# UK Consumer Price Statistics: A Review

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# Contents

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All that said I should stress of course that all the conclusions and opinions, and in particular all the mistakes, which appear in this review are mine and mine alone.

**Paul Johnson**

# Terms of reference

On 16 May 2013, Sir Andrew Dilnot, Chair of the UK Statistics Authority, invited Paul Johnson, Director of the Institute for Fiscal Studies, to conduct a review of UK price indices with the following terms of reference:

Consider what changes are needed to the range of consumer price statistics produced for the UK to best meet current and future user needs.

In doing so:

– recommend a framework of consumer prices statistics that will understand and best meet the needs of users, and be accountable, flexible, transparent, and no more burdensome than is clearly justified;

– promote recognised and high-quality statistical standards;

– consider the arguments for using cost of living or cost of goods concepts;

– consider how public and private sectors can best work together, using all possible data to maximise quality and efficiency; and

– work within the findings of the Authority's review of the governance arrangements and structures supporting the production of price statistics.


The review will be led by Paul Johnson.

The review will report to the Board of UK Statistics Authority and deliver a final report for publication with recommendations in January 2015[1].

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[1] The review was initially scheduled to deliver its final report in summer 2014.

# Summary and recommendations

## Introduction

Most of us probably think we know what inflation is – it's just the rate at which prices increase. But that simple definition hides a host of choices over what we really want to measure, and a whole set of difficulties over how to measure it. There is no single correct answer to the question: "what is consumer price inflation?"

That partly reflects the different uses to which inflation figures are put. It may be that the question the Bank of England is asking when it wants to know what economy wide inflation is for the purposes of setting interest rates and targeting inflation, is subtly different from the question one is posing when asking about the inflation that has been experienced by households. The inflation rates experienced by different households – by rich and poor, by pensioners and those of working age – will likely be quite different.

But there is an even more fundamental question about what we mean by inflation. When we talk about inflation we usually talk about the "cost of living" – inflation of 2 per cent suggests that the cost of living, or the amount we have to spend to be just as well off as we were before prices rose, has risen by 2 per cent. In fact the inflation measures we use don't do that at all. They measure the increase in prices of goods and services that we bought a year ago, not the amount by which our incomes would have to rise to make us as well off as we were. We could try to do the latter, but no statistical agency in fact does – and there are good reasons, both practical and principled, for that.

Even if we could agree on exactly what concept of inflation we want to measure there are big choices to be made over what prices to collect, how to collect them and how frequently. You have to decide how much weight to give to different items in the shopping basket. Crucially you need to decide how to aggregate up all the individual price changes to create a single inflation number. And you need to cope when new goods are introduced or when the quality or characteristics of goods change – what happens when smartphones are introduced or when flat-screen TVs replace bulky old TVs?

These are not issues of merely statistical interest. They matter enormously. Inflation statistics are amongst the most important official statistics. They underpin the UK's monetary policy and affect the incomes of millions of people. They have been used to adjust benefit levels. They form the basis of many wage negotiations. And inflation statistics are used in hundreds of billions of pounds worth of contracts, most notably for index-linked gilts. So the inflation figures produced by the Office for National Statistics (ONS) need to credible, trusted and stable – frequent or substantial changes in the way they are produced could undermine confidence in vast swathes of contracts and in particular in contracts for government debt.

These are just some of the issues we have had to contend with in this review of the range of consumer price statistics. Commissioned in the wake of the controversy surrounding the outcome

of the former National Statistician's consultation on the future of the long-standing Retail Prices Index (RPI), the review has set out to achieve two key things:

- Provide some clarity over what consumer price statistics are for, and what statistics are required to meet user needs.
- Review a whole range of methodological issues in constructing price indices, including data sources, aggregation, how to account for owner occupiers' housing costs, how to compare goods over time, amongst others.

We have been guided in doing this by three central considerations.

First, there is rarely a single "correct" answer. There is frequently a set of judgements and trade-offs that need to be made in determining everything from how many headline statistics to produce, to exactly how to collect prices, how to aggregate over different items and how to compare items over time. All the way through we have tried to set out the different considerations and explain why we have come to a particular judgement, whilst stressing that in the end it is only a judgement.

Second, there are issues beyond "statistical purity" that matter. Inflation statistics need to command public confidence, be broadly explicable, and to be robust over time.

