Prices (HICP).

Concurrent with the Chancellor's announcement and reflecting its new role as the main UK domestic measure of inflation for macroeconomic purposes, the National Statistician decided that the UK HICP would in future be known as the 'Consumer Prices Index' (CPI) in all National Statistics releases and publications. This should not be interpreted as implying that there is any intention to develop the CPI differently from the HICP. The CPI and the HICP will remain one and the same index.

The historical contexts of the all-items Retail Prices Index (RPI) and the CPI are very different. The RPI began life as a compensation index, developed as an aid to protect ordinary workers from price increases associated with the First World War, and it was only much later that it came to be used as the main domestic measure of inflation from a macroeconomic perspective. A government inflation target expressed in terms of the RPIX was first adopted in 1992, and the all-items RPI is used to adjust benefits, tax allowances and thresholds, and also index-linked gilts.

HICPs were developed in the European Union (EU) expressly from a macroeconomic perspective, and launched in 1997. Initially, HICPs were used to assess which EU Member States passed the inflation convergence criterion for membership of Economic and Monetary Union (EMU), and so cross-country comparability was a key issue in designing the HICP. Since EMU has been established, it has been used by the European Central Bank to assess price stability in the euro area.

Nevertheless, the basic approach to the measurement of inflation adopted by both the CPI and RPIX is the same. Both track the changing cost of a fixed basket of goods and services over time, and both are produced by combining together some 120,000 individual prices collected each month for about 650 representative items. The CPI and RPIX baskets are 'fixed' in the sense that the relative quantities purchased of the various items in the baskets are assumed to be constant from month to month, although the baskets are updated on an annual basis. This ensures that within-year changes in the indices reflect only changes in prices.

As fixed quantity indices, both the CPI and RPIX are likely to 'overstate' changes in the cost of living in that, faced with rising prices overall, consumers are likely to substitute purchases of items which become relatively expensive for those which become relatively cheaper. This will help to limit the increase in the cost of their own 'shopping basket'. A cost of living index, by contrast, would allow for substitution of this type as it takes place: so as the prices of individual items go up, and at different rates, a cost of living index will always show a lower rate of change in prices overall than a fixed basket index. In practice, this potential problem is mitigated by annually updating the contents of the CPI and RPI baskets and the expenditure weights associated with them.

As well as adopting the same basic approach to the measurement of inflation, exactly the same underlying price data collected each month are used to compute both the CPI and RPIX indices in most cases. However, there are persistent and sometimes significant differences in the UK rate of inflation according to the two measures. Since January 1989, RPIX inflation has exceeded CPI inflation by an average of 0.7 percentage points and, at 1.3 percentage points in October 2003, the difference is currently quite wide.

These differences can be explained in terms of a series of detailed choices about how the two indices are constructed, for example:

- which particular consumers or households the index is designed to represent
- the range of goods and services that should be included and
- the way that their prices should be measured.

At a more technical level, but of great importance in practice, the CPI and RPIX also use different techniques to combine together the individual prices collected each month. This also affects their respective inflation rates and is called the formula effect. These differences between the CPI and RPIX measures are summarised in the box.

ONS publishes each month in summary form a numerical breakdown of the contribution of these factors to the difference between the annual rate of inflation according to the CPI and RPIX, although this is only available over the period since January 1997. It is important to note that this period is too short to view the resulting differences as the long-run deviation between the CPI and RPIX, or the longer-term contribution to that difference from any single factor. In particular, some housing costs that are excluded from the CPI have risen relatively rapidly over this period.

Bearing in mind these caveats, the analysis shows that, in practice, there are two main factors that serve to raise RPIX inflation relative to the CPI. First, the exclusion from the CPI of council tax and a range of owner-occupier housing costs included in RPIX has had the largest effect, on average lowering CPI inflation by 0.56 percentage points relative to RPIX since January 1997. Second, the formula effect has, on average, lowered CPI inflation relative to RPIX by 0.51 percentage points over the same period. The contribution from the housing components excluded from the CPI has varied markedly over this period, whereas the formula effect has been much more stable. On average, the impact of the other differences between the CPI and RPIX has been less important.

Box: Comparing the CPI and RPIX

In terms of **commodity coverage**, the CPI excludes a number of items that are included in RPIX, mainly related to housing:

- council tax
- owner-occupier housing costs such as house depreciation and buildings insurance
- house purchase costs such as estate agents' and conveyancing fees
- trade union subscriptions and vehicle excise duty.

Conversely, the CPI includes the following items that are not in RPIX:

- unit trust and stockbrokers fees
- university accommodation fees
- foreign students' university tuition fees
- foreign exchange commission for purchases of sterling by overseas visitors.

This partly reflects the differences in the **population base** for each index:

- RPIX is representative of private UK households excluding the highest income households and pensioner households mainly dependent on state benefits.
- The CPI covers all private households, institutional households and foreign visitors to the UK.

This also means that the weights for all the items in the CPI basket reflect the spending of the wider population.

There are also some specific differences in **price measurement** between the two indices:

- New car prices in RPIX are imputed from movements in second-hand car prices whereas the CPI uses a quality-adjusted index based on the published prices of new cars.
- The index for personal computers in the RPI currently uses the 'option cost' method for quality adjustment, whereas the CPI uses 'hedonic regression' techniques.
- The CPI classifies insurance spending net of claims receivable, whereas RPIX is based on gross premiums.

Finally, **individual prices are combined** in the CPI and RPIX within each detailed expenditure category according to different formulae:

- The CPI uses the geometric mean, which allows for consumer substitution from more expensive brands or varieties of each item towards cheaper alternatives when relative prices change.
- RPIX uses arithmetic means, which do not allow for substitution.

The formula effect arises because RPIX uses arithmetic means to combine individual prices in each detailed product group whereas the CPI uses the geometric mean (GM). For given price data, in practice the geometric mean always gives a lower estimate of price change. This is because within each detailed product group the use of the GM formula implicitly assumes that consumers switch purchases away from particular brands or varieties which become relatively more expensive, whereas arithmetic means do not. In addition, in producing a chain-linked index spanning several years, in some circumstances one of the arithmetic techniques used in RPIX can lead to a small upward bias known as 'price bounce'.

In terms of their basic usability as macroeconomic indicators, there is little to choose between the CPI and RPIX. Both are published monthly, to a common timescale, and are subject to minimal revisions (the RPI and RPIX, by convention, are never revised). Compared to RPIX, however, the CPI's later and explicit development as a macroeconomic indicator means that it has some distinct advantages over RPIX for this purpose.

In particular, the CPI benefits from greater coherence with other macroeconomic data, reflecting its foundation in National Accounts principles in determining index scope and population. The use of the GM averaging technique also has advantages, and is increasingly preferred in other countries. The GM formula is not susceptible to any bias due to price bounce and, in the context of cross-country comparisons, is much less influenced by detailed differences in index and sample design in individual countries.

Against this, the familiarity and credibility of RPI and RPIX based on their longer history is a key advantage. Inevitably, it will be some time before the CPI measure becomes as widely recognised. In addition, the CPI's exclusion of most elements of owner-occupier housing costs is an outstanding issue, and lessens its relevance for some users. However, this must be weighed against the significant difficulties encountered in measuring such costs appropriately, reflected in the absence of any international consensus in this area. The RPI's inclusion of owner-occupier housing costs partly reflects its use as a compensation index, but has necessitated some significant compromises in terms of the conceptual consistency of the index.

The ONS is currently taking part in a Eurostat pilot study assessing the possibility of including in the HICP an index of owner-occupier housing costs based on the net acquisitions approach. This would include household sector costs in acquiring new houses or existing houses from other sectors, bills for major repairs and renovations, and other house buying costs including estate agent and conveyancing fees. It is likely that the cost of major repairs and renovations would be measured by an index of construction costs. This has advantages over RPIX in that depreciation costs, which are measured via a smoothed house price index, are likely to be distorted through movements in land prices.

The pilot study is now close to completion and could be extended, subject to funding in 2004, to embrace all Member States. However, there are a number of difficult implementation issues to be addressed, and this means that the longer-term outcome cannot be assessed with any certainty at this stage. Any extension of the HICP and therefore CPI to cover owner-occupier housing costs is not likely to take place before January 2006 at the earliest, and could take longer.

Introduction

On 10 December 2003, in his statement on the Pre-Budget Report, the Chancellor of the Exchequer confirmed that with immediate effect the UK inflation would change from one based on the Retail Prices Index excluding mortgage interest payments (RPIX) to one based on the Consumer Prices Index (CPI), previously published in the UK as the Harmonised Index of Consumer Prices (HICP). At the same time, the Chancellor confirmed that pensions, benefits and index-linked gilts will continue to be calculated on exactly the same basis as previously, that is with reference to the all-items Retail Prices Index (RPI) or its derivatives.

Reflecting its new role as the main UK domestic measure of inflation for macroeconomic purposes, the National Statistician decided that the UK Harmonised Index of Consumer Prices (HICP) would in future be known as the 'Consumer Prices Index' (CPI) in all National Statistics releases and publications. This should not be interpreted as implying that there is any intention to develop the CPI differently from the HICP. The CPI and the HICP will remain one and the same index.

The new name is simpler, emphasises the CPI's role as a UK index, and is consistent with the naming of other price indices. The term CPI is used throughout the text of this article instead of HICP, except where the discussion relates specifically to the index in the European Union (EU) context, for example in the summary of the institutional arrangements in Box 4 or EU plans for the extension of HICP coverage of owner-occupier housing costs in a later section.

The reasons for the change in the inflation target and implications for the conduct of UK monetary policy are set out by HM Treasury in the Pre-Budget Report 2003 and in the Appendix attached to the new remit for the Bank of England's Monetary Policy Committee. This article is intended to promote understanding of the new target measure from a statistical perspective, in the context of its publication in the UK as a key element in a range of inflation measures used in public policy.

The article is organised as follows. Firstly the historical background to the development of the RPI, RPIX and CPI indices is set out. This is followed by a description of how the indices measure inflation, focusing on the underlying similarities in approach. Differences in the annual rate of UK inflation according to RPIX and the CPI are then analysed in terms of a series of more detailed choices concerning index coverage and construction. Key differences between RPIX and the CPI, including the coverage of owner-occupier housing costs and the formula effect, are described in detail. This feeds into an overall evaluation of the statistical properties of the two indices as macroeconomic indicators of inflation. Finally, there is a discussion of the longer-term options for the extension of CPI coverage in the field of owner-occupier housing costs.

Historical context: the evolution of consumer price indices in the UK

The historical contexts of the RPI and the CPI are very different, and this helps to explain their different statistical properties as described later in this article. The RPI has its origins in an index originally developed as an aid to protect ordinary workers from what were initially expected to be the temporary economic consequences of the First World War. To begin with then, its primary purpose was as a compensation index rather than a macroeconomic indicator of inflation. It was only much later that it evolved into the all-purpose index it is today.

The modern RPI is now used for a very wide variety of purposes. Government uses of the RPI include the uprating of benefits, taxation allowances and thresholds, the indexation of index-linked gilts, and the regulation of privatised utilities. The RPI is also used in private sector contracts to specify benchmark price changes. More generally, it has been used as the main macroeconomic indicator of inflation by economic analysts and policy makers. This multi-purpose role has helped to shape its development over time; a brief history of the RPI is provided in Box 1.

