# Use of the CPI for cost-of-living adjustments

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## 1. Introduction

This paper looks at whether the UK's Consumer Price Index (CPI) is an appropriate index for the Airways Pension Scheme to use to measure and adjust for changes in the cost of living. It is organised as follows:

Section 2 sets out the background and history of the CPI: what its purpose was and how it was developed.

Section 3 looks at the details of the CPI's construction and how it performs as a price index in practice.

Section 4 has a brief discussion of some of the statistical aspects of the Government's decisions in 2010 and 2011 to make greater use of the CPI.

Finally, Section 5 draws conclusions about the appropriateness of the CPI for cost-of-living adjustments.

## 2. Background and History of the CPI

The CPI has its origin in the Harmonised Index of Consumer Prices (HICP) which was introduced by the EU in 1997 in order to provide an internationally comparable measure of inflation. This was needed because inflation is one of the convergence criteria for participation in the Euro, which was launched at the beginning of 1999. The calculation of the HICP is governed by the HICP framework regulation and Commission regulations developed by Eurostat (the statistical Directorate-General of the European Commission) in consultation with national statistical authorities.

Because the HICP had to be an internationally-comparable measure of monetary convergence, this influenced both its coverage and the statistical techniques that could be used in its calculation. In particular:

> As a measure of monetary convergence, the HICP aims to cover all monetary transactions in an economy, whether by domestic residents or by foreigners and it excludes non-monetary transactions, such as the receipt of benefits in kind, as well as transactions such as fees and property taxes that, in national accounts terms, are counted as transfers.

> Because of the different housing systems in the EU and the very different treatment of housing costs by the national statistical authorities, there has been no agreement on how to treat owner-occupied housing costs in the HICP, and they are currently simply excluded.

To ensure that differences between the national HICP indices are not caused by differences in statistical technique, the HICP regulations limit the techniques that can be used in their compilation. This will be discussed in detail in Section 3, but it is relevant to note at this point that this affected the UK far more than the other fourteen countries that were in the EU at the time, since one of the excluded techniques was used much more extensively by the UK. This "formula effect" difference between the HICP and the national inflation measure (the difference caused purely by different statistical techniques rather by differences in coverage) was not more than 0.1 percentage points for any of the other EU15, whereas for the UK it was 0.5 percentage points.[1]

With the exception of the UK and Romania all of the now twenty-seven EU countries have continued to use their own national consumer price indices for both macroeconomic purposes and for measuring the cost of living.[2]

Initially the UK, too, continued to use the RPI and its variants for all its domestic purposes, but in December 2003, the Government announced that the inflation target for the Bank of England was being switched from RPIX (the RPI excluding mortgage interest payments) to the HICP, which at the same time was renamed the Consumer Price Index. The Treasury statement at the time listed three advantages that it considered that the CPI had over RPIX for monetary policy purposes:[3]

> "the CPI better allows for the substitution of cheaper for more expensive goods and services within expenditure categories when relative prices change and so may be considered a more realistic depiction of consumer behaviour;
>
> the CPI has a wider population coverage and is more consistent with national accounts principles of consumer expenditure, so it shares a coherence with other economic statistics and gives a better picture of spending patterns in the UK; and
>
> the CPI is a more comparable measure of inflation internationally and represents international best practice."

For all other purposes, the RPI or its derivatives would continue to be used:

> "Furthermore, as stated by the Chancellor on 9 June 2003, pensions, benefits and index-linked gilts will be calculated on exactly the same basis as now. In addition, the RPI, or where applicable its derivative indices, will continue to be used for the indexation of benefits, tax credits and tax allowances. The Government will continue to issue gilts linked to the RPI measure of inflation."

It was recognised that the CPI consistently yielded a lower rate of inflation than RPI and therefore the Bank of England's inflation target was adjusted from 2.5% on the RPIX measure to 2% on the CPI measure. In fact, at the time CPI was averaging about 0.8% less

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[1] J. O'Donoghue and C. Wilkie, "Harmonised Indices of Consumer Prices," *Economic Trends* 532, February 1998 (available at http://www.ons.gov.uk/ons/rel/elmr/economic-trends--discontinued-/no--532--february-1998/index.html)

[2] UK Statistics Authority, "Communicating Inflation," *Monitoring Brief 7/2010*, 6 December 2010.

[3] http://www.bankofengland.co.uk/monetarypolicy/pdf/annex031210.pdf

than RPIX, and both the Bank of England and financial commentators realised that the new target therefore represented a slight easing of the monetary stance.[4]

The CPI continued to be used for macroeconomic purposes and the RPI and its derivative as the government's cost-of-living measure until 2011. In the Budget in June 2010, the new Government announced that, from April 2011, the CPI would be used for uprating benefits, tax credits and public sector pensions. On 8 July 2010, the Government announced that, also from April 2011, the CPI would become the statutory minimum for uprating private sector pensions (but the Government subsequently said that it would not introduce legislation to over-ride, or make it easier to change, private sector contracts or pension scheme rules). In the March 2011 Budget, the Government said that from April 2012, the CPI would become the default index for uprating direct tax thresholds, although the RPI would remain the default index for uprating indirect taxes. The statistical aspects of these decisions will be discussed briefly in Section 4.


## 3. Construction and Performance of the CPI

Although there is some price data collected by the private sector for its own purposes (e.g. for the UK Retail Sales Monitor compiled by the British Retail Consortium), in practice the only source for a national consumer price index is the monthly price survey organised by the Office for National Statistics (the actual local price enumeration has been contracted out since 1995). This is based on about 700 Representative Items, which are chosen each year, on the basis of the annual Living Costs and Food Survey, to be representative of overall consumer spending – in practice, only a few Items are dropped or introduced for the first time each year, to reflect changing consumption patterns. Each month about 120,000 price quotes are collected in local shops or centrally, in order to estimate an average price for each Item. The same price quotations are used by the ONS to calculate both the RPI and the CPI and the definition of the Items is the same for both[5] (but not the method by which each Item's average price is calculated from the price quotations).