Third, we start where we are. We are constrained by UK and European legislation. Both the CPI and, especially, the RPI, are used in long term contracts which need to be respected. Some degree of consistency is important in making comparisons over time. And simple practical considerations in some instances mean that major changes to data sources, for example, may be difficult to achieve in the short term. Nevertheless we have of course tried to set out how these constraints have affected conclusions and where the conclusions may have been different in the absence of these constraints.

## Current practice

The Consumer Prices Index, or **CPI**, is currently the headline measure of inflation. It was first published in 1997 to measure inflation consistently across all European Union states. In 2003 the CPI became the Bank of England's inflation target. The CPI is required by European law and ONS has to produce the CPI to the specification of European legislation.

**CPIH** was introduced in 2013. It includes a measure of owner occupiers' housing costs using a rental equivalence method. It is otherwise identical to the CPI, although its calculation and structure are controlled by ONS and so it may deviate further from the CPI in future.  It has currently had its status as a National Statistic suspended because of concerns over the process used for calculating increases in rents which feeds in to measure owner occupiers' housing costs.

The Retail Prices Index, or **RPI**, is the longest running measure of consumer price inflation; it was introduced in 1947. The RPI has a somewhat different structure and coverage from the CPI and CPIH, but is created from the same price quotes. The RPI lost its National Statistics status in March 2013 because a formula used to calculate average price change does not meet international

standards. Because of its use in long term contracts, including index-linked gilts, there is national legislation controlling changes to the RPI.

Alongside the de-designation of the RPI, **RPIJ** was created following the National Statistician's consultation. RPIJ is identical to the RPI except that the "Carli" formula used in aggregating price quotes in the RPI is replaced by the (internationally standard) "Jevons" method (hence "J"). This index was primarily created as a tool to show the effect of using the Carli in the RPI. RPIJ was made a National Statistic in November 2013.

The recommendations of the review fall into two categories – those that relate to the overall question of what it is that we are, or should be, trying to measure, and those that relate to ensuring that data and methodology are appropriate for the task at hand.

## What should we be measuring?

### Why might there be more than one measure of inflation?

"Inflation" can mean a range of different things. There are at least three different concepts we might want to distinguish:

- The increase in prices between period 1 and period 2 (suitably weighted to reflect consumption of different goods and services);
- The increase in spending required to achieve the same level of welfare in period 2 as in period 1, in the face of rising prices;
- The increase in the actual cash outlay required by households to achieve the same consumption between periods 1 and 2 – what some have referred to as a "household index" or an "uprating index".

CPIH, once the shortcomings in the processing of private rents data have been addressed, will achieve the first of these pretty well. It is a good, comprehensive measure of price change in the household sector. The second and third measures are not so much about pure price changes as about costs faced by households.

The second concept asks not about price change but about how much more money households might require to reach the same level of welfare as before. This is sometimes referred to as a Cost of Living Index or COLI. It would take account of the fact that households might choose to substitute goods and services whose price rises slowly in the place of goods and services which become more expensive more quickly. One would expect this measure to be lower than CPIH, and indeed work for this review suggests it might be substantially so. We return to the subject of the COLI later.

The third measure is different again and captures the idea behind what some (for example, Leyland, 2014) have called a "household index". The household index has been put forward by some as a concept that could be used as a basis for deciding by how much incomes (wages, pensions, benefits) need to rise to compensate recipients for rising living costs. The argument is

that indices like CPIH do not take account of things like increases in mortgage interest costs which clearly have an effect on the spending required by some households.

Several differences between a "household index" of this sort and CPIH have been suggested, but the key difference is that the household index would focus on households' payments for goods and services rather than the price at the point of acquisition (or consumption in the case of owner occupied housing). Relative to CPIH it might focus on gross (rather than net to households) insurance costs and it would probably not include the full effect of Higher Education fees up front (since they don't impact on household costs for a long while). It would also treat housing costs differently from how they are currently treated in CPIH. In particular, it would include mortgage interest payments (MIPs) and an explicit allowance for renovations and repairs.

### The household index and the payments approach

One possible example of a difference between a classic price index and a "household" index is the way insurance is dealt with. In CPIH, the target concept is the net cost for insurance. That is, the difference between premiums paid by households and claims received. This difference is the cost of the insurance service provided. Economically speaking, that is the price[2].