The RPI excluding mortgage interest payments, later to be called RPIX, was introduced in 1975 when the rental equivalent approach to the measurement of owner-occupier housing costs in the RPI was replaced by the mortgage interest payments approach. The inclusion of mortgage interest payments means that changes in interest rates have a direct, and often substantial, effect on the all-items RPI. Moreover, from a monetary policy perspective, the short-term impact of interest rate changes on the RPI is perverse. For example, action taken to reduce inflation by increasing interest rates increases the RPI initially. This is because the direct impact of increased mortgage interest payments is felt immediately, dominating for a period the more gradual reduction in price pressures for other goods and services that usually follows an increase in interest rates.

The introduction of RPIX therefore reflected a specific requirement for an inflation measure unhindered by the direct effect of interest rate changes. As a simple transfer between sectors, exclusion of the mortgage interest also has the advantage of helping to focus RPIX on prices for consumer goods and services as traditionally defined. The adoption of an official inflation target defined in terms of RPIX was first announced in October 1992. In fact, RPIX is just one example of a range of indices that have been developed, based on the all-items RPI, in response to the widening range of user needs. Other examples include:

- RPIY was introduced in 1995, and is designed to measure movements in underlying prices by excluding price changes that are directly due to changes in indirect taxation as well as movements in mortgage interest rates. By necessity, RPIY assumes that indirect tax changes are immediately and fully reflected in retail prices at the moment they occur, although in practice retailers may choose to absorb the change in their profit margins, at least for a period.
- The Tax and Prices Index (TPI), first produced in 1979, measures how much the average person's gross income needs to change to purchase the RPI basket of goods, allowing for the average amount of income tax and national insurance paid on earnings. Note that the TPI calculation also makes a number of simplifying assumptions[2] and, more importantly, has no distributional dimension despite the fact that the net impact of changes in incomes, prices and taxes often varies widely across different income groups.

Box 1: A brief history of the RPI

The RPI as it exists today is very different from the first official consumer price index produced in 1914 as an aid towards protecting ordinary workers from price rises associated with the First World War. The first index, designed as a compensation index for urban working class families, was influenced by highly subjective assessments of what constituted proper expenditure for a working class family. For example, beer was excluded entirely and the weight for tobacco in the index was much less than its share in actual spending. This index, with unchanged weights, was produced throughout the 1920s and 1930s.

In 1936 the then Ministry of Labour announced its intention to update the RPI weights using the results from a large-scale household expenditure survey carried out in 1937–38. However, this process was disrupted by the onset of the Second World War and so the results of the survey were not incorporated until the late 1940s when an 'interim' retail prices index was compiled. It was also from this point that the government convened a succession of RPI Advisory Committees to investigate and make recommendations on a number of measurement issues.

By the mid-1950s, sufficient information from the Household Budget Inquiry was available to underpin a new index and the first official Retail Prices Index was introduced in 1956. This coincided with the expansion of household coverage from working class families to all wage earners except those on very high and low incomes (the modern RPI has similar coverage) and the first proper articulation of the definition of the index and its scope in terms of which goods and services should ideally be included.

Since then the RPI has continuously evolved to reflect changes in user needs, statistical methods and household spending patterns, based on the recommendations of successive RPI Advisory Committees. A number of statistical improvements have been made to the RPI over the past decade. These include the introduction of a component for foreign holidays from 1993 and UK holidays from 1994, implementation of random sampling of locations in 1995, and the introduction of explicit quality adjustments for the first time, with the inclusion of an index for personal computers in 1998.

Further historical background to the evolution of consumer price indices in the UK is provided in Appendix A. The main RPI Advisory Committee recommendations are given in Appendix B.

The CPI, by contrast, has a much shorter history. HICPs were developed in the EU for the sole purpose of assessing whether prospective members of European Monetary Union would pass the inflation convergence criterion and then of acting as the measure of inflation used by the European Central Bank to assess price stability in the euro area. The main requirement therefore was for a measure that could be used to make reliable comparisons of inflation rates across EU Member States. Such comparisons are not possible using national consumer price indices due to differences in index coverage and construction. As described later in this article, this comparability requirement has had an important bearing on the design and methodology adopted in constructing the HICP.

The Office for National Statistics (ONS) first published UK inflation rates on the CPI basis in February 1997 with back data for index levels to January 1996. Estimates extending further back to 1988 have also been made, along with indicative figures for the period 1975–1987. These estimates are described in O'Donoghue (1998), *Harmonised Index of Consumer Prices: historical estimates,* which is available on the National Statistics website.

RPIX and the CPI: what do they measure and to what extent are they similar?

Fixed basket price indices

Although there is no single definition of the word 'inflation', many consumers might think of it as an ongoing decline in the value of money driven by a more or less continuous increase in the price of goods and services that they purchase. One straightforward method of measuring inflation therefore is to calculate the amount of extra money required in some period to purchase the same basket of goods and services that could be purchased by a given sum of money in some earlier period. The amount of money needed to purchase a fixed basket of goods and services is known as the internal purchasing power of the currency. Both RPIX and the CPI measure inflation by estimating changes in this amount of money over time. The approach is formalised in the price index formulae shown in Box 2.

In principle, the cost of the basket should be calculated with reference to all consumer goods and services purchased by households, and the prices measured in every shop or outlet that supplies them. In practice, both the RPI and CPI are calculated by collecting a sample of prices for a sample of representative goods and services in a representative selection of retail outlets. They are currently produced by combining together some 120,000 individual prices collected each month for about 650 representative items.

Within each year then, both the RPIX and the CPI are described as fixed quantity or Laspeyres price indices.[3] As prices change over time, they assume that the relative quantities of each product purchased remain constant. This deliberate design choice is critical in ensuring that within-year movements in the indices reflect only changes in prices. For this reason, RPIX and the CPI are sometimes called 'pure' price indices.[4]

Box 2: Fixed basket price index formulae

Fixed quantity price indices are calculated as the cost of a fixed basket of n goods and services in the current period (time t) relative to the cost of the same basket of goods and services at the base date (time 0). As the index formula below makes clear, the basket is 'fixed' in that the quantities of the goods or services bought in the two periods are assumed to be constant. This ensures that it is only changes in prices that are reflected in the index and not changes in purchasing patterns.

$$I_{t,0} = 100 \times \frac{\sum_{i=1}^{n} P_{it} Q_{i0}}{\sum_{i=1}^{n} P_{i0} Q_{i0}}$$

where $I_{t,0}$ = index for period t based on base date, time t=0

P_{it} = price for the i^{th} item at time t

P_{i0} = price for the i^{th} item at the base date, time t=0

Q_{i0} = quantity of the i^{th} item purchased in the base period

The formula can be re-written as follows:

$$I_{t,0} = 100 \times \sum_{i=1}^{n} (P_{it}/P_{i0}) w_i$$

where $w_i = P_{i0}Q_{i0} / \Sigma(P_{i0}Q_{i0})$

In this case, it is more easily seen that the index may be calculated as a weighted average of price relatives or price changes for the various items in the basket. For each item in a given period, a price relative is calculated as the ratio of the current price to the base price, and so measures the proportionate change in the price of the item. The relatives are weighted by the share of each item in total nominal expenditure in the base period.

Consumer substitution and the cost of living

From an alternative perspective, however, pure price indices are likely to 'overstate' changes in the cost of living to the extent that, in the face of the relative price changes that typically accompany a general increase in prices, consumers are likely to substitute purchases of relatively expensive items for similar goods that have become relatively cheaper. This will help to limit the rise in the cost of their own 'shopping basket' in the face of a general increase in the cost of goods and services overall.

Therefore the RPI and the CPI do not measure 'the cost of living'. Avoiding value judgements about what constitutes a reasonable or minimum acceptable standard of living, a cost of living index can be defined as the minimum expenditure (or income) a consumer faced by rising prices requires to achieve the same level of utility as in some earlier period, relative to their expenditure (or income) in the earlier period. In this case, there is no assumption that relative quantities of goods and services purchased in the two periods are the same and so a cost of living index is conceptually quite different to fixed basket indices like the RPI and the CPI.

Box 3: Fixed basket price indices and cost of living indices compared

Suppose we have a single representative consumer who buys only two goods, say food and clothing, with quantities purchased and prices denoted F,C and P_f, P_c respectively. Further, assume that the utility or the satisfaction they derive from these purchases takes the general form:

$$\text{Utility, } U(F,C) = F^{\alpha}C^{1-\alpha} \quad (1)$$

where $0 < \alpha < 1$.

This particular form of consumer preferences, known as Cobb-Douglas, is used at this stage for illustrative purposes, and the conclusions that follow are not dependent on this functional form[1]. However, this particular utility function is directly relevant to the later discussion of the aggregation formulae used at the detailed level in the CPI and RPIX.

The consumer is faced with the problem of choosing the quantities of food and clothing that they purchase in order to maximise utility subject to an overall budget constraint:

$$\text{Income, } Y = P_f.F + P_c.C \quad (2)$$

Given this constraint on total spending, any change in say the quantity of food purchased must involve an offsetting adjustment to the amount spent on clothing. One way of solving the problem therefore begins with the total differentiation of equation (1):

$$dU = (\delta U/\delta F).dF + (\delta U/\delta C).dC$$

so $$dU/dF = \delta U/\delta F + (\delta U/\delta C).(dC/dF) \quad (3)$$

where, from (1) and (2), $\delta U/\delta F = \alpha U/F$, $\delta U/\delta C = (1-\alpha)U/C$, and $dC/dF = -P_f/P_c$

By setting (3) equal to zero and substituting in the partial differentials of U with respect to F and C and also dC/dF, it can be shown that the optimal quantities of food and clothing purchased are:

$$F = \alpha.Y/P_f \quad (4)$$

and $$C = (1-\alpha).Y/P_c \quad (5)$$

It is now clear that the shares of spending devoted to food ($P_f.F/Y$) and clothing ($P_c.C/Y$) are constant at α and $(1-\alpha)$ respectively, and so are invariant to changes in relative prices. That is, a proportionate increase in the relative price of either food or clothing leads to an equal and offsetting proportionate reduction in the relative quantity purchased, leaving its share in total spending unchanged. This means that elasticity of substitution[2] between the two goods is equal to 1.

[1] Note also that because consumer utility is not cardinally measurable, the apparent restriction implied by equation (1) that the exponents on F and C sum to one is not in practice significant.

These results are used in the table below to illustrate the impact on utility of an increase in prices. For illustrative purposes, it is assumed that income in the base period is £1,000 and the price of both food and clothing is £1 (see column 1 of the table). In this case, the consumer buys equal quantities of both commodities and, according to equation (1), maximises utility at 500.

Income, Y	1,000	1,000	1,414	1,500
Prices: Pf, Pc	1,1	2,1	2,1	2,1
Quantities: F, C	500,500	250,500	354,707	375,750
Utility (α=½)	500	354	500	530

Now suppose that the price of food increases to £2 in some subsequent period with the price of clothing unchanged (Column 2). Not surprisingly, the consumer now chooses to buy less food since it is now relatively more expensive. But with income still at £1,000, and higher prices overall, utility is lower. Column 3 shows that, at the new prices, income would need to increase to £1,414, or by just over 41 per cent, to achieve the same utility as in the base period. This is the cost of living adjustment.