The prices for the Items are then combined in stages to get an overall price index. In the case of the CPI the price indices for the Items (e.g. "large sliced white loaf") are combined, on the basis of weights based the National Accounts and the Living Costs and Food Survey, to get a price index for a Class (e.g. "bread and cereals"); the Classes are then combined to get a price index for a Group (e.g. "food"); the Groups are combined to get a price index for a Division

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[4] *Bank of England Quarterly Bulletin*, Winter 2003;  http://www.independent.co.uk/news/uk/politics/new-inflation-target-could-halt-interest-rate-increases-576299.html
[5] There are two areas where different raw price data are used for the CPI and RPI. In the case of new cars the CPI uses an index constructed on the basis of list prices adjusted for quality changes as new models are introduced (the RPI imputes new car prices on the basis of movements in second-hand car prices). In the case of insurance, the CPI, in principle, includes only the *net* cost of insurance, i.e. insurance premiums less claims, on the grounds that this represents the net monetary payment by the household sector. (In practice, the lack of timely data on claims means that the CPI uses insurance premiums as its price index, but with a weight equal only to that of net insurance cost). Expenditure on claims is, instead, allocated among other spending categories according to the nature of the claim.

(e.g. "food and non-alcoholic beverages"); and, finally, the Divisions are combined to get the overall Consumer Price Index.[6]

As explained above, there is only the one source of price data. There is clearly scope for both bias and error in the sampling procedure, but the ONS has been at pains to improve sampling procedure over the last fifteen years and there are validation procedures in place whereby unusual price quotes are scrutinised. Although some serious problems with price collection have been documented[7], the ONS procedure is generally well regarded. In response to increasing interest in and scrutiny of its price indices, in August 2011 it started publishing the disaggregated price data for the first time.

Since the raw price data is given, an assessment of the CPI depends on two areas:

    i.    Which Items are included in the overall price index and the weight that they are given in that index (what the index covers),

    ii.    How the individual price quotes are combined to get a price index for each representative Item (the formula for first-stage aggregation).

It is to these two questions that we now turn.

## 3.1 The Coverage of the CPI

As an index developed for monetary policy purposes, the aim of the CPI is to include all monetary expenditure that takes place in the UK. It therefore covers expenditure in the UK by private households, residents of institutional households and foreign visitors. This population coverage means that the expenditure of the richest households has a large influence on the weights with which Items, particularly luxury items such as stockbrokers' fees, enter the overall index. This is in line with the usual practice for consumer price indices, which use "plutocratic" weights, based on actual expenditure, rather than "democratic" weights, where the expenditure pattern of each household is given an equal weight.

The population coverage also means that the CPI includes foreign students' university tuition fees and the foreign exchange commission paid on the purchase of sterling by overseas visitors (but it excludes the spending of UK residents abroad, such as on foreign holidays).

The CPI excludes non-monetary transactions, for example imputed rents or the value of a company car. It also excludes expenditure that is not classified as household final expenditure in the national accounts, including council tax (whether paid by tenants or owner-occupiers), trade union subscriptions, vehicle excise duty and television licence fees.

In the case of housing, the current HICP approach treats owner-occupied housing as an asset and therefore excludes expenditure on it entirely from consumer spending. The EU statistical

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[6] For a fuller description, see ONS, *Consumer Price Indices Technical Manual*, 2010. The procedure for constructing the RPI is similar, except in this case the Items are first combined into Sections, then into Groups and finally into the RPI.

[7] In response to Bank of England concerns, the ONS in 2010 revised the way it collects clothing data, particularly around sales periods. The Bank of England estimates that previously clothing price inflation had been under-recorded by an average of around 5.5% a year, equivalent to an average under-estimate of CPI inflation by 0.3 percentage points a year.

authorities recognises that this is unrealistic and that owner-occupied housing also provides a service in the form of shelter to its owners, and there has been a long-running research pilot organised by Eurostat to develop a measure of owner-occupied housing costs along these lines. However, the very different circumstances and statistical approaches in the EU countries have so far delayed any agreement.

Since the CPI follows the HICP regulations, this means that all owner-occupiers' housing expenditure is excluded, namely: buildings insurance, ground rent, house depreciation (which is included in, e.g. the RPI, as a proxy for new house prices), other house purchase costs such as estate agents' fees and conveyancing fees, and mortgage interest payments. The exclusion of owner-occupiers' housing costs is an admitted weakness of the CPI, and, at the request of the Statistics Authority, Treasury and Bank of England, the ONS is undertaking research with the aim of including owner-occupier housing costs within a new CPI measure by the end of 2012 using either the net acquisitions or rental equivalence approaches.[8] It should be noted that the net acquisitions approach is designed to fit into the HICP approach of measuring only net expenditure on housing by the household sector taken as a whole and that the rental equivalence approach, although departing from HICP methodology by using an imputed payment, aims to reach a similar result. Both measures would, therefore, be somewhat narrower than an approach such as user cost, which measures actual housing expenditure.[9] Even so, these narrower measures of owner-occupied housing cost would still represent between 7% and 10% of an expanded CPI.

## 3.2 The Formula for First-Stage Aggregation

Once the statisticians have calculated an average price index for each Representative Item, these price indices are aggregated in stages to get an overall consumer price index. This is done by weighting each Item by its expenditure share (as measured by data provided by the annual Living Costs and Food Survey and the national accounts) and taking an arithmetic average. This is called upper-level aggregation and, although alternatives have been suggested and trialled,[10] the statistical procedure of aggregating by taking an arithmetic average is uncontroversial and almost universal. There are still major statistical issues in upper-level aggregation, particularly in linking and chaining to get a consistent index over time, but the procedures used do not differ systematically between indices and are not an issue for the CPI.