A payments approach would measure the gross cost of insurance; that is the premiums paid. That is the cost faced by households which take out insurance and for most might provide a better sense of what it costs them to buy a service – insurance. A change in the premium is a genuine change in costs facing households who want to buy insurance. But if the changes in the premium reflect changes in the amount of money recycled back to households in payments then the price of the service has not changed.

Much more important, potentially, is the treatment of housing costs. It is not easy to capture owner occupiers' housing (OOH) costs in any price index. ONS uses the "rental equivalence" approach in CPIH. A home provides a flow of accommodation services that are consumed by households. The rental equivalence approach estimates the price of consuming these services as being equivalent to what the owner would have to pay if renting the property. Internationally, rental equivalence is the most widely-used method for estimating owner occupiers' housing costs.

Under rental equivalence the estimated rent is assumed to include the costs faced by landlords. To avoid double-counting, goods and services that landlords would pay for are not included separately. For example, landlords pay for buildings insurance and major repairs, so these do not have to be separately priced when rental equivalence is used for OOH costs.

But rental equivalence is an imputed transaction. It does not tell you how much more money households need to spend on specific payments related to owner occupation.  The payments approach, by contrast, aims to measure the actual consumption spending of households in relation to occupying the home they live in. That clearly includes mortgage interest payments and the costs of maintenance and repairs.

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[2] In practice, insurance is included on a "gross price, net weight" basis as net insurance prices are not known.

Capital payments, on the other hand, are generally defined as being out of scope of any kind of consumer price index. This is because they are an investment in an asset, and so add to household wealth, rather than being spending on consumption. For this reason, a payments approach would track house prices much less closely than perhaps users might expect.

However, the inclusion of mortgage interest payments is an obvious immediate attraction to the payments approach. Rising interest rates make those with mortgages worse off by increasing the costs they face. To many, not including this in an inflation measure seems perverse.

But measuring payments is harder than just measuring increases in mortgage interest payments. In particular, major works are difficult to measure. The RPI deals with this by including house depreciation, but as no actual payment is made, this is a departure from the payments approach. The payments approach is not a simple alternative to the rental equivalence approach.

In addition, rather as in the case of insurance payments, it is also important to understand that changes in interest rates create redistribution within the household sector. If I'm paying a higher interest rate on my mortgage, you're receiving more interest on your savings.

### A second measure?

And there, perhaps, lies the flaw in the concept of a single "household" index. The idea that there is one measure of inflation which tells us how much costs are changing for all different households is clearly absurd. Suppose one were to include mortgage interest payments, or some wider measure of the cost of credit, in an index covering all households, aimed at measuring household living costs. This might increase the value of such an index when thinking about the impact of price changes on working age households and those in debt. But it would actually have perverse effects when considering other groups, such as pensioner households, and those with net savings.

Is that not also true of any price index? Different households face different price changes depending on the basket of goods they consume. But a price index such as CPIH is a statistically coherent measure of the changing level of prices across all household spending on consumption. Its definitions are designed with this in mind. So aspects of the measurement make sense at an aggregate level.

The conclusion we draw is that there is not a case for publishing, alongside CPIH, a single monthly "household index".

- It could create confusion and inflation rate "shopping", where users may seek the rate of inflation that gives the right number, rather than the appropriate measure;
- Advocates of the uprating index argue such a measure would be appropriate for uprating wages and benefits. But it would not be. It would certainly not be appropriate for uprating pensions or other benefits;
- It would be no better than CPIH as a measure of prices faced by any individual group and could be misleading for some if taken as the "household cost measure".

These are powerful arguments and no doubt help explain why, to our knowledge, a population wide index of this type is not produced by any national statistics institute in the world. Only in Ireland, so far as we are aware, is a population wide index including the payments approach to owner occupiers' housing costs produced.

That said households, looking at their budgets, perceive certain costs, particularly mortgage interest payments, differently to how they are treated in consumer price statistics. There is a case for producing measures that reflect these costs. But these are not meaningful in isolation. They must be accompanied by measures that also capture the changes to household income. And the focus of these measures should be on subgroups of the population, not households as a whole.

The Australian Bureau of Statistics produces measures of inflation following the payments approach for four subgroups: working households, self-funded retirees, working age households supported by benefits, and pensioner households mainly supported by benefits. The last two groups are combined into the Pensioner and Beneficiary Living Cost Index. This has been one of the indices used to increase the Age Pension in Australia, although the 2014-15 Budget proposes to end this (Klapdor, 2014). New Zealand has stated an intention to produce similar subgroup indices from 2015. But notably neither produces an aggregate index across all households following this approach, to avoid competing with their headline CPI.