Column 4 of the table meanwhile shows the situation where the consumer's income has been adjusted in line with the percentage increase shown by a fixed basket price index following the change in the price of food. Using the formula in Box 2, the increase in the total cost of the original basket is 50 per cent (that is, it costs 50 per cent more after the price change to purchase the original basket composed of equal quantities of food and clothing). However, since the consumer has substituted consumption away from food, which is relatively more expensive, he is able to raise utility above that achieved in the base period.

Where consumers have choice therefore, the percentage increase in the fixed basket price index overstates the increase in income or expenditure necessary to maintain living standards in the face of rising prices. Where relative price changes are large, the difference is also large. But for smaller price changes, a fixed basket price index is a reasonable approximation to a true cost of living index.

[2] For any good, the elasticity of substitution (σ) can be defined as the proportionate change in the relative quantity purchased divided by the proportionate change in its relative price. In the example above:

$\sigma = d(C/F)/(C/F) \,/\, d(P_f/P_c)/(P_f/P_c) = d(C/F)/d(P_f/P_c) \,/\, (C/F)/(P_f/P_c)$

dividing (5) by (4) gives $C/F = (1-\alpha)/\alpha.\ (P_f/P_c)$, so

$d(C/F)/d(P_f/P_c) = (C/F)/(P_f/P_c) = (1-\alpha)/\alpha$ and $\sigma = 1$

Box 3 examines this issue in greater detail. It shows that a price index based on a fixed basket of goods and services overstates the extent to which consumers' expenditure or income must rise in order to maintain constant utility as prices rise. Although the point is illustrated with reference to a particular form of consumer preferences, the result always holds when there is consumer substitution between different products. That is, when prices rise, so long as consumers have a choice, they can always achieve a given standard of living at lower cost by varying the relative quantities of the goods they purchase, compared to simply increasing overall spending on a fixed bundle of goods.[5]

The degree to which the fixed basket price indices like the RPI and the CPI may overstate changes in the cost of living depends on the scale of price changes. In practice, the potential problem is minimised by regularly updating the contents of the RPI and CPI baskets and the expenditure weights associated with them. In both cases, within-year price indices based on a fixed basket of items and constant expenditure weights are calculated for the period from January to the following January. These overlapping within-year indices are then chained together to form a single price index spanning several years. Annual updating of RPI and CPI baskets and weights ensures that the indices remain representative of consumer spending patterns over time.

The degree of consumer substitution between products in the face of relative price changes is an important concept. Later in this article it is shown that the various averaging techniques used to combine prices at a low level of detail in RPIX and the CPI embody different assumptions about the degree of substitutability between different varieties or brands of products. Not surprisingly, this has an important bearing on the measured rate of inflation according to the two indices.

What is the CPI?

Reflecting its new role as the main UK domestic measure of inflation for macroeconomic purposes, the CPI is the new name for the inflation measure previously published in the UK as the HICP.

The HICP was developed by Eurostat, the Statistical Office of the EU, and EU Member States. It is constructed in each EU country in accordance with a series of regulations and guidelines that followed from an initial regulation passed in October 1995. These regulations and guidelines are designed to ensure comparability of measured inflation rates across Member States, something which is not possible with national consumer price indices because of differences in coverage and construction.

Eurostat combines these figures into aggregate indices for the Monetary Union area and the whole of the EU. The weights are based on each country's share of household final consumption expenditure. The UK's weight in the aggregate EU index in 2003 is just under 17 per cent. The UK has the second largest weight after Germany (24 per cent), but not much different from France (16 per cent) and Italy (15 per cent). Eurostat publishes both the HICPs for individual countries and the aggregate indices on a monthly basis. They are also published in the individual countries; in the UK they are published monthly in the consumer price indices First Release.

Box 4 summarises the institutional arrangements for the production and development of the HICP across the EU. It should also be noted that the published HICP and UK CPI figures can in principle be revised, whereas by convention the RPI and RPIX are never revised. That said, past revisions to the previously published UK HICP figures have been minimal, with only one set of changes made since 1996.

Box 4: Institutional arrangements for the development of the HICP

The HICP is defined in a series of legally binding regulations. The Council Regulation (EC) No 2494/95 of 23 October 1995 'concerning harmonised indices of consumer prices' provides the legal basis of the HICPs and a series of subsequent Council and Commission regulations define its construction and coverage.

The aim of these regulations is to establish a set of minimum standards that ensure that the HICPs constructed in Member States are comparable. They aim to promote good statistical practice by defining a series of 'minimum standards' while recognising the principle of 'subsidiarity' to allow for national circumstances.

HICP regulations are drafted by the European Commission (Eurostat) in conjunction with Member States through the HICP Working Party. This work is overseen and approved by the Statistical Programme Committee (SPC) made up of Heads of EU National Statistical Institutes and the Head of Eurostat. Like other Member States, the UK can influence legislation but cannot dictate it. As the HICP is the measure of inflation used by the European Central Bank (ECB) for monitoring inflation in the euro area, the 'opinion' of the ECB is also sought on all regulations.

The HICP regulations are obligatory in every EU Member State. Eurostat, on behalf of the Commission, undertakes an ongoing compliance monitoring programme to evaluate compliance with the HICP regulations.

Member States' interests in the development of the HICP are represented at the HICP Working Party, which meets about three times a year. HICP regulations normally require a qualified majority vote before they are brought forward for legislation. In addition, there are also a number of guidelines, which have been agreed by Eurostat and Member States, as a practical and flexible way of taking forward development of the HICP. These guidelines do not have the force of law but often form the basis of subsequent regulations. Guidelines may also give practical examples and general advice on how the legal requirements of regulations should be implemented.

As noted earlier, the change in name of the HICP in the UK to the CPI should not be interpreted as implying that there is any intention to develop the CPI differently from the HICP. The CPI and the HICP will remain one and the same index.

Why and how does the CPI differ from RPIX?

We have already seen that both RPIX and the CPI adopt the same fundamental approach to the measurement of inflation. Both measures are based on the simple idea of tracking the changing cost of a fixed basket of goods and services over time. Indeed, for the vast majority of goods and services in the RPIX and CPI baskets, the same underlying price data is used to calculate the two indices.

There are, nevertheless, persistent and sometimes significant differences in the UK rate of inflation according to the two measures. Figure 1 compares the annual inflation rates for RPIX and the CPI each month since January 1989.[6] For most of this period, the annual change in RPIX has exceeded that for the CPI. On average, the difference has been 0.7 percentage points over this period. It is also clear that the difference varies over time and, at 1.3 percentage points in October 2003, the difference is currently quite wide.

As discussed below, the inclusion of a range of housing costs in RPIX, but not in the CPI, has tended to result in larger increases in RPIX than the CPI because over this period housing costs have tended to increase by more than prices generally.[7] The only period when the RPIX annual rate was lower than for the CPI was the 12 months from April 1991. This was mainly due to a 30 per cent cut in the community charge in April 1991 lowering RPIX inflation but not the CPI from which it is excluded.[8] The discussion below also shows that increases in RPIX are usually larger than in the CPI because of the different methods adopted in the two indices to combine prices at the most basic level of detail, all other things being equal.

Coverage and methodology

More generally, compilation of fixed basket indices such as RPIX and the CPI involves a range of detailed choices concerning index coverage, construction and methodologies. Some of the more important choices concern:

- **Population base**: *which particular consumers or households is the index designed to cover?*

  The CPI is based on the purchasing patterns of *all* private households. RPIX, by contrast, excludes the expenditure of the top 4 per cent of households by income and pensioner households that derive at least three-quarters of their total income from state benefits (the latter accounting for around 10 per cent of UK households). Note that the exclusion of households with very low and very high incomes from the national consumer price index is not common in other countries. In addition, the CPI also includes the expenditure of people living in institutional households, such as nursing homes and student hostels, and of foreign visitors to the UK, all of which are excluded from RPIX.

- **Commodity coverage**: *in principle, which types of goods or services should be included in the index?*

  The types of goods and services which in principle should be included in the index is known as the scope of the price index. The CPI largely follows National Accounts concepts of what constitutes household consumption in determining index scope, and mainly uses National Accounts data sources to weight together the items in the basket. The expenditure coverage of RPIX is similar but has evolved in a largely pragmatic way, drawing on evidence on UK consumer spending patterns provided by the Expenditure and Food Survey (EFS) as the basis for the selection and weighting of items in the basket.

  However, as described later, there are a number of specific and important differences in commodity coverage between the two measures. These mainly relate to the treatment of owner-occupier housing costs, and also council tax, which are covered in detail in RPIX but largely excluded from the CPI.[9]

- **Price measurement**: *how should prices in the index be measured?*

  Although the physical collection and measurement of prices may seem straightforward, some difficult issues do arise in a few specific areas. A particular challenge lies in ensuring that the price index is not affected by changes in the quality of goods and services purchased over time. This is particularly important for sectors where the rate of technological progress is high, and product specifications change frequently (for example, computers). A range of methodologies exist to adjust the prices of such goods for changes in quality, and the RPIX and CPI measures adopt different approaches in some cases.

- **Index methodology (the formula effect)**: *how should prices be combined at the lowest level of detail?*

  In practice, individual prices used in the RPI and CPI indices are collected and combined together to form sub-indices at a fine level of disaggregation. For many products, distinct sub-indices will be constructed for each region of the UK and may also be further subdivided by shop type. These elementary indices are then weighted together to form the overall price index.

  Within each elementary index, however, expenditure weights are not available with which to combine the prices and so one of a number of simple averaging techniques