However, first-stage aggregation – combining the individual price quotes to get a price index for a Representative Item – is more difficult and controversial. The difficulty arises from the fact that at a level of detail below Item level there is no data on expenditure or quantities bought. For example, if the Item is "large sliced white loaf", the enumerators will visit various shops and record the price – for example, an own-brand large sliced white loaf at a

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[8] Consumer Prices Advisory Committee – *2010 Annual Report to the UK Statistics Authority*, Annex A "Progressing the Implementation of Owner Occupiers' Housing Costs in the Consumer Prices Index."
[9] They would also continue to exclude Council Tax, whether paid by tenants or owner-occupiers.
[10] e.g. by the US Bureau for Labor Statistics as reported in D. S. Johnson et al, *What has happened to price measurement since the Boskin Report? The U.S. Experience*, US Bureau of Labor Statistics, 2005.

Sainsbury's store in Milton Keynes: they would then go back every month to the same store to record the price for an identical loaf. Another enumerator, meanwhile, will have visited a convenience store in Plymouth and recorded their price for a large sliced white loaf, and so on. The ONS goes to some trouble to make sure that the price sampling is balanced across locations and types of outlet. However, when it comes to calculating the average price for a white loaf, there is no data on how many of each type of loaf is sold in each type of store, and therefore no way of assessing the relative importance of each price quote. The ONS practice is to treat then equally and take an average of them. In the case of white loaves, this is unproblematic: although the actual price quotes reveal a surprising amount of variation, white loaves are sufficiently similar that simply taking an average of their prices is likely to provide a fair result. Before 1980 it was the universal practice of statistical authorities to calculate the mean or *arithmetic* average, and this is still the practice in many countries and is currently used in the UK for some Items in both the CPI and RPI. It is known as the Ratio of Averages.

Although the Ratio of Averages method works for relatively homogeneous Items like a white loaf, it is unsuitable for disparate Items, for example "dining table." In a case like this, there are wide differences in quality and price, and simply taking an average price would give excessive weight to the more expensive types of table. What the UK has traditionally done in such a case is to record the price *change* for each product and then to take an arithmetic average of these price changes to get the movement in the overall index. For example if the cheap table increased in price by 20% over the year and the expensive table increased in price by 10%, then, on average, dining tables will have increased in price by 15% (thus, if the price index was 100 at the start of the year it would be 115 at the end of the year). This method is known as the Average of Relatives. This was the statistical technique banned by Eurostat in the compilation of the HICP, not because it was statistically inferior, but so as not to have any cross-country differences in technique caused purely by different statistical methods.[11]

The alternative technique allowed by the HICP regulations and used for the majority of CPI Items is to calculate a *Geometric mean* (the Geometric mean of n terms is formed by multiplying the n terms together and taking the $n^{th}$ root).[12] The Geometric mean has a couple of desirable statistical properties, compared to the Average of Relatives method; in particular it allows for time reversal (if all the data for the two periods are interchanged, then the resulting price index equals the reciprocal of the original price index) and transitivity (the chain index between two periods equals the direct index between the same two periods).[13]

However the main feature of the Geometric mean relative to the arithmetic average is that, as a matter of arithmetic, the Geometric mean of a set of numbers is always be less than the arithmetic average, and the difference between the two averages will be greater the more

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[11] Strictly speaking, the use of the Average of Relatives is not forbidden, but is allowed only when it yields a result that is not different to the other methods.

[12] It is one of the attractive properties of the Geometric mean that it gives the same result, whether the index is specified as the ratio of the Geometric mean of the prices of the products in the final period to that in the initial period, or as the Geometric mean of the relative price change of the products: thus there is no counterpart to the distinction in the case of the arithmetic average between the Ratio of Averages and the Average of Relatives.

[13] International Labour Office, *Consumer Price Index Manual, Theory and Practice*, International Labour Office, Geneva, 2004, Chapter 16.

dispersed the numbers are. This means that, compared to using the Average of Relatives (but not, in general, compared to using the Ratio of Averages), using the Geometric mean will always yield a lower inflation rate. Another way of looking at this is to say that the Geometric mean always places a greater weight on prices that fall or at least rise less slowly, whereas the Average of Relatives gives the same weight to every price change.

The economic interpretation of this is that the geometric mean is allowing for price substitution by consumers, who are assumed to switch purchases to the product that has gone up less in price.

A numerical example will illustrate this. Suppose we have three loaves of bread, all with an initial price of 100 pence. (Note that the loaves are not identical – they are bought from different shops and have different characteristics). Suppose that, at the end of the period, their prices have become 80p, 100p, and 120p. Their new prices are, respectively 0.8, 1 and 1.2 times the original price, and taking the arithmetic average of these price rises shows that, on average, bread prices are unchanged.

By contrast, taking the Geometric mean gives a price 0.986 times the original price: i.e. there has been a price fall of 1.4%. This is justified by the assumption that some of the people who used to buy loaf 3 have now switched to buy loaf 1, and that, therefore, greater weight should be given to the price fall of loaf 1 than to the price rise of loaf 3.

This gives rise to two questions. The first is a conceptual one: even if consumers behave in this way, is this a valid assumption to make in constructing a consumer price index? The difficulty arises, because using a Geometric mean for first-stage aggregation means that the resulting price index is no longer, strictly-speaking, a fixed-basket index: i.e. the basket of loaves (in this case) whose price is being tracked has changed during the period – it now has fewer of loaf 1 and more of loaf 3 – and we are, therefore, no longer comparing like with like. It is, therefore, no longer a pure price index, reflecting how the price of a given basket of goods has changed from one period to the next.[14] As against this, the proponents of the Geometric mean would say that if consumers do, in fact, substitute in this way, then it is just as legitimate to use the basket at the end of the period and look backwards as to use the basket at the beginning of the period and look forwards, and that an index calculated as a Geometric mean of the price changes provides a good average of these two approaches.