## Conclusions

There are different ways to measure consumer price inflation.

CPIH provides a good estimate of price changes across the economy. It should be the main headline index produced by ONS. In addition, ONS would better address user needs by publishing a set of measures on an annual basis to provide more complete information on the change in costs households face to maintain their standard of living. These should be published for specific groups of the population and it should be made clear what the measures of income are with which those measures should be compared. Such a set of measures would inform users and enhance the debate around the cost of living.

## Recommendations

1. **ONS should move towards making CPIH its main measure of inflation. In the meantime, the CPI should continue to be the main measure of inflation.**
2. **ONS should develop an annual analytical publication that produces inflation indices as experienced by a range of different household types, along with appropriate advice on what income measures these analytical indices can be compared to.**

## Towards CPIH as the main measure of inflation

CPIH is conceptually the best overall measure of inflation in the UK. It is however not widely used at the moment, for a variety of reasons. This may be in part because CPIH is still relatively new. The shortcomings recently identified in the way the private rents data are processed to measure owner occupiers' housing costs may also be a factor.

Looking forward, the lack of statutory underpinning for CPIH may be an important barrier to greater use. UK legislation sets out the process for approving major changes to the RPI. Through its link to HICP, the production and scope of the CPI is governed by EU regulations. CPIH currently uses the concepts and definitions of HICP (except for owner occupiers' housing costs), but it is not bound by the same legislation. This provides ONS with flexibility – for example to include council tax (see **recommendation 22**). But this flexibility may be an important disadvantage for potential users.

One complication is the decision of Eurostat (the EU's statistical office) to use the net acquisitions approach in developing the HICP – and hence the CPI – to include OOH. This approach was rejected by the Authority for CPIH because the data available to ONS did not allow the correct calculation of a net acquisitions measure, in particular a price for housing excluding land[3].

That CPIH is controlled by the UK statistical system is therefore a distinct advantage over the CPI. Over time, CPIH will continue to evolve to meet user needs in the UK. The UK will need to continue to produce an index meeting the HICP regulations, and this will be the best measure for comparing inflation between countries, but it should no longer be the UK's main measure of inflation.

CPIH will soon be supported by the two new Advisory Panels on Consumer Prices recommended by the Authority's recent review of governance (UK Statistics Authority, 2014). However, CPIH would meet user needs more fully if stronger, perhaps legally binding, arrangements were put in place. The requirement to produce CPIH could be established in law, alongside an outline of the process for making major changes to it.

### Recommendation

3. **The Authority should consider making the case for legislation governing the production of CPIH, guaranteeing its production and setting out the process for making major methodological changes.**

## The future of the RPI

In 2013 the UK Statistics Authority stripped the RPI of its status as a National Statistic. This followed the outcome of the then National Statistician's consultation on whether the way price quotes are aggregated together in the RPI should change.

Specifically, there is a difficulty about how to produce an average price change for basic items like shirts or vacuum cleaners when there is quite a range of prices but you don't have any information about how many of each is bought. You don't know how much weight to place on each price

[3] Eurostat are requiring EU member states to produce measures of owner-occupier's housing costs using this approach and including the price of land (see ONS, 2014).

collected. For many items the RPI uses the Carli formula. This is an arithmetic average of price relatives, or the average change in price since the beginning of the year. In the CPI, and in almost all other consumer price indices produced by national statistical institutes around the world, the Carli formula is eschewed entirely in favour of the geometric average price change (Jevons formula) and arithmetic average of prices now compared with those at the beginning of the year (Dutot formula).

*This review concurs with the Authority's conclusion that the use of the Carli is statistically flawed and can result in an upward bias in recorded inflation.* This is not essentially, as some have argued, because the Jevons method takes account of substitution between goods. Rather it is because there are basic statistical flaws and biases in using the Carli formula. As we stressed above it is generally hard in this area to come to absolute conclusions. But it is our strong view that the use of the Carli is inappropriate and that the RPI is upwardly biased because of its use. In light of this, ONS has introduced an additional inflation measure – RPIJ – which is essentially the same as the RPI except that it uses the Jevons method wherever the RPI uses the Carli.