Figure 1
CPI and RPIX inflation

Per cent, month on a year ago

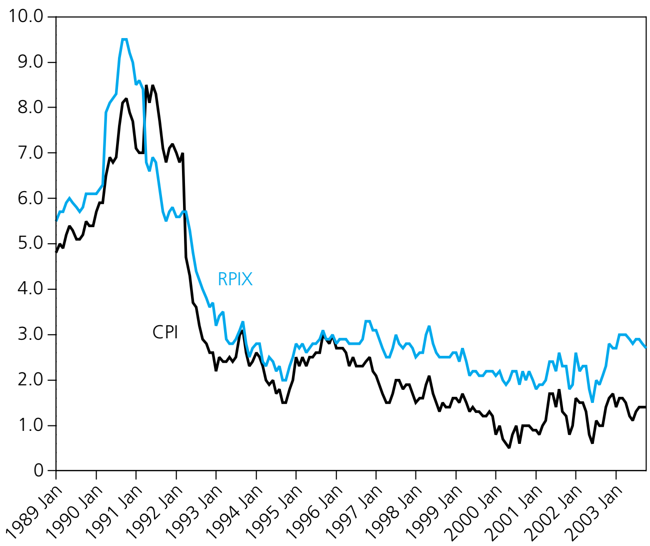
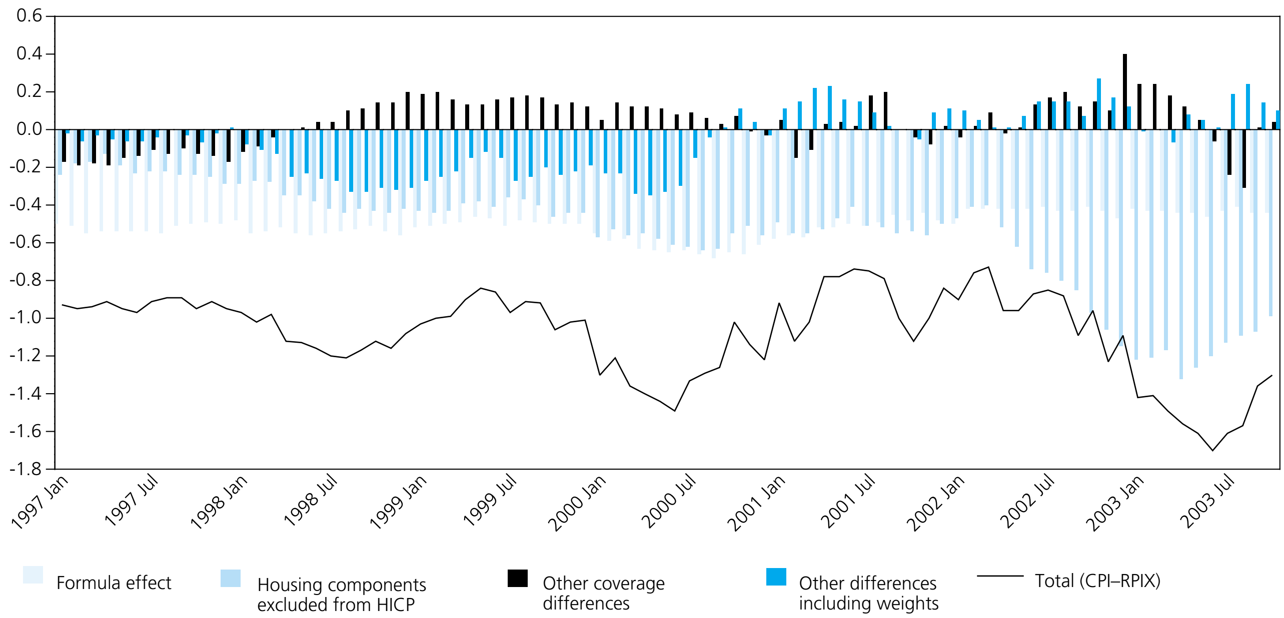


Figure 2
Contributions to the difference between CPI and RPIX inflation

Percentage points, month on a year ago



must be employed. The CPI generally uses the geometric mean to average prices at this basic level, whereas RPIX employs a mixture of arithmetic mean techniques. As described later in this article, this means that the CPI produces a lower estimate of the change in prices at this level than RPIX. This is known as the formula effect.

Reconciling the CPI and RPIX inflation rates

ONS publishes each month a detailed reconciliation of the differences in the annual rates of inflation according to the RPIX and CPI measures. This analysis is only available for the period since 1997, corresponding to the period for which official CPI figures have been published in the UK. It is important to note that this period is too short to view the resulting differences as the long-run deviation between the CPI and RPIX, or the longer-term contribution to that difference from any single factor. In particular, the housing components excluded from the CPI have risen relatively rapidly over this period.

Bearing in mind these caveats, estimated contributions to the difference in the annual rates of CPI and RPIX inflation since January 1997 are shown in Figure 2. The data are provided in Appendix C and are summarised in Table 1.

It is clear that, in practice, there are two main contributors to the difference between the CPI and RPIX annual inflation rates:

- The exclusion of council tax and most components of owner-occupier housing costs from the CPI has had the largest effect since January 1997, on average reducing CPI inflation by 0.56 percentage points relative to RPIX. While the exclusion of the housing components has consistently lowered CPI inflation relative to RPIX over the period under consideration, its impact has also been the most variable, ranging between –0.13 and –1.32 percentage points.

Table 1:
Differences[1] in CPI and RPIX inflation rates since January 1997

	January 1997 to October 2003			
	average[2]	minimum	maximum	standard deviation
Difference between annual rates:				
(CPI *less* RPIX):				
Rounded (published) figures	–1.1	–1.7	–0.7	0.2
Unrounded figures	–1.08	–1.70	–0.73	0.23
Breakdown of differences:				
Housing components excluded from CPI	–0.56	–1.32	–0.13	0.30
Other differences in coverage[3]	+0.04	–0.31	+0.40	0.13
Formula effect	–0.51	–0.68	–0.41	0.07
Other differences including weights[4]	–0.05	–0.35	+0.27	0.17

1. Negative figures indicate that CPI inflation is lower than RPIX or factors which lower CPI inflation relative to RPIX.
2. The period covered by the table is too short to consider these figures as the long-run deviation between the CPI and RPIX.
3. Includes differences in price measurement, as described later in this section.
4. Derived as a residual.

- The formula effect has, on average, lowered CPI inflation by 0.51 percentage points since January 1997. As with the housing effect, the formula effect has consistently lowered CPI inflation relative to RPIX over this period, but its impact has been much more stable, ranging from –0.41 to –0.68 percentage points.

Given their importance, these differences in commodity coverage and the formula effect are explained in greater detail in the sections that follow. The analysis also shows that:

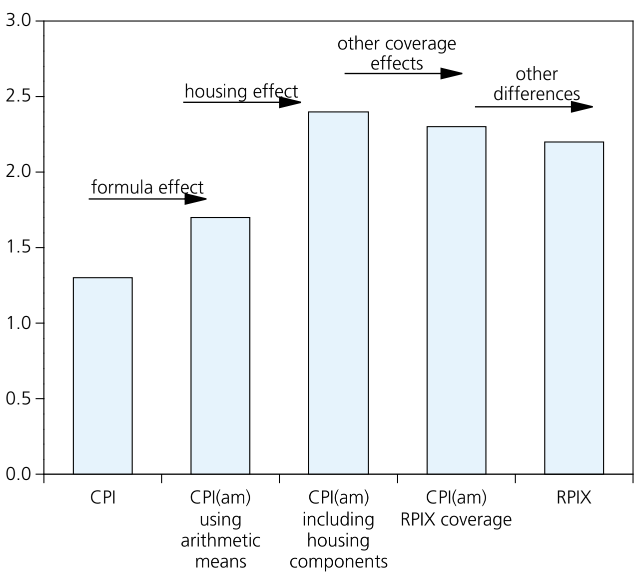
- Other differences in commodity coverage including price measurement effects described later have typically had a smaller impact on the difference between the CPI and RPIX inflation rates since January 1997. The average impact over this period has been just +0.04 percentage points, but has ranged from –0.31 to +0.40 percentage points in individual months. This variation reflects in part changes in the coverage of the CPI.
- A similar story can be told for the remaining differences between CPI and RPIX, including differences in weights stemming from different population coverage and sources of weights data. Their impact has ranged from –0.35 to +0.27 percentage points since January 1997, with an average of –0.05 percentage points over the full period.

Figure 3 summarises the relationship between the two measures. Moving from left to right, it sets out the key steps involved in moving from CPI inflation to RPIX inflation in 2002, the latest full year for which data are available:

- First, as in RPIX, prices at the lowest level of detail in the CPI must be combined according to arithmetic rather than geometric averaging techniques. This would raise the CPI measure of inflation by around 0.4 percentage points in 2002.

Figure 3
The relationship between CPI and RPIX inflation in 2002

Per cent



- Next, in adjusting the commodity coverage of the CPI basket to match RPIX, the addition of council tax and owner-occupiers housing costs has the most significant impact in 2002, increasing CPI inflation by 0.7 percentage points.
- Adjusting for other differences in coverage has a much smaller impact, lowering CPI inflation by just 0.1 percentage points in 2002.
- Finally, the impact of remaining differences, including the impact of the different weights that are attached to those items common to both indices, is downward but small overall.

Commodity coverage and price measurement effects

The range of goods and services covered by the CPI is generally quite similar to RPIX. The main differences are in the area of housing, and particularly owner-occupier housing costs, which are largely excluded from the CPI. This reflects the diverse treatment of such costs in national consumer price indices, and the difficulties in establishing an international consensus on how they should be measured.

Specifically, the following housing components are included in RPIX, with a total weight of 9.5 per cent in 2003, but are excluded from the CPI:

- Council tax. This is excluded from the CPI because it is treated as a direct tax in the National Accounts and so is not considered a part of household final consumption.
- House depreciation. This is designed to measure the ongoing costs homeowners face to maintain their properties at constant quality, and is imputed in the RPIX by a smoothed house price series.
- Buildings insurance and ground rent and
- House transaction costs: surveyors' valuation fees, home buyers survey costs, estate agents' fees and conveyancing fees.

The CPI also excludes mortgage interest payments, which are included in the all-items RPI but not of course in RPIX. The possible extension of the coverage of EU HICPs and the CPI to include these various components of owner-occupier housing costs is discussed later. Finally, the CPI also excludes trade union subscriptions and vehicle excise duty, again because these items are not counted as part of household final consumption.

Conversely, there are a number of items which are included in the CPI but not covered in RPIX, mainly due to differences in the population basis of the two measures. Specifically, because the CPI population also includes residents of institutional households, foreign visitors to the UK and those high-earning private households that are excluded from RPIX, it includes the following items:

- university accommodation fees
- foreign students' university tuition fees
- unit trust and stockbrokers' charges and

- foreign exchange commission on the purchase of sterling by overseas visitors.

It is important to note that the impact of the CPI's wider population base goes much further than the inclusion of these additional items that are not in RPIX. More important, it means that the weights for all items in the CPI basket take account of spending by all UK households, residents of institutional households and foreign visitors to the UK.

The coverage of the EU HICPs and therefore the UK CPI has been extended in stages since their official launch meaning that the differences between the CPI and RPIX have changed over time. For instance, there were extensions to CPI coverage in 2000 and 2001 bringing in components for health and education, which were already included in RPIX. By contrast, the extension of the CPI population basis in 2000 to include expenditure in the UK by foreign visitors and residents of institutional households means that it now includes a number of items that are not included in RPIX as described above.

In terms of price measurement, there are a few specific differences between the CPI and RPIX. These mainly relate to the methods used to quality adjust prices so that the price index is not affected by changes in product specifications over time:[10]

- In RPIX, new car prices are imputed on the basis of movements in second-hand car prices. Since HICP regulations do not permit the use of imputed prices, the CPI includes a specific index for new cars. This is based on the list prices of a sample of around 50 cars covering a range of manufacturers, and is quality adjusted using the option cost technique for any changes in specifications.
- Quality adjustment of personal computer prices in RPIX is currently based on the option cost methodology whereas the CPI uses hedonic regression techniques. However, under the National Statistics Protocol on Consultation with Ministers, the National Statistician has written to Treasury Ministers advising that he proposes to extend hedonic regression as the basis for quality adjusting personal computers to the RPI in 2004.[11]
- In the RPI, all expenditure on insurance is considered to belong to the relevant insurance heading (for example, housing or motoring insurance premiums). By contrast, in the CPI, the amount paid out in claims is distributed among other spending categories according to the nature of the claim with only the residual (that is, the service charge) allocated to the relevant insurance heading. In practice, this affects only the weights of insurance in RPIX and the CPI; there is no practical means of measuring insurance *prices* net of claims paid out.

The formula effect

Both RPIX and the CPI are produced by weighting together some 120,000 individual prices collected each month for about 650 representative items. The indices are constructed 'bottom-up', with sub-indices at each stage weighted together by expenditure shares to give higher level indices and then finally the overall or aggregate price index.