This leads to the second question. Do consumers in fact indulge in price substitution in this way? It is not merely a question of whether there is some price substitution: use of the geometric mean assumes quite a high level of substitutability, such that expenditure on each product is unaffected by price changes: i.e. the quantity purchased moves in inverse proportion to the price change. In Economics terms, it assumes an own-price elasticity of (minus) one. Moreover, the assumption is that price changes represent substitution along a stable consumer demand curve, caused entirely by changes in supply conditions – if any price changes are in fact caused by demand shifts, induced, say, by advertising or changes in

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[14] United Nations Economic Commission for Europe et al, Practical *Guide to Producing Consumer Price Indices*, United Nations, New York and Geneva, 2009, Chapters 10 and 13.

fashion, then prices and quantities will tend to move in the same rather than in the opposite direction, as assumed by the Geometric mean.

There is, in fact, remarkably little empirical evidence on the degree of price substitution at the level of first-stage aggregation, precisely because of the lack of expenditure data at the very lowest level. There have been a few quite extensive studies of price substitution at higher levels:[15] these generally find some evidence of substitution, but with more of the calculated elasticities being close to zero than to (minus) one. There is reason to think that elasticities at the lower level will generally be higher, because the goods involved are closer substitutes: as against that, substitution at the lower level often involves a switch to a different outlet, and factors of habit and distance may make that less likely. For example, Entertainment is one sector where there is some evidence of price substitution at the higher level: thus, say, an increase in the price of theatre tickets relative to cinema tickets will cause a shift from the purchase of theatre tickets to the purchase of cinema tickets. It remains an open question, however, whether a relative price movement between theatres will cause a proportionately greater shift from more expensive to less expensive theatres than was the case for movements between theatre and cinema.

It is also interesting to look at supermarket scanner data, although most of the data that are available relate only to within-store substitution and are therefore not directly applicable to purchases that require substitution across outlets. The scanner data does, however, indicate that the level of aggregation at which product substitution becomes strong is very fine, much finer than for the UK CPI Items. For example, Wedel and Ahang[16] find that there are strong substitution effects within each of three categories of orange juice, namely shelf-stable, refrigerated and frozen, but that substitution across these categories is much weaker. Even where within-store data shows high own-price elasticities of substitution, the cross-elasticities of substitution are often low, suggesting that much of the effect of price discounting is to alter the profile of purchases in time, rather than to induce substitution between goods.[17]

The empirical data is not systematic, but it does reinforce the view that for broadly-defined Items that are reasonably inexpensive, which is the vast majority in the UK's CPI, the elasticity of substitution is closer to zero than to minus one. This may not be the case for more homogeneous, expensive Items, such as household durables.[18] The advent of internet shopping also has the potential to increase substitutability, through reducing search costs. On the other hand, it also has the potential to increase product differentiation, narrowing the categories over which price competition is likely to be strong.

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[15] e.g. S.D. Braithwait, The Substitution Bias of the Laspeyres Price Index: An Analysis Using Estimated Cost-of-Living Indexes, *American Economic Review*, 70 (1980), pp 64 – 77.

[16] Michel Wedel and Jie Ahang, "Analyzing Brand Competition Across Subcategories," Journal of Marketing Research,Vol. 41, November 2004, pp 448-456.

[17] e.g. I Song and PK Chintagunta, "Measuring Cross-Category Price Effects with Aggregate Store Data," Management Science, vol 52 no 10, October 2006, pp 1594-1609, who look at scanner data on detergent sales.

[18] Braithwait, op. cit., has Household Durables and Entertainment as his two high substitution categories (out of ten in total), with Recreational Goods and Clothing on the margin between high and low substitution.

## 3.3 Aggregation in the UK CPI

The discussion of first-stage aggregation has so far been in general terms and it is worth looking at the particular characteristics of the UK's CPI. In constructing any consumer price index, there are judgements to be made about how to define the Items and how to organise sampling. There is an underlying trade-off to be made between defining Items so as to make them homogeneous and defining them more broadly to be representative of the whole spending category. Homogeneity is desirable, because if the goods that are sampled are tightly defined and very similar, then their price movements are likely to be very similar and one can be sure that on aggregation – whatever aggregation method is used – one will get an accurate picture of their average price movement. On the other hand, with very tightly defined Items, there may be a problem of representativeness: one has an accurate picture of the price movement of a particular product, but there is always the possibility that its price movement was not representative of the Item as a whole.

As an example (taken from the 1996 ONS revision), suppose that from national accounts and survey data we have statistics on household spending on the broad category of jam, which will become an Item in the price index. One could define the Item narrowly, such as "1lb jar of strawberry jam": this leaves little room for enumerator judgement or error and will give us a good picture of how the price of strawberry jam moves. However, we cannot be sure that the price of strawberry jam will move in the same way as the price of other jams and therefore whether our assumption is valid that all spending on "jam" is subject to the price movement that we have picked up for strawberry jam. An alternative would be to adopt a broader Item definition, such as "pot of jam". It is then up to the enumerator to visit a shop, pick out a particular pot of jam and record its price in that shop each month. In this way, we will be picking up price data for a range of jams and can be assured of the representativeness of our sample. This may, however, be at the expense of accuracy: with smaller samples for each type of jam, there is greater scope for random and enumerator error, and there will inevitably be a much greater spread or variability of the price relatives, and in this case the method of aggregation becomes important.

In practice, the UK has chosen to have Items with unusually broad descriptions, compared to the practice in other countries, which have tended to take much more narrowly-described Items as being representative of a category. This seems always to have been the case – at least since 1956, when the RPI in something close to its present form was created[19] – and was made more pronounced by the 1996 revision of the RPI, which considerably broadened the Item descriptions.[20] It is not clear what was the motivation for this choice, but it has had the effect of minimising any problem of representativeness for the Items in the UK's RPI. This was reinforced in 1996 by a simultaneous rebalancing which broadened the range (although not the number) of outlets and locations used for sampling.