RPIJ corrects the inadequacies of the formula used in the RPI and keeps the rest of the methodology untouched. But it is not just the use of the Carli which is problematic in the construction of the RPI as a measure of consumer price inflation. Issues with the data source of the weights, population coverage and treatment of some goods (like insurance and owner occupiers housing costs) make the RPI less suitable as a measure of overall inflation. RPIJ is problematic for all the same reasons.

The RPI is still used in large numbers of commercial contracts, including in £470 billion[4] worth of index linked gilts. The sale of these gilts is used by the government to fund part of the national budget deficit. Some of these gilts will not be redeemed until 2068 and in future new gilts may be issued with even longer terms. And the continued existence of long-term liabilities linked to the RPI continues to create demand for assets that provide returns also linked to the RPI, regardless of the statistical issues.

So despite its statistical inadequacy, the RPI cannot simply be discontinued. Indeed, cognisant of these needs, ONS also noted that there is 'significant value to users in maintaining the continuity of the existing RPI's long time series without major change' (ONS, 2013). It was with this in mind that the National Statistician recommended that the formulae used at the elementary aggregate level in the RPI should remain unchanged.

To continue to do so would meet the needs of users tied into long term contracts. But there are significant problems with this stance:

- The RPI has a long history and public recognition; it continues to be used widely;
- So long as the RPI continues to be produced, many users may still refer to it as the main measure of inflation despite its known problems;
- There is ambiguity about the National Statistician's commitment to "no major change" – which aspects of the calculation of the RPI are able to change as the available data sources and methods develop? The timescales involved are very long indeed;

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[4] Total market value of index-linked gilts at the time of writing

– Most seriously, the maintenance of the RPI on its current basis creates risks for the integrity of other inflation measures and/or for the public finances.

This last risk is worth dwelling on. Suppose, as is entirely plausible, it is determined that changes need to be made to how price information is collected and compared in order to get a better measure of CPIH. This is essentially what happened in 2010 when the way in which clothing prices were collected was changed – more items of clothing were deemed "comparable". Because of the underlying statistical methodology this had a much bigger effect on the RPI than on the CPI and CPIH – the "formula effect" grew. Further changes of this kind could further increase (or decrease) the formula effect and the wedge between CPIH and the RPI (and between RPIJ and the RPI).

In the situation of such a change arising, the Authority would be left to choose between three difficult options:

– Make the change and allow the "formula effect" to change. An increase in the effect would offer a windfall gain to some (for example holders of index linked gilts) and a loss to others (for example the taxpayer);

– Make no change and hence leave the CPI and CPIH less good than it should be – though in many cases that would not be compliant with EU legislation;

– Make the change for the CPI and CPIH only, thereby resulting in supplementary data collection or possible parallel running for the RPI, with associated costs and potential for confusion.

Producing the CPI and CPIH to the best possible statistical standard is the first priority. The logic of the current situation is that the RPI is purely a "legacy" measure produced because of the needs of users who have long term contracts. By not changing its calculation to make it a more "correct" measure of inflation in the face of clear evidence that the current methodology is flawed, the Authority has set a clear precedent. The National Statistician recognised that by stating that the methodology of the RPI would remain unchanged. This means that improvements to the methodology of the CPI and CPIH will not be carried over to the RPI.

That is a coherent (if uncomfortable) place to be. No further changes should be made to the RPI methodology other than those that ensure its continued functionality, for example the update of the basket or annual weights change.

This will over time likely result in parallel collection for, and production of, the RPI and reduce its appropriateness as a measure of inflation even further. The cost of production will rise. The usefulness of the measure will diminish. The logical outcome must be the eventual discontinuation of the RPI, although this would require the Statistics and Registration Service Act 2007 (which requires the production of the RPI) to be amended. Given the existence of so many long term contracts this will obviously need to be carefully managed over an extended period.

The Authority and ONS should make it clear to users that the RPI is not a credible measure of consumer price change. The RPI should not be used for new contracts. Taxes, benefits and regulated prices should not be linked to the RPI. The RPI should also not be used as the measure of inflation when comparing living standards over time, at least for recent years where better consumer price indices are available. The issuance of index-linked gilts is more complex, but

government should move away from selling gilts linked to the RPI, subject to consultation and assurance about the demand for CPI or CPIH linked gilts.

As the headline RPI is not a robust measure of inflation, it makes little sense to continue to produce analytical indices, such as the Pensioner Price Indices and the Tax and Price Index, which are based on the RPI. Where there is demand for analyses of this type to continue, these can be replicated on a CPIH basis (where they are not already), or within the scope of the subgroups analysis set out in **recommendation 2**.