At the lowest level of aggregation, prices are grouped into about 5,000 elementary aggregates representing further subdivisions of items, usually by the type of outlet and/or the region of the country where the prices were collected. So, for example, an elementary index might be calculated for best minced beef sold in independent shops in London. However, at this level of detail, there is no information on the expenditure shares (that is, weights) for the individual shops from which prices are collected. In this case, it is usual to take a simple unweighted average of the prices in computing the elementary index.

The RPI and RPIX use two different types of arithmetic means to compute indices for the elementary aggregates: the Ratio of Averages (RA) and the Average of Relatives (AR). RA compares the unweighted average of prices in the current period with the unweighted average of matching prices in the reference period. AR meanwhile calculates, for each pair of matching prices, the ratio of the price in the current period with the price in the reference period and then averages these ratios.

The RA method implicitly gives greatest weight to the highest priced products or brands in estimating price change overall. For this reason it is mainly used in RPIX for items that are fairly tightly defined, such as food, alcohol and tobacco. This helps to ensure that the various prices collected in any given period are quite similar, meaning that the estimate of price change should not be unduly dominated by any particular product within the aggregate. The AR method, by contrast, gives equal weight to each of the price relatives and is used for products such as clothing and furniture, where wider variations in prices resulting from broader item descriptions limits the application of the RA technique.

The CPI, by contrast, uses the geometric mean[12] (GM) to form the price indices for these elementary aggregates. Each low-level index is computed as the ratio of the simple unweighted geometric mean of prices in the current period relative to the unweighted geometric mean of the matching prices in the reference period. An identical result would be found by taking the unweighted geometric mean of the price relatives, and in this sense GM shares some similarities with both the RA and AR techniques.

However, these different methods of averaging prices within the elementary aggregates do produce different results. A number of mathematical properties of the various techniques are set out in Box 5. The key points are as follows:

- As a general mathematical result, the geometric mean of a given set of values is always lower than the corresponding arithmetic mean, except when those values are all equal (in this particular case there is no difference between the geometric and arithmetic mean).
- This means that, for a given set of price relatives, the GM averaging formula used in the CPI will always produce a lower estimate of price change for an elementary index than one based on the AR aggregation technique employed in RPIX.

- The scale of this difference depends on the dispersion of the price relatives; as the variance of the price relatives increases, so does the discrepancy between the GM and AR results.
- However, for a given set of matching prices in two periods, the estimate of price change for an elementary index based on the RA technique employed in RPIX can in theory lie above or below the corresponding result based on GM, depending on the variance of prices in the current and base periods.

Box 5: Arithmetic and geometric means, and elementary aggregation techniques

Denoting the arithmetic and geometric mean functions a(x) and g(x) respectively, in the case of 2 real values, x_1 and x_2, the functions are defined as follows:

$a(x) = (x_1+x_2)/2$ and $g(x) = \sqrt{(x_1.x_2)}$

so $\quad a(x) = (\sqrt{x_1}^2 + \sqrt{x_2}^2 + 2\sqrt{(x_1.x_2)} - 2\sqrt{(x_1.x_2)}\,)\,/\,2$

$\quad\quad a(x) = g(x) + (\sqrt{x_1} - \sqrt{x_2}\,)^2\,/\,2$

Since the final term on the right-hand side is always greater than or equal to zero, it follows that the arithmetic mean of two values is always greater than the geometric mean except where the two values are equal. This result holds for any higher number of observations of x.

Moreover, since the extent to which a(x) exceeds g(x) is proportional to the square of the difference between the square roots of x_1 and x_2, this means that it must increase according to the variance of the x values.

Now let P_t denote a set of n prices collected in the current period, $\{P_{1,t}\ldots P_{n,t}\}$, and P_0 denote the set of matching prices in the base period, $\{P_{1,0}\ldots P_{n,0}\}$. The corresponding set of price relatives may be denoted, $R_t = \{R_{1,t}\ldots R_{n,t}\}$ where $R_{it}=P_{it}/P_{i0}$. The various elementary aggregation methods are defined as:

Average of Relatives, AR = $a(R_t)$

Ratio of Averages, RA = $a(P_t)/a(P_0)$

Geometric mean, GM = $g(P_t)/g(P_0) = g(R_t)$

Comparing AR and GM:

$AR - GM = a(R_t) - g(R_t)$

Following from the earlier results, it is clear that that the arithmetic mean of the price relatives is always greater than the geometric mean of the price relatives except where all price relatives are equal, and that the difference is increasing in the variance of the price relatives.

Now comparing RA and GM:

$RA - GM = a(P_t)/a(P_0) - g(P_t)/g(P_0) = k(a(P_t)/g(P_t) - a(P_0)/g(P_0))$

where $k = g(P_t)/a(P_0)$

The difference between RA and GM therefore is proportional to the difference in the ratio of the arithmetic and geometric means of prices in the current period compared to the same ratio in the base period. Since $a(x) \geq g(x)$, both of these ratios will be greater than or equal to 1. Moreover, because these ratios are increasing in the variance of prices in each period, it follows that:

If the variance of the base prices > variance of current prices then GM > RA

If the variance of the base prices < variance of current prices then GM < RA

If the variance of the base prices = variance of current prices then GM = RA

This use of arithmetic averaging techniques in RPIX, as opposed to GM in the CPI, does mean that the former shows a higher rate of change for given price data. This observation is directly related to the earlier discussion concerning consumer substitution between products when relative prices change. As described in Box 3 of this article, substitution helps to limit the increase in total spending consumers require to maintain living standards in the face of a general increase in prices. The GM formula implicitly assumes that consumers will switch to cheaper alternatives when relative prices change, whereas arithmetic means are consistent with an elasticity of substitution of zero.[13,14] Focussing on within-year price changes then, the use of both RA and AR techniques contributes to the formula effect. To the extent that it is considered desirable to allow for these substitution effects, GM has advantages over both of the arithmetic techniques.

In practice, the bulk of the formula effect arises due to the use of the AR technique in RPIX rather than GM as in the CPI. There are two factors in particular which serve to raise the dispersion of price relatives within the elementary aggregates, so increasing the difference between the AR and GM estimates of price change:

- The use of January as the base month. Prices in January are somewhat atypical in that there is widespread and variable discounting for a range of products due to sales. Price relatives anchored on a January comparison period therefore tend to be more dispersed than they would be if the comparison period were some other month of the year.
- Price collection methods. Price collectors are given generic descriptions of items (for example, 'men's long sleeved shirt') rather than exact specifications (which could, for example, specify the brand of shirt, and its fabric composition, style and cut). This could raise the dispersion of the price relatives in that price changes for different types of shirts and other similar goods may vary widely, thus contributing to the formula effect. Note that generic price descriptions are cost effective in that they improve coverage by allowing prices to be collected for a broad range of products.

However, relative to GM and also RA, the use of AR in RPIX has further implications. As noted earlier, within-year indices for RPIX and the CPI (and their component indices) are chain linked together to form indices spanning several years. It can be shown that in certain circumstances, the use of the AR aggregation technique when combined with chain linking of the within-year indices introduces an upward bias in the overall price index. This phenomenon is called 'price bounce'.

Price bounce occurs when prices within an elementary aggregate change but then subsequently return to their original level over the period of the chain link. With January chain linking, this is indeed quite common in practice, since the prices of many goods fall in the New Year sales and recover in subsequent months. In these circumstances, it can be shown that an AR index does not return to its starting level of 100, but to a level slightly above this, introducing an upward bias in the index.[15] The RA and GM aggregation methods, by contrast, are not affected by price bounce. Box 6 explains price bounce in greater detail and provides a simple example.

Box 6: Price bounce

Consider the construction of a simple price index, based on the collection of just two price quotes in each period for a particular item. Further, suppose that prices for this particular item tend to fall in January as a result of sales, returning exactly to their previous level in February. Illustrative price data for the period December to February is provided in the table below.

	price 1	price 2	*arithmetic mean*	*geometric mean*
December 2002	100p	100p	*100p*	*100p*
January 2003	60p	80p	*70p*	*69.3p*
Price relative	*0.60*	*0.80*		
January 2003	60p	80p	*70p*	*69.3p*
February 2003	100p	100p	*100p*	*100p*
Price relative	*1.67*	*1.25*		

Price indices can now be calculated according to the AR, RA and GM aggregation formula discussed earlier in this article for the sub-periods January 2003 (based on December 2002 = 100) and February 2003 (based on January 2003 = 100), as shown in the table below:

Price index:	AR	RA	GM
January 2003			
(December 2002=100)	70.0	70.0	69.3
February 2003			
(January 2003=100)	145.8	142.9	144.3

These indices can now be chained together to produce an index covering the full period based on December 2002=100 as shown below. Denoting an index for period t based on time 0 as $I_{t/0}$:

$I_{Feb03/Dec02} = (I_{Feb03/Jan03} / 100) \times I_{Jan03/Dec02}$

In the AR case this is equal to (145.8/100) x 70.0 = 102.1

In other words, the AR aggregation method combined with chain linking suggests that the price of the item in February remains around 2 per cent above its December level, despite the fact that all the prices sampled have returned exactly to their December starting points. In the case of RA and GM approaches, by contrast, it is easily verified (ignoring rounding effects) that the corresponding chain-linked indices are both exactly 100.0 in February, and so are not affected by price bounce.

This bias in the AR method is a product of chain-linking and the behaviour of prices across the chain link. Specifically, price changes are negatively correlated across the chain link: in this example, price falls are followed by price increases. But if prices in February 2003 had been compared *directly* with December 2002, it is clear that the average of the two price relatives would be equal to 1, and so a direct AR index with no chaining would also show an index level of 100 in February.

Although the overall impact of price bounce on RPIX is much smaller than suggested by the contrived example set out in Box 6, it does make an important contribution to the overall size of the formula effect set out earlier in this article. Since RPIX is annually chain linked each January, and price movements for many items are negatively correlated across this link period due to New Year sales, the use of AR for certain products leads to a greater estimate of price change than the GM technique employed in the CPI.

It is now also clear that detailed index construction choices, such as the choice of base month or sampling procedures, when combined with the AR aggregation method, can have a significant impact on the measured rate of inflation. The GM approach, by contrast, is much more robust to such factors. This important point is considered further in the next section.

Evaluating RPIX and the CPI as macroeconomic indicators of inflation

The Government's monetary policy framework was introduced in 1997. The Monetary Policy Committee of the Bank of England now has full operational independence to set interest rates to meet the symmetrical inflation target set by the Government. Section 11 of the Bank of England Act states that the primary objective of monetary policy is to maintain price stability, and subject to that, the Bank is required to support the Government's objectives on growth and employment. These objectives and the policy framework are described in detail in Balls and O'Donnell (eds.) (2002) *Reforming Britain's Economic and Financial Policy.*

There are a number of criteria which are relevant in assessing the merits of alternative inflation measures from an economic policy perspective:

- The conceptual basis that is adopted to record transaction prices. There are three main approaches: acquisition, payments and user cost (or consumption).[16]
- The scope of the index, and in particular the extent to which the transactions covered by the index correspond with those which monetary policy is intended to influence. This will be determined by commodity coverage and the population basis of the index.
- The index should be unbiased in relation to what it is trying to measure. Bias can take a number of forms, including those arising from changes in quality of the products being priced, or differences due to the formulae used for aggregation purposes.
- In terms of its basic usability, a price index should be timely (that is, available sufficiently quickly after the period to which it relates), accurate, subject to minimal revisions, and published with sufficient frequency to be fit for purpose.