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[19] Philip Gooding, *History of and Differences between the Consumer Prices Index and Retail Prices Index*, ONS, July 2011.
[20] David Fenwick, "The impact of choice of base month and other factors on the relative performance of different formulae used for aggregation of Consumer Price Index data at an elementary aggregate level," paper presented to the Ottawa Group fifth meeting, August 1999, www.statice.is/ottawa/fenwick.pdf

Greater representativeness was an advantage of the UK's choice. Inevitably there are concomitant disadvantages. With such broad Item definitions, there are relatively few that are homogeneous and therefore there are relatively few – mainly in the food and beverages groups, or for products like petrol – where the UK was able to use the Ratio of Averages approach. The broader Item definitions also mean that in most cases there is considerable dispersion in the price relatives, so that, in the remaining groups, the choice of whether to use the Average of Relatives or the Geometric mean will make a relatively large difference to the result.

A good example of how this operates comes from the changes made at the beginning of 2010 to the way the UK samples clothing prices. As already mentioned, it was becoming clear by then that the UK was seriously under-estimating clothing inflation. In part, this was because it was not picking up the rise in clothing prices after sales had ended, because there were problems in finding the same products to sample before, during and after sales. Consequently, from January 2010 the ONS, while keeping the Item categories unchanged, widened its sampling criteria and relaxed the requirements for matching like with like. This seems to have mitigated the under-estimation of clothing inflation, but a side-effect has been that the variability of prices within each clothing Item (e.g. "skirt", "men's shirt") has increased and that, consequently, the difference between clothing price inflation measured using the Geometric mean (as for the CPI) or the Average of Relatives (as for the RPI) has widened dramatically. Over the period 1996 to 2009, for clothing as a whole, average annual inflation was 2.8 percentage points less under the CPI measure than for the RPI measure. However, for 2010, the CPI measure showed clothing price inflation as 8.5 percentage points lower than under the RPI measure. The ONS calculates that clothing, which had previously contributed 0.21 percentage points to the difference between the overall CPI and RPI inflation measures, contributed 0.51 percentage points to the difference between these two measures in 2010.[21]

As a matter of history, the original choice of Item definitions and their subsequent revision was made when the UK was using the RPI as its sole general consumer prices index, and, for historical reasons was using the Average of Relatives as its main method of first-stage aggregation. In these circumstances, broad Item definitions made sense. As we have seen, the broader the Item definition, the lower the substitutability between the products that are priced within it, and therefore the more likely it is that using the Average of Relatives for aggregation gives an accurate average and – equivalently – that the Geometric mean gives an underestimate[22].

Meanwhile, countries such as France were working with much tighter Item definitions[23] and using the Ratio of Averages for first-stage aggregation[24]. This meant that, for them,

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[21] P. Gooding and D. Morgan, *CPI and RPI: increased impact of the formula effect in 2010*, ONS Information Note, 2011.
[22] Examination of Braithwait, op. cit, suggests – and it can be no more than a very broad indication – that the cut-off point, beyond which a switch from the average of relatives to the geometric-mean approach gives a better estimate, is a compensated own-price elasticity of about (minus) 0.63.
[23] Fenwick, *op cit*.
[24] In the pre-computer age, calculating the geometric mean represented a considerable computational challenge, so that, before 1980, only the Ratio of Averages or Average of Relatives methods were used. By 1997 some EU

calculating their HICP on the basis of their existing Item definitions gave results not much different from their domestic price index and that switching the method of aggregation for some Groups to the Geometric mean made relatively little difference to the result.

As we have seen, for the UK, the use of broad Item definitions and the consequent relatively high variance of sampled price relatives meant that the HICP calculation produced results that were widely different from the existing RPI index. We shall leave to Section 5 an assessment of what this means for the accuracy of the CPI. However, it is probable that had the UK been constructing its price sampling system from scratch, while being constrained to using the techniques allowed by the HICP regulations, it would have chosen more numerous and more narrowly defined Items. (Being more narrowly defined, each Item would have required fewer sampling points, so the overall price collection effort need not have been greater).

## 4. Wider Use of the CPI from 2011: Statistical Aspects

As already mentioned, the Chancellor of the Exchequer, in his June 2010 Budget, announced that, from 2011, there would be switch to a system of uprating benefits, tax credits and public service pensions using the CPI rather than the RPI. He also announced that, in the next Budget, the Government would move the indexation of the tax system from RPI to CPI "in a way that protects revenues."

There are some relevant points to note about these announcements:

The predominant motive behind the changes was "to put the whole welfare system on a more sustainable and affordable footing" and to improve government finances. This is demonstrated by the changes to tax indexation: the default index for the indexation of direct tax thresholds (increases in which decrease tax revenue) will be the CPI, whereas the default index for indirect tax bands (increases in which increase government revenue) remains the RPI. Improving the government finances and reducing the fiscal deficit are laudable government aims: the point is that the switch from RPI to CPI was not primarily motivated by a reassessment of the statistical merits of the two indices.

Before announcing the switch in the June Budget, the Government was able to study and draw on all the published ONS analysis of the properties of the RPI and CPI. But it did not ask for the expert advice of the ONS or the National Statistician on making the change from the one index to the other.[25] Although the duties of the National Statistician include: "to provide advice to ministers, the Cabinet Secretary and other senior officials on the production, dissemination and use of statistics across government," there is no corresponding

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countries were using the geometric mean for first stage aggregation in some or all of their domestic price indices and six of the original EU15 switched some or all of their domestic index to the geometric mean in 1997, when the HICP was introduced, thus reducing the effort involved in calculating two indices.

[25] Letter from Sir Michael Scholar, chairman of the UK Statistics Authority, to Mark Courtney, 6 September 2010, copied to Dame Anne Begg, MP, Chair of the Work and Pensions Select Committee: "My office has consulted the National Statistician's Office and I understand that the National Statistician was not asked for advice on the switch from the Retail Prices Index (RPI) to the Consumer prices index (CPI) for the purpose of uprating benefits and pensions."

duty on ministers to consult her, even on major changes in the use of statistics, so there was no constitutional impropriety involved. However, it does mean that the decision did not have the benefit of expert statistical advice and that subsequent statistical justifications have been *post hoc* (This does not mean that they are incorrect, merely that the original decision cannot be presumed to have had the approval of the semi-independent ONS).

On 8 July 2010 Steve Webb, a DWP Minister, announced in a written Ministerial statement that the Government intended to make the CPI the index used for the statutory minimum uprating of private sector pensions, because the Government believed it was right to use the same index for this purpose as for uprating benefits and public sector pensions. This decision, therefore, took place after the June 2010 Budget and had not been foreshadowed in it. The consistency between the government treatment of its role in public sector and private sector pension indexation therefore also came as a *post hoc* addition to the original announcement aimed at improving the public finances. (Again, this does not mean that the statistical justifications put forward for the change in statutory minimum uprating are incorrect, merely that they cannot be presumed to be the main government motivation for the change or to have had the benefit of ONS advice).

## 4.1 Judicial Review

A number of public sector unions and pensioners' associations have challenged the decision to switch the uprating of public sector pensions from the RPI to the CPI, and the judicial review hearing is scheduled for 25-27 October 2011. This is not the place to discuss all the issues involved, but it is relevant to review the main point at issue:

Although government spokesmen have often said that they consider that the CPI is a better measure of consumer prices than the RPI, the grounds on which the Government is defending its decision in the context of the judicial review is much narrower. Section 150 of the Social Security Act 1992 gives the Secretary of State considerable discretion over how to determine whether payments have maintained their value in relation to the general level of prices – they can be "estimated in such manner as the Secretary of State thinks fit." The government contention is, therefore, that the Secretary of State can choose any "valid" consumer price index he likes: it does not have to be the best available or meet any particular standard for being unbiased. Moreover, it is entirely legitimate for him to use the effect on the public finances as a reason for choosing one "valid" consumer price index over another.

Similarly the public sector unions' challenge is also on quite narrow legal grounds. They do not challenge the right of the Secretary of State to use whatever index he sees fit to determine whether the payments have maintained their value. Instead they point to Section 150 (2), which requires the Secretary of State, once he has made that determination, to increase "each of the sums ... by a percentage not less than the percentage by which the general level of prices is greater at the end of the period than it was at the beginning." Their contention is that this wording requires the use of what we have called a fixed-basket price index, whereby the price of the same basket of goods is measured at the end of the period as at the beginning. The CPI is not a fixed-basket index and the unions' claim is that, because it includes an assumption about consumer behaviour which alters what is being measured during the period, it is not a pure price index, as required by the legislation.

It will be seen, therefore, that the question at issue in the judicial review is much narrower than the appropriateness or otherwise of using the CPI to uprate payments to compensate for changes in the cost of living. The issue is not the quality of the CPI or how well it would perform this function, but about whether – whatever its merits or demerits – as a non-fixed-basket index it meets the requirements of the legislation.[26]

## 5. Assessment of whether the CPI is an appropriate index to use for cost-of-living adjustments

### 5.1 Criteria

Any general consumer price index is a compromise. There are cost constraints on the extent of sampling that can be undertaken and judgements to be made about coverage and technique according to the purpose for which it is being constructed. Consequently, in looking for an appropriate index with which to measure fluctuations on the cost of living, one is not looking for perfection, and one needs to take into account that there are, in many cases, legitimate alternative specifications.

On the other hand, if one identifies that an index has a significant and systematic bias in its measurement of consumer-price inflation (and if there are available alternatives that do not display such bias) then it will not be an appropriate index on which to base cost-of-living adjustments.

### 5.2 The CPI as an indicator for monetary policy

Although it is not part of this paper's purpose to assess how the CPI performs as a target indicator for monetary policy, it is worth looking at this question briefly, in order to highlight the different properties that one is looking for in an indicator for monetary policy: it is possible that an index might be appropriate for one purpose and not for the other. Thus, there may be properties of an index that are a weakness or a matter of indifference as far as measurement of changes in the cost of living are concerned but which are positive advantages for a monetary indicator. And factors that might constitute a serious defect when measuring

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[26] In a separate strand that might have a greater read-across to private-sector pensions, the public sector unions are pursuing a more broadly based issue, relating to public employees who relied on statements or actuarial tables promising uprating using the RPI when making voluntary contributions or changes to their pension arrangements. Thus the CSPA website:
"Also, whatever the outcome of the Judicial Review we will be pursuing the cases of those members who have bought particular financial packages based on actuarial tables, which assumed RPI. Such packages include purchase of added years; purchase of added pension; allocation of pension; conversion of lump sums into pension; pension splitting on divorce; transfer-in of pension benefits from non-public sector schemes; and actuarially-reduced pensions. There might be others. Undoubtedly, if such packages had been bought from the private sector, the politicians, the media and the Financial Services Authority would have been up in arms about 'pensions miss-selling'. We have had encouraging initial advice from our solicitors and have had tentative discussions with Cabinet Office as to how such cases should be pursued. The Cabinet Office has maintained that it has acted within the scheme rules but, if specific complaints are made by members, they will have to deal with them under the terms of the Internal Disputes Resolution (IDR) procedures. We have argued that it would be sensible to take a number of 'lead' cases in the first instance, with other cases being decided in the light of those. The likely route would be a complaint under the IDR procedures. If that were to be rejected, the case could be pursued with to the Pensions Ombudsman. If he were to reject, we could then pursue via the courts."

the cost of living might be of only minor concern when the index is used to inform monetary policy.

Since the CPI is based on the HICP, which was developed specifically as a monetary indicator, it will come as no surprise that it has many properties that make it suitable for that role.[27] Without attempting an overall assessment, some of these are listed below:

• The fact that the CPI covers all monetary spending in the UK is an advantage for a monetary indicator. It is irrelevant whether some of this spending is done by foreigners and it is an advantage that UK residents' overseas spending is excluded.

• There are reasons for thinking that indirect taxes and charges, such as TV licences, vehicle excise duty and council tax, which constitute an expense as far consumers are concerned, can legitimately be excluded from a monetary indicator, since they are under government control and do not, therefore, constitute an external source of inflationary pressure.