In terms of the basic usability criteria, both RPIX and the CPI are published to a common timescale, and likewise both are subject to the minimum of revision (in the case of RPIX, there are no revisions). This partly reflects the similarities in their basic approach to the measurement of inflation, the large degree of overlap in commodity coverage, and the fact that the raw price data feeding into each index is the same in most cases. However, in comparing the statistical properties of RPIX and the CPI, this article has already presented a range of evidence that is relevant in assessing RPIX and the CPI according to the other criteria. The key points are reviewed below.

In the last decade, a global consensus has begun to emerge about the desirable form of consumer price indices appropriate for measuring inflation at a macroeconomic level. This consensus has helped to shape the CPI during its development, meaning that it has some distinct advantages over RPIX as a macroeconomic indicator of inflation, partly reflecting the fact that the latter was not developed specifically for this single purpose. From a statistical perspective, these advantages fall under two broad headings:

- coherence of CPI coverage with other macroeconomic data
- the use of the geometric mean aggregation technique.

Coherence of the CPI with other macroeconomic data stems from the fact that CPI commodity and population coverage largely follows National Accounts principles. Commodity coverage is rooted in the European System of Accounts 1995 (ESA95) definition of household final consumption and the population basis likewise matches that used in the National Accounts. CPI weights therefore are based on the final consumption expenditures of all individuals in the domestic territory, including spending by private households, institutional households (such as nursing and residential homes) and foreign visitors. Unlike RPIX, expenditures of high and low-income households are not excluded from the CPI. National Accounts principles have also influenced the classification of goods and services within the index whereas the RPI employs its own unique classification system.

Following from the previous section, it can be also be seen that use of the GM aggregation formula has some advantages in relation to the AR technique that is applied for some parts of RPIX. It has been shown that the use of AR can lead to a small upward bias in a price index depending on the behaviour of prices across the chain link. In addition, the use of GM in the CPI facilitates cross-country comparisons of inflation rates since it is more robust to detailed index construction choices, such as sample design and the coverage and definition of the elementary aggregates used to construct price indices. This was clearly a key requirement for HICPs in the EU context, but the use of GM is an advantage for international comparisons more generally.

The geometric mean is increasingly preferred in other countries. For instance, in recent years Canada, the USA, and Australia have switched to using the geometric mean in their national consumer price index. Among the UK's partners in the EU: six use the geometric mean (Sweden, Italy, Finland, Portugal, Luxembourg and Greece); four use the ratio of averages variant of the arithmetic mean (Spain, Belgium, Ireland and the Netherlands); and four use a mixture of the geometric mean and ratio of averages (France, Denmark, Germany and Austria). Internationally, very few countries use the AR technique.

Against this, at present one key advantage of the RPI and its derivatives such as RPIX is their familiarity and credibility built upon a long history. This impacts on public perception and so adds to their acceptability as measures of inflation. By definition, this type of credibility takes time to build, and it will inevitably be some period before the CPI becomes as widely recognised. It is intended that this article will help in this process.

In addition, the CPI's exclusion of most elements of owner-occupier housing costs is an outstanding issue, and lessens its relevance for some users. However, this must be weighed against the significant difficulties encountered in measuring such costs appropriately, reflected in the absence of any international consensus in this area. RPI's detailed treatment of owner-occupier housing costs mainly reflects its important history as a compensation index, and has necessitated significant compromises in conceptual consistency in this area. For most categories of expenditure, the RPI can be considered an acquisitions index but, in the area of owner-occupiers housing costs, the inclusion of mortgage interest payments and house depreciation reflects elements of the user cost approach. From the perspective of a macroeconomic indicator of inflation, the inclusion and appropriate treatment of owner-occupier housing costs in consumer price indices raises a number of difficult statistical challenges. These are described in the next section.

Owner-occupier housing costs

It is very difficult to establish an international or even national consensus concerning the treatment of owner-occupier housing costs in consumer price indices. This is reflected in the limited coverage of owner-occupier housing costs in the HICP, and the slower evolution of an EU-wide consensus, despite the strong arguments for their inclusion in consumer price indices as a matter of principle.

The various options for the treatment of owner-occupier costs in the RPI were last considered by an RPI Advisory Committee in 1992–94 (Cmd 2717). The Committee concluded that mortgage interest payments should continue to be included in the RPI and that a new component of shelter costs should be introduced to represent the cost of depreciation of owner-occupied dwellings. Depreciation was intended to represent the ongoing, though typically infrequent, major costs homeowners face in maintaining the standard of their properties[17], and it was decided that depreciation costs should be measured via a smoothed house price index.

RPIX excludes mortgage interest payments but includes the depreciation component, as well as a range of other owner-occupier housing costs including buildings insurance and various house purchase costs including estate agents' and conveyancing fees. RPIX also includes council tax, primarily reflecting its importance in household budgets, and the fact that it might be viewed as expenditure for specific local services received. However, from a National Accounts perspective, council tax is treated as a direct tax rather than household final consumption, and so is not included in the HICP.

The current treatment of owner-occupier housing costs in the RPI can be seen as a compromise in terms of the conceptual consistency of the index. The inclusion of mortgage interest payments, as a key component of actual payments made by owner-occupier households, can be viewed as important from the perspective of the income-related uses of the RPI, even though the index can be seen as acquisitions-based in most other areas. The measurement of depreciation costs through house prices also causes problems in that the latter are strongly influenced by land prices in the UK, which is likely to distort estimates of depreciation costs for the dwellings. Moreover, inclusion of house prices means that the index is affected by changes in the price of a major household asset, and hence a wide range of factors that determine household investment portfolio decisions.

An alternative approach to measuring owner-occupier housing costs is one based on the net acquisitions concept. Under this approach owner-occupier housing costs would include total expenditure on acquiring newly built or converted dwellings or existing dwellings newly acquired by the household sector (for example, purchases of council houses from local authorities). It is argued that the land element should be excluded from house purchase costs in principle in that it is a non-produced asset, whereas the focus for a consumer price index should be the acquisition of produced goods and services only, in this case the dwellings.

As with the introduction of depreciation into the RPI in 1995, a key problem arises in that none of the house price indices currently available in the UK exclude the price of land, and this can exaggerate changes in the cost of the dwellings themselves. The impact will be significant if land represents a high proportion of overall house prices and its price moves differently from the house construction costs and construction companies' profits. Indeed, there is good evidence, for example at the regional level, that changes in the price of land have a strong impact on UK house prices.

Notwithstanding these conceptual arguments, treatment of land in national consumer price indices is diverse. Exclusion of land prices is not regarded as essential in some other countries that include house prices in their national consumer price indices. Moreover, in countries where households often purchase plots of land separately (as distinct from a dwelling including land), it is in some cases considered important that the coverage of the national consumer price index should include land.

The ONS, along with the national statistical offices of Spain, Germany, Poland and Finland, is taking part in a preliminary Eurostat pilot study to assess the possibility of including in the HICP an index of owner-occupier housing costs based on the net acquisitions approach. Under this approach, costs would also include estate agents' fees, conveyancing fees, stamp duty, dwellings insurance and major repairs and renovations, which are currently excluded from the HICP, as well as the cost of the dwelling itself (excluding land).

The possible treatment of owner-occupier housing costs in the HICP, and their actual treatment in the RPIX, is summarised in Table 2. It is important to note that the figures in the table are indicative at this stage. While it is likely that the total weight of owner-occupier housing costs could be at least as large in an augmented HICP as in RPIX, the composition would be different. In particular, the weight of depreciation or major repairs and renovations would be lower in the HICP, possibly 2.5 per cent, compared with their current weight of 4.4 per cent. Since major repairs and renovations would probably be measured in an extended HICP through an index of construction costs, this is likely to mean that the weight of house prices would be lower than in RPIX.

The pilot study is now close to completion and could be extended, subject to funding in 2004, to embrace all Member States. However, there are a number of difficult implementation issues to be addressed, and this means that the longer-term outcome cannot be assessed with any certainty at this stage. Any extension of the HICP to cover owner-occupier housing costs is not likely to take place before January 2006 at the earliest, and could take longer.

Table 2:
Possible treatment of owner-occupier housing costs in the HICP compared with RPIX

	Treatment	RPIX weight (per cent, 2003)	Indicative HICP weight[1] (per cent)
Major repairs and renovations	Represented in RPIX by house depreciation, and proxied by house prices. Represented by construction costs in HICP	*4.4*	*2.5*
Net acquisitions of dwellings	Excluded from RPIX. Represented by price of new houses and purchases from other sectors in HICP	*Excluded*	*2.0–2.5*
House transactions costs	RPIX includes conveyancing fees and estate agents' fees. In addition, the HICP would also include stamp duty	*0.6*	*1.0–2.0*
Dwellings insurance	Weight in RPIX based on cost of gross premiums. HICP weight based on net premiums (i.e. net of claims paid out)	*0.7*	*0.1*
Total		*5.7*	*5.6–7.1*

[1] *Based on the net acquisitions approach. Illustrative figures using best available data.*

Notes

1. This article was originally published on the National Statistics website on 10 December 2003 to coincide with the Chancellor's Pre-Budget Report 2003 statement. The authors are grateful for a number of helpful comments received on the article and so this version contains some clarifications, although the key points and conclusions are unchanged. Significant input and advice from Jim O'Donoghue of the Office for National Statistics is likewise gratefully acknowledged.

2. For instance, the basic sample survey data on incomes and taxes paid is not up-to-date and so must be projected forward. In addition, it is assumed for simplicity that all changes in taxes and allowances announced in the annual Budget impact from the beginning of the financial year.

3. More accurately, the RPI and CPI are described as 'Laspeyres-type' indices. To be true Laspeyres indices, the base period used to calculate the quantities of the items in the basket must coincide with the base date for the measurement of prices (both in time and period). Since the RPI and CPI measure prices with reference to the previous January, matching weights data is not usually available, and would be unreliable over such a short period. In practice, data for the most recent available 12 months are used.

4. As described later in the article, the CPI does allow for substitution at a more detailed level, that is between different brands or varieties of particular products.

5. A Paasche index, the third major form for price indices, is calculated as the current cost of purchasing a basket of goods and services reflecting the current period's purchasing patterns relative to the cost of purchasing the same basket at some earlier period's prices. Denoting the Laspeyres index in period t based on based on period 0 as $L_{t,0}$ and the corresponding cost of living and Paasche indices as $COLI_{t,0}$ and $P_{t,0}$ respectively, it is always the case that $L_{t,0} \geq COLI_{t,0} \geq P_{t,0}$. The intuition is similar for both inequalities. Just as L typically exceeds the COLI because there is a lower cost route to achieving the same level of utility associated with the previous period's basket through substitution, the COLI generally exceeds P because the level of utility associated with the current period's purchases could likewise be achieved at lower cost in the earlier period by varying quantities purchased to suit the previous period's prices.

6. Official figures for the CPI are available from January 1996. CPI inflation rates for the period January 1989 to December 1996 are those estimated by O'Donoghue (1998).