• As we have seen, it is a matter of controversy whether an index used for cost-of-living adjustment needs to be a fixed-basket index, but this is not the case for the a monetary indicator. If consumers really do indulge in extensive price substitution (an important qualification), then a monetary indictor certainly wants to capture it, since it is interested in the total expenditure that takes place in the country, regardless of whether substitution towards products with lower price rises does or does not make consumers worse off.

• It is well known that the CPI has consistently shown a lower inflation rate than RPIX, which was previously used as the monetary policy indicator. If either of them were being used as a measure of the cost of living, it would be vital to know which was the more accurate, but for monetary policy purposes the actual level of inflation is of secondary importance: what is important is that the index is an accurate indicator of <u>changes</u> in inflation – differences in the level of inflation can be adjusted for by changing the target, as was the case in December 2003, when the switch was made from RPIX to CPI.

• The fact that the CPI excludes owner-occupied housing is a weakness that the Bank of England wishes to see corrected.[28] Even so, it is not a fatal weakness, for two reasons. Firstly, a measure of owner-occupied housing costs that is suitable for monetary policy purposes would be a rather narrow one and so would constitute less of the overall index then the actual expenditure by consumers might indicate.[29] Secondly, house price inflation tends to follow a different cycle to the rest of consumer pressure, so, although not ideal, it is possible for the Bank of England to look on the CPI as an

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[27] Office for National Statistics, "Implications of the differences between the Consumer Prices Index and Retail Prices Index," *Information Note*, August 2011, has a checklist of the differences between the CPI and RPI and the implications for macroeconomic and compensation purposes, but it makes no attempt to quantify the relative importance of the different factors and diplomatically makes no judgement between them on most counts.

[28] Consumer Prices Advisory Committee – *2010 Annual Report to the UK Statistics Authority*, November 2010.

[29] In particular, it is desirable to exclude mortgage interest payments from monetary indicator, because increases in interest rates (which are the means that the Bank uses to try to lower inflation) would show up in the short term as increases in a consumer price index that included mortgage interest payments, giving a misleading signal of the effects of monetary policy.

indicator of inflationary pressure excluding housing and then look at inflationary pressure from the housing market separately.

## 5.3 The CPI as a Cost of Living Indicator

As indicated in the description of the CPI in Section 3, the two areas where the performance of the CPI needs to be assessed are in its coverage, and in the statistical technique it uses for first-stage aggregation.

### 5.3.i Coverage of the CPI

As discussed above, the CPI was developed as a monetary policy indicator and there are aspects of its coverage which do not fully reflect the consumption purchases of UK residents, because it covers only monetary purchases, only expenditure in the UK and excludes a number of charges and indirect taxes.[30]  Nevertheless, that would only be a reason to reject the CPI if such exclusions resulted in a significant bias in the CPI, and that would be the case only if the exclusions separately or together accounted for a non-negligible fraction of expenditure and if the price developments in these sectors deviated from developments of the overall index.

These criteria are met only in the case of owner-occupied housing expenditure, which is excluded from the CPI.  This has a significant share in total consumption expenditure: on the RPI measure it constitutes 16.5% of consumer expenditure if mortgage interest payments are included and 13.3% if they are excluded.  Even on the narrower measures being developed by the ONS on HICP principles, the share will be between 7% and 10%.  Moreover, in the past, owner-occupied housing expenditure has developed differently, both because it has a different cyclical pattern and because it has had a long-term trend of faster inflation.  It is likely that this long-term trend will continue into the indefinite future, because continued growth in population and the number of households will interact with a housing stock that is constrained in its growth, and because house-building and house-maintenance are sectors that are unlikely to benefit from the technological change that moderates price increases in some other sectors.

What is the effect of the exclusion of owner-occupied housing on the overall CPI?  The ONS produces tables showing the causes of differences between the CPI and RPI, and these show that over the whole period from January 1997 to August 2011, the exclusion of owner-occupied housing caused the CPI on average to be 0.56% below the RPI if mortgage-interest payments are included and 0.47% below the RPI if mortgage interest payments are excluded. If only the last seven years are considered, both of these figures become 0.31%.[31]  The September 2010 figure, on which the government's April 2011 uprating order was based,

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[30] Where a consumer price index is to be used to indicate the cost of living of a distinct sub-group, it may be possible to adjust the coverage to reflect their buying habits.  However, for a large private-sector pension scheme, only a general index, covering the full range of consumer expenditure for the whole population, is likely to be acceptable.

[31] The current DWP assumption is that the exclusion of housing costs will lower CPI inflation by 0.07% per annum.  It is not clear why their figure is so much smaller than the past average, but it would be consistent with government fiscal projections for them to be projecting current conditions, particularly for council tax and interest rates, into the indefinite future.  c.f. DWP, *Impact Assessment: Impact of the Move to CPI for Occupational Pensions*, February 2011.

showed that the exclusion of housing lowered the overall index by 0.73% on the inclusive basis and by 0.56% if mortgage interest payments are excluded. (Because the housing market is currently in a severe downturn, the latest, August 2011, figures, show that the influence of owner-occupied housing is to place the CPI <u>above</u> the RPI, by 0.05% including mortgage interest payments and by 0.12% if they are excluded).

The housing market is notoriously difficult to predict and it may be that the trend over the next few years will be more moderate – relative to general inflation – than over the past. Nevertheless it is certain that owner-occupied housing will have a different cyclical price experience from other consumer items and all but certain that, on average, its exclusion will result in an underestimate of the cost of living by a significant amount: on past evidence by between 0.3% and 0.5% per annum.

### 5.3.ii Techniques for First-Stage Aggregation in the CPI

We have seen that there is debate over whether a consumer prices index that is used to measure the cost of living needs to be a fixed-basket index, which the CPI is not. It is true that a fixed-basket index is easier to understand and explain. It is also true that all the available techniques for first-stage aggregation are based not on evidence but on assumptions about consumer behaviour, and that therefore only an index that uses an arithmetic average (which assumes no change in consumer purchasing patterns) can give an unambiguous assurance that adjustments based on it will leave consumers no worse off at the end of the period than they were at the beginning. Nevertheless, the use of the Geometric mean is a well-established technique for first-stage aggregation and, unless there is an indication that its use will bias the results, there is no statistical reason to reject it on principle.

In the UK it makes an enormous difference whether the Geometric mean or the Average of Relatives is used for first-stage aggregation – this is the so-called formula effect. The ONS produces tables showing the causes of differences between the CPI and RPI. These show that, neglecting all other differences of coverage or weighting, the formula effect alone caused the CPI, taking the average over the whole period from 1997 to 2009, to be 0.53 percentage points lower using the Geometric mean than if it had been calculated using the Average of Relatives – and the size of the formula effect was quite stable, never being less than 0.43 percentage points. From January 2010, the ONS widened its sampling criteria for the clothing Items, with the result that price dispersion and the size of the formula effect increased. From January 2010 to August 2011 it averaged 0.88 percentage points. (Over the last year, from August 2010, as the new sampling method has bedded in, the formula effect has averaged 0.96 percentage points and was never less than 0.86 percentage points).[32] Given that the new sampling technique is now in place, it is likely that, unless the ONS makes further changes to the way the CPI is calculated, the formula effect is likely to stay at the higher level, in the range from 0.8 to 1.0 percentage points.

This is, indeed, an enormous effect. If an index calculated using the Geometric mean is consistently around 0.9 percentage points lower than an otherwise identical index calculated

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[32] The DWP assumption, in the already cited February 2011 impact assessment, is that the formula effect will be 0.8 percentage points into the indefinite future. The basis of this estimate is not given but it is likely to be based simply on a forward projection of the then current levels.

using the Average of Relatives, then they cannot both be giving an acceptable measure of the change in the cost of living. Either one or the other must be correct, or else the true value must be somewhere in between.

As already discussed, there is no decisive theoretical reason to prefer one rather than the other, and there is also no conclusive empirical evidence. However, the fact that the UK's Item definitions and sampling procedure were originally developed and then broadened to complement first-stage aggregation using the Average of Relatives, might lead one to suspect that the true cost of living is closer to an index using this method of aggregation.

The size of this effect can be gauged by looking at other countries' experience. As already mentioned, none of the other EU15 countries exhibited a formula effect of more than 0.1 percentage points when their domestic consumer price indices were compared to their HICP index. However, none of them were making as extensive a use in their domestic index of the Average of Relatives as the UK, so although this result provides some evidence of the general effect of tighter Item definitions, it is not directly comparable.

A much closer comparison comes from the experience of Australia and the USA, since both of these countries were originally using the Average of Relatives for first-stage aggregation across most of their consumer price indices. Australia switched to the geometric mean for most first-stage aggregation in 1999. There were a few other changes made to the index at the same time, so the effect of the change in aggregation formula was not obvious, but the Australian Bureau of Statistics estimated the effect of the change in aggregation formula at between 0.1 and 0.2 percentage points.[33] The USA also switched the majority of Items in its consumer prices index to first-stage aggregation using the geometric mean in 1999. The estimated effect of this switch was to lower the index by between 0.15 and 0.2 percentage points.[34]

Both Australia and the USA believed that switching the formula for first-stage aggregation in this way was correcting a previous over-estimate of consumer prices. Both also believed that, after the switch, there was no longer any significant over-estimation from first-stage aggregation. The implication is that, had the UK been using similar Item definitions and sampling techniques, its formula effect would have been in the range of 0.1 to 0.2 percentage points. To the extent that the UK formula effect is greater, that is because its broader definitions and sampling techniques give a much greater variance of sampled prices, and in these circumstances, using the Geometric mean for first-stage aggregation implies an implausible degree of consumer price substitution.

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[33] Australian Bureau of Statistics, *Information Paper: Introduction of the 13th Series Australian Consumer Price Index*, 1998.

[34] The Bureau of Labor Statistics estimated that using a geometric mean rather than the Average of Relatives for first-stage aggregation across the entire CPI would cut the estimated inflation rate by 0.25 percentage points a year, but that it would be appropriate to do so for only some categories. c.f. Bureau of Labor Statistics U.S. Department of Labor "Measurement issues in the consumer price index". *Statistical Journal of the UN Economic Commission for Europe*, 1998, Vol. 15, Issue 1. From 1999 the BLS switched 61% of the categories to the geometric mean. The estimated reduction in the overall inflation rate was between 0.15 and 0.2 percentage points. c.f. D.E. Lebow and J.B. Rudd, "Measurement Error in the Consumer price Index: Where do we Stand?", *Journal of Economic Literature*, vol 41, March 2003.

The conclusion is that any formula effect greater than 0.1 percentage points raises the possibility that using the Geometric mean for first-stage aggregation will under-estimate changes in the cost of living; and that a formula effect greater than 0.2 percentage points makes such under-estimation probable. The current formula effect in the range of 0.8 to 1.0 percentage points is indicative of severe under-estimation, probably in the range of 0.6 to 0.9 percentage points.[35]

### 5.3.iii Conclusion

The CPI as currently calculated in the UK exhibits a significant and systematic under-estimate of the overall cost of living, because it does not cover owner-occupied housing. It also exhibits a significant and systematic under-estimate of the cost of living because it uses the Geometric mean for first-stage aggregation in the context of a price collection and sampling system that was designed and developed for a different technique of first-stage aggregation, namely the Average of Relatives. This means that the CPI is not an appropriate index for the Airways Pension Scheme to use in order to measure and adjust for changes in the cost of living.

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[35] For completeness, the reverse of this assessment should be pointed out: if one believes that a good cost-of-living index need not be a fixed-basket index but should incorporate our best guess at the extent of consumer price substitution, then a consumer price index using the Average of Relatives for first-stage aggregation is probably over-estimating inflation by about 0.1 percentage points and there is a possibility that it might be over-estimating it by as much as 0.2 percentage points.