7. It should be noted that housing depreciation costs have only been included in the RPI and RPIX from 1995, and so longer-run comparisons should be undertaken with caution.

8. The community charge was later replaced by the council tax which is likewise included in RPI and RPIX but excluded from the CPI.

9. The CPI does include regular maintenance and repair of the dwellings and also water and sewerage charges.

10. As measures of price change alone, both RPIX and the CPI are designed to track changes in the prices for goods and services of constant quality. When products in the RPI and CPI samples disappear or are replaced with new versions of a different quality or specification, it is important that prices are adjusted to ensure a 'like for like' comparison. Under the option cost method, these adjustments are based on the cost of the additional features contained in the new model when bought separately or as an additional option. The hedonic approach by contrast uses regression analysis to relate the price of various product models to their observable characteristics as the basis for valuing changes in quality. Ball and Andrew (2003), '*The introduction of hedonic regression techniques for the quality adjustment of computing equipment in the Producer Prices Index (PPI) and the Harmonised Index of Consumer Prices (HICP)*', available on the National Statistics website, provides further detail.

11. This proposal is for consideration under the terms of the National Statistics Code of Practice and, if adopted, would take effect from the indices for February 2004 which will be published in March 2004. Treasury ministers are seeking the opinion of the Bank of England for its view on the likely impact of these changes, as outlined in the relevant prospectuses for index-linked gilts.

12. The simple or unweighted geometric mean of a set of n values $x_1...x_n$ is equal to the n^{th} root of the product of the n values. For example, the geometric mean of 2, 4 and 8 is equal to $\sqrt[3]{(2x4x8)} = \sqrt[3]{64} = 4$. Note that the corresponding arithmetic mean is larger, at (2+4+8)/3 = 4.7.

13. It is easily verified that the unweighted geometric mean of the price changes described in the illustrative scenario set out in Box 3 is exactly equal to the increase in income that was needed to maintain living standards at the new prices. Returning to the results set out in the box and equating utility in the two periods (denoted time 0 and 1), we have $U_0 = U_1$ or $F_0^{\alpha}C_0^{1-\alpha} = F_1^{\alpha}C_1^{1-\alpha}$. Substituting in expressions for F_0, C_0, F_1, C_1 from equations (4) and (5) it can be shown that:

$$Y_1/Y_0 = (P_{f,1}/P_{f,0})^{\alpha}.\,(P_{c,1}/P_{c,0})^{1-\alpha}$$

That is, the change in the cost of living is equal to the weighted geometric mean of the price relatives. If $\alpha = 1/2$, as in the scenario set out in Box 3, this is also equal to the simple (unweighted) geometric mean of the price changes. Use of the *unweighted* GM formula to construct an elementary index therefore is consistent with consumer preferences where the elasticity of substitution between each specific element within the aggregate is equal to 1, with the further assumption that the utility derived, all other things being equal, from a given quantity purchased of any of the items is the same. In the case of elementary aggregates, in which the prices of various brands or varieties of a particular item collected in a specific region of the UK are combined, this latter assumption seems plausible. By allowing for substitution at this low level, the CPI is closer to a cost of living index than a 'pure' price index such as RPIX.

14. In practice, the elasticity of substitution between particular products is likely to vary. For example, there is not likely to be much substitution in the case of adult replica football shirts, whereas brand loyalty for say washing powder is probably much lower.

15. Likewise if prices were to rise and then fall by the same amount over the chain link, the index would remain above 100. In other words, price bounce occurs whenever price changes are *negatively* correlated across the link month.

16. Under the *acquisition* approach the total value of all goods and services delivered during a given period, whether or not they were wholly paid for during the period, is taken into account. With *payments*, the total payments made for goods and services during a given period, whether or not they were delivered, is taken into account. Finally, *user cost (or consumption)* considers the total value of all goods and services consumed during a given period. The distinction between the three approaches is particularly important for purchases financed by some form of credit, notably major durable goods and housing, which are acquired at a certain point of time, used over a considerable number of years, and paid for, at least partly, some time after they were acquired, possibly in a series of instalments.

17. Depreciation might be thought of as the costs of major repairs and renovations, with minor maintenance and decorating costs covered elsewhere in the index.

Appendix A: Historical background to the development of the RPI

Cost of living index

Although there were occasional official comparisons of prices for food in the late 19th century and early 20th century, the Government first began a systematic, continuous check on the increase in the cost of living in 1914. From July of that year, the Board of Trade instituted a regular monthly inquiry into the retail prices of the principal items of working class family expenditure, publishing the percentage change each month in its *Gazette*. The published figures initially related only to food prices, but after June 1916 the index was expanded and calculated retrospectively to cover clothing, fuel and some other items.

The new index was accepted as a valuable aid towards protecting ordinary workers from what were initially expected to be temporary economic consequences of the First World War. The information used for weighting together the components of the index was crude in the extreme. Expenditure data obtained from a survey of urban working class households back in 1904 was constrained by highly subjective assessments of what constituted legitimate expenditure for a working class family. For example, beer was completely excluded and the weight used for tobacco was much less than the actual proportion of expenditure on tobacco.

Between the World Wars

This index, with unchanged weights, was produced throughout the 1920s and 1930s. Criticism mounted, especially towards its out-of-date weights (by the 1930s, candles and lamp oil were grossly over-weighted while electricity was completely excluded and ready made clothing was under-weighted). In 1936, the Ministry of Labour announced the institution of a large-scale household expenditure inquiry to update the weights; this was carried out in 1937–38. However, by the time the results became available, war had broken out and further action on the revisions was deferred.

After World War 2

In 1946, a new committee, the Cost of Living Advisory Committee, was set up. An interim report in 1947 advised that as a short-term measure, the results of the 1937–38 expenditure inquiry should be used to update the weights until a new inquiry, reflecting vastly different post-war spending patterns, could be carried out. It also recommended some fundamental changes in, for example, the selection and number of representative items for which prices should be collected. This new index, the Interim Index of Retail Prices, started in June 1947 and ran on (with some minor modifications and a re-basing in January 1952) to January 1956, and laid many of the foundations for the compilation of the modern RPI.

By the beginning of 1955, sufficient information from the Household Budget Inquiry became available for the committee to formulate a new index. This became the first official Retail Prices Index (RPI) and began from January 1956. Among the changes brought in at this stage were:

- expansion of scope of households included in the RPI from just working classes to all wage earners, excluding extremely high and low-earning households
- a firm definition of the RPI for the first time
- a definition of the scope of the index, which largely remains today
- a new structure that, by and large, continued to 1987
- the first serious attempt to measure owner-occupier housing costs.

The committee also recommended that the Household Budget Inquiry should become a continuous survey. This led to the creation of the regular Family Expenditure Survey (FES) from 1957. Once these data settled down, the weights could be revised annually and this process, which continues to the present day, was begun with a re-basing of the RPI in January 1962. A new Expenditure and Food Survey (EFS) was launched in April 2001 to replace the FES and the National Food Survey.

The 1960s and 1970s

Various changes occurred to the RPI through the 1960s and 1970s, including:

- abolition of the name 'Cost of Living' and the associations it implied
- introduction of a 'meals out' group (now called 'catering') from 1968
- construction of separate 'pensioner' indices from 1969
- several changes to the methods of calculating owner-occupier housing costs, including the introduction of a new method of calculating mortgage interest payments from 1975
- introduction of 'seasonal' weights for fresh fruit and vegetable items from 1975
- introduction of a new index, the Tax and Price Index (TPI) in 1979.

The 1980s

An advisory committee was convened in the early 1980s to review the RPI. It produced a wide-ranging report in 1986, which led to many changes to the RPI from January 1987, when it was again re-based. These recommendations largely form the basis of today's RPI, including the definition, scope and coverage, treatment of subsidies and discounts and treatment of owner-occupier housing costs.

Recent developments

In 1989, responsibility for the production of the RPI moved from the Employment Department to the newly re-organised Central Statistical Office (CSO). There have been two Advisory Committees since then. A report of the earlier committee in 1990 recommended the development of a holidays index, which was further considered by the later committee, leading to the introduction of a component for foreign holidays from 1993 and UK holidays from 1994. The later Advisory Committee produced a report in 1994 which led to the introduction of a new element of owner-occupier housing costs, the ‘depreciation costs’ component, from January 1995. At the same time, the collection of prices was contracted out to a market research company. In 1996, the Central Statistical Office became part of the new Office for National Statistics.

Appendix B: Main RPI Advisory Committee recommendations

1947 Report (Cmd 7077)

Recommended that the old 'cost of living' index should be terminated and a new price index be constructed based on the 1937–38 expenditure enquiry. The new index started in June 1947.

1951 Report (Cmd 8328)

Recommended that only one official index of retail prices should be published each month, relating to all wage earners and moderate salary earners, and that a new expenditure enquiry should be undertaken as soon as possible to provide up-to-date weighting information.

1952 Report (Cmd 8481)

Recommended certain modifications, which could be introduced immediately, as temporary expedients, until such time as a new index could be produced on the basis of the forthcoming expenditure enquiry. These modifications included the use of improved weights derived from the estimated pattern of expenditure in 1950, and incorporation into the index of information about the rents of houses built since 1947. The re-weighted index was introduced in January 1952.

1956 Report (Cmd 9710)

Recommended that the interim index produced since 1947 should be replaced by a new index, based on the large scale Household Expenditure Enquiry of 1953. The new index was to be designed to cover all households except for those consisting of pensioners mainly dependent on state benefits and those whose head had a gross income of £20 a week or more in 1953. This committee also established the group and section structure of the index which, with some changes, is still in use. Finally, it recommended certain additions to the list of items for which prices were to be collected and some improvements to the methods of obtaining information, particularly as regards the housing group with the introduction of 'equivalent rents' as a measure of owner-occupier housing costs. The recommendations were implemented in January 1956.

1962 Report (Cmd 1657)

Recommended that the index weights should be revised every year, on the basis of information from a new continuous enquiry, the Family Expenditure Survey (FES), which was instituted at the beginning of 1957. This came into effect from the 1962 index. Some changes were proposed in the precision and frequency with which indices were published. This recommendation was implemented with effect from January 1963.

1968 Report (Cmd 3677)

Recommended that: 'meals outside the home' should be included in the index as a separate group from February 1968; that special indices should be compiled and published back to 1962 for the pensioner households excluded from the coverage of the index; that certain changes should be made in the published level of detail. The Committee also recommended that there should be a study of the technical problems that would be involved in comparing price levels in different regions or areas. A technical committee was appointed to carry out the study envisaged.

1971 Report (Cmd 4749)

Endorsed a Technical Committee recommendation that the compilation of regional price indices would be feasible although costly, but were not unanimous as to whether their publication would be desirable. The then Department of Employment did not proceed with compilation.

1974 Report (Cmd 5905)

Recommended that owner-occupier housing costs should be represented in the index by mortgage interest payments, instead of the equivalent rents formerly used. This came into effect in 1975. The Committee also recommended that the RPI weights should in general be based on FES results for the latest twelve months rather than the latest three years, and that variable monthly weights should be introduced for fruit and vegetables. The recommendations were implemented almost immediately.

1977 Report (*Employment Gazette*, February 1978 article)

Recommended that certain component indices should be published in more detail and that when combining price quotations, there should be stratification by region and shop type.

1986 Report (Cmd 9848)

This report covered a wide range of issues and consolidated much of the general documentation on the compilation of the RPI. Recommendations included: changing the reference date for the RPI to January 1987=100; updating the group and section structure of the RPI; the production of indices for holidays as soon as possible subject to resolution of technical problems; to publish indices for more services; that the income limits used to define index households should relate to the household as a whole rather than the head of a household; that component indices with a weighting of more than five parts per 1000 should be published; that no allowances should be made for subsidies and discounts provided on a selective basis and funded by a third party; further recommendations on the construction of indices for owner-occupier housing costs; further modifications on the weighting and definition of seasonal foods; recommendations on the treatment of quality changes. Most of these recommendations were implemented with effect from 1987.

1989 Report (Cmd 644)

Recommended that the community charge be included in the RPI, subject to the principles on the treatment of discounts and subsidies established by the previous Committee. This Committee, like many before it, also defined the exact price indicator to be used for the new item. Although the Committee was asked to look at other issues, due to the urgency of the community charge issue, they decided to make their recommendations for this in this report and then to deal with the other points in a subsequent report, which became the 1990 report. The community charge was introduced in April 1989 in Scotland and the following year in England and Wales.

1990 Report (Cmd 1156)

Recommended the compilation of 'pilot' indices for holidays in both the UK and abroad with a view to including them in the RPI at a later date, subject to the resolution of certain technical problems. The committee also made several recommendations on the coverage of financial services in the index and reviewed the progress on some of the long-term improvements suggested by the 1986 Committee.

1993 Reports (Cmd 2142 and 2153)

When the community charge was replaced by the council tax, another committee was set up to review the treatment of local taxation in the index. It recommended that the council tax be included from its introduction in April 1992, and made several recommendations on the measurement of the price indicator. The Committee's Terms of Reference were then extended to look at the inclusion of a holidays index and the treatment in the RPI of new cars and owner-occupier housing costs. The committee also recommended the introduction of a holidays index. The foreign holidays index was introduced in 1993 and the UK holidays index in the following year. The Committee continued to look into the other issues, which led to a further set of reports.

1994 Reports (Cmd 2716 and 2717)

The first of these command papers recommended that direct measurement of new car prices could not yet be brought into the RPI but that the Department should continue technical investigations. Meanwhile, it recommended certain small changes to the way that used car prices were measured and that these should be used as a proxy for new car prices. The second paper looked at the treatment of owner-occupier housing costs and recommended the introduction of a second component to go alongside mortgage interest payments, a 'depreciation costs' component, of which the price indicator should be a house price index. The depreciation component was introduced into the RPI with effect from February 1995.

Appendix C: Analysis of differences in CPI and RPIX annual rates

	Difference between annual rates CPI – RPIX (per cent)		Breakdown of differences (unrounded figures)[1] (percentage points)			
	rounded figures	unrounded figures	Housing components excluded from CPI	Other differences in commodity coverage[2,3,4]	Formula effect[5]	Other differences[6]
1997 Jan	–1.0	–0.93	–0.24	–0.17	–0.50	–0.02
1997 Feb	–0.9	–0.95	–0.18	–0.19	–0.51	–0.06
1997 Mar	–1.0	–0.94	–0.17	–0.18	–0.55	–0.03
1997 Apr	–1.0	–0.91	–0.13	–0.19	–0.54	–0.05
1997 May	–0.9	–0.95	–0.19	–0.15	–0.54	–0.06
1997 Jun	–1.0	–0.97	–0.23	–0.14	–0.54	–0.06
1997 Jul	–1.0	–0.91	–0.22	–0.11	–0.54	–0.04
1997 Aug	–0.8	–0.89	–0.22	–0.13	–0.55	0.00
1997 Sep	–0.9	–0.89	–0.24	–0.10	–0.51	–0.03
1997 Oct	–0.8	–0.95	–0.24	–0.13	–0.50	–0.07
1997 Nov	–0.9	–0.91	–0.25	–0.14	–0.49	–0.02
1997 Dec	–0.9	–0.95	–0.29	–0.17	–0.50	0.01
1998 Jan	–1.0	–0.97	–0.29	–0.12	–0.48	–0.08
1998 Feb	–1.1	–1.02	–0.27	–0.09	–0.55	–0.11
1998 Mar	–1.0	–0.98	–0.28	–0.04	–0.54	–0.13
1998 Apr	–1.1	–1.12	–0.35	0.00	–0.52	–0.25
1998 May	–1.2	–1.13	–0.35	0.01	–0.55	–0.23
1998 Jun	–1.1	–1.16	–0.38	0.04	–0.56	–0.26
1998 Jul	–1.1	–1.20	–0.42	0.04	–0.55	–0.27
1998 Aug	–1.2	–1.21	–0.44	0.10	–0.54	–0.33
1998 Sep	–1.0	–1.17	–0.42	0.11	–0.53	–0.33
1998 Oct	–1.2	–1.12	–0.43	0.14	–0.51	–0.31
1998 Nov	–1.1	–1.16	–0.44	0.14	–0.54	–0.32
1998 Dec	–1.1	–1.08	–0.42	0.20	–0.56	–0.31
1999 Jan	–1.0	–1.03	–0.43	0.19	–0.52	–0.27
1999 Feb	–0.9	–1.00	–0.44	0.20	–0.51	–0.25
1999 Mar	–1.0	–0.99	–0.43	0.16	–0.50	–0.22
1999 Apr	–0.9	–0.90	–0.39	0.13	–0.49	–0.15
1999 May	–0.8	–0.84	–0.38	0.13	–0.46	–0.12
1999 Jun	–0.8	–0.86	–0.41	0.16	–0.47	–0.15
1999 Jul	–0.9	–0.97	–0.36	0.17	–0.51	–0.27
1999 Aug	–0.8	–0.91	–0.37	0.18	–0.48	–0.25
1999 Sep	–0.9	–0.92	–0.40	0.17	–0.49	–0.20
1999 Oct	–1.0	–1.06	–0.46	0.13	–0.50	–0.24
1999 Nov	–0.9	–1.02	–0.44	0.14	–0.50	–0.22
1999 Dec	–1.0	–1.01	–0.44	0.12	–0.50	–0.19
2000 Jan	–1.3	–1.30	–0.57	0.05	–0.55	–0.23
2000 Feb	–1.2	–1.21	–0.53	0.14	–0.59	–0.23
2000 Mar	–1.3	–1.36	–0.56	0.12	–0.58	–0.34
2000 Apr	–1.3	–1.40	–0.55	0.12	–0.63	–0.35
2000 May	–1.5	–1.44	–0.58	0.11	–0.64	–0.33
2000 Jun	–1.4	–1.49	–0.61	0.08	–0.65	–0.30

	Difference between annual rates CPI – RPIX (per cent)		Breakdown of differences (unrounded figures)[1] (percentage points)			
	rounded figures	unrounded figures	Housing components excluded from CPI	Other differences in commodity coverage[2,3,4]	Formula effect[5]	Other differences[6]
2000 Jul	–1.2	–1.33	–0.62	0.09	–0.64	–0.15
2000 Aug	–1.3	–1.29	–0.64	0.06	–0.66	–0.04
2000 Sep	–1.2	–1.26	–0.63	0.03	–0.68	0.01
2000 Oct	–1.0	–1.02	–0.55	0.07	–0.65	0.11
2000 Nov	–1.2	–1.14	–0.51	–0.01	–0.66	0.04
2000 Dec	–1.1	–1.22	–0.56	–0.03	–0.61	–0.03
2001 Jan	–0.9	–0.92	–0.49	0.05	–0.58	0.11
2001 Feb	–1.1	–1.12	–0.55	–0.15	–0.56	0.15
2001 Mar	–0.9	–1.02	–0.55	–0.11	–0.57	0.22
2001 Apr	–0.9	–0.78	–0.53	0.03	–0.52	0.23
2001 May	–0.7	–0.78	–0.47	0.04	–0.52	0.16
2001 Jun	–0.7	–0.74	–0.41	0.02	–0.50	0.15
2001 Jul	–0.8	–0.75	–0.51	0.18	–0.51	0.09
2001 Aug	–0.8	–0.79	–0.52	0.20	–0.49	0.02
2001 Sep	–1.0	–1.00	–0.55	0.00	–0.45	0.00
2001 Oct	–1.1	–1.12	–0.54	–0.04	–0.48	–0.05
2001 Nov	–1.0	–1.00	–0.56	–0.08	–0.44	0.09
2001 Dec	–0.9	–0.84	–0.50	0.02	–0.48	0.11
2002 Jan	–1.0	–0.90	–0.47	–0.04	–0.50	0.10
2002 Feb	–0.7	–0.76	–0.41	0.02	–0.42	0.05
2002 Mar	–0.8	–0.73	–0.40	0.09	–0.42	0.01
2002 Apr	–1.0	–0.96	–0.52	–0.02	–0.42	0.01
2002 May	–1.0	–0.96	–0.62	0.01	–0.42	0.07
2002 Jun	–0.9	–0.87	–0.74	0.13	–0.42	0.15
2002 Jul	–0.9	–0.85	–0.76	0.17	–0.41	0.15
2002 Aug	–0.9	–0.88	–0.80	0.20	–0.43	0.15
2002 Sep	–1.1	–1.09	–0.85	0.12	–0.43	0.07
2002 Oct	–0.9	–0.96	–0.97	0.15	–0.41	0.27
2002 Nov	–1.2	–1.23	–1.06	0.10	–0.43	0.17
2002 Dec	–1.0	–1.09	–1.15	0.40	–0.47	0.12
2003 Jan	–1.3	–1.42	–1.22	0.24	–0.42	–0.01
2003 Feb	–1.4	–1.41	–1.21	0.24	–0.43	0.00
2003 Mar	–1.4	–1.49	–1.17	0.18	–0.43	–0.07
2003 Apr	–1.5	–1.56	–1.32	0.12	–0.44	0.08
2003 May	–1.7	–1.61	–1.26	0.05	–0.44	0.05
2003 Jun	–1.7	–1.70	–1.20	–0.06	–0.46	0.01
2003 Jul	–1.6	–1.61	–1.13	–0.24	–0.43	0.19
2003 Aug	–1.5	–1.57	–1.09	–0.31	–0.41	0.24
2003 Sep	–1.4	–1.36	–1.07	0.01	–0.44	0.14
2003 Oct	–1.3	–1.30	–0.99	0.04	–0.44	0.10

1. *Estimates of the contributions from the individual factors are calculated independently and are not strictly additive.*
2. *From January 2000, CPI coverage was extended to include some health, education, insurance and social protection services (such as child minding). The population basis for the CPI weights was broadened at the same time to include expenditure by foreign visitors and residents of institutional households in addition to private households. These changes impact on the estimates in this column. See also notes 3 and 4.*
3. *From January 2001, CPI coverage was extended to include some hospital services, nursing and retirement homes.*
4. *From January 2002, CPI coverage of financial services was extended to include services charged as a proportion of the transaction value, such as foreign exchange commission, unit trust and stockbroking fees.*
5. *Difference due to the use of different formulae to aggregate prices at the most basic level.*
6. *Derived as a residual. Includes differences due to the different weights attached to items in the CPI and RPIX booklets.*