What then of RPIJ, the fourth and final current main measure? It was produced to provide to users a form of the RPI that replaces the flawed Carli index with an index in line with best practice. However, RPIJ is not widely used. In fact, it seems to cause confusion, with users not clear whether they should move to RPIJ or CPIH. Ultimately, RPIJ should be discontinued.

## Recommendations

4. **ONS and the UK Statistics Authority should re-state its position that the RPI is a flawed statistical measure of inflation which should not be used for new purposes and whose use should be discontinued for all purposes unless there are contractual commitments at stake.**

5. **Government and regulators should work towards ending the use of the RPI as soon as practicable. Where they decide to keep using it the UK Statistics Authority should ask them to set out clearly and publicly their reasons for doing so. Where the Authority judges the continued use of the RPI to be inappropriate, it should say so.**

6. **ONS should consult users on discontinuing the analytical series it publishes that are based on the RPI, such as the pensioner indices and the Tax and Price Index. Where there is a strong user need for such analyses to continue, the series should be recreated using the CPIH framework.**

7. **We have noted that producing the CPI and CPIH to the best possible statistical standard is the first priority. The UK Statistics Authority should ensure that this priority is reflected in a work programme for the CPI and CPIH that allows each to be improved with best statistical practice.**

8. **The logic of the National Statistician's recent decisions is that the RPI should be considered a legacy measure to be used only where contractually required. No further changes should be made to the RPI. If a change is made to the CPI and CPIH that would affect the RPI, the production of the indices should be spilt to retain the best practice of the CPI and CPIH and the constancy of the RPI. Over the long term the Authority should look to phase out production of the RPI in consultation with users, amending the law (the Statistics and Registration Service Act 2007) as necessary.**

9. **ONS should consult on discontinuing RPIJ. ONS should continue to publish an estimate of the "formula effect" between the RPI and the main measure of inflation.**

## The Cost of Living and Cost of Goods concepts

Current price indices measure the change in the price of a basket of goods over time. They do not measure changes in the "cost of living" – the amount by which spending would have to change to maintain living standards. That is essentially because the indices are not constructed to take account of substitution behaviour – they do not take account of the fact that if the cost of meat rises a household may buy less meat and more beans. They effectively assume the household continues to buy just as much meat throughout the year, independent of any change in price.

A Cost of Living Index (COLI) theoretically reflects substitution behaviour which can be approximated through use of a superlative index number formula. Such a measure cannot be published in a timely fashion, but can be published at a substantial lag. ONS has carried out research into what a lagged superlative index might look like. This work suggests that such an index could be significantly lower than standard price indices – that the cost of living rises measurably less quickly than prices. Research in this area should continue.

### Recommendation

10. **ONS should continue its research on producing an experimental superlative index for the UK and should aim to publish such an index annually in arrears once that work is complete and has been fully quality assured.**

# How should we be measuring?

So far we have addressed the question of what consumer price inflation statistics should be measuring. While it is not always easy to make a sharp distinction, we now move to the question of how the ONS should go about measuring inflation. We clearly cannot be comprehensive, and do not here comment on the many areas where current ONS practice is good. We focus here on areas where there may be issues to address and where ONS is not currently engaged in making significant progress.

## Sources and aggregation of price data

Prices are currently collected through a combination of central and local collection. Around 110,000 price quotes, from around 140 locations, are collected by contracted price collectors visiting shops and other outlets. The prices are collected once a month, at the same time each month. ONS has been piloting work looking at the impact of collecting prices on more days for items where prices are volatile and is also already reviewing the boundaries of the locations used for local price collections. This process will update where the prices are collected to better reflect current consumer behaviour. These are important exercises.

A further 70,000 price quotes are collected centrally by ONS staff, from web sites, telephone calls, catalogues and brochures. In some cases the choice of data collection method owes more to

history than a consistent reflection of how these items are purchased by consumers. This process could usefully be set out more robustly and reviewed.

Once price quotes have been collected, they are combined together. Weights are used where available; where they are not, a Dutot or Jevons formula is used to combine the price quotes (Carli or Dutot in the case of the RPI). ONS could usefully review and set out clear criteria for choosing between the use of Dutot and Jevons in combining price quotes in the CPI and CPIH.

Developments in technology are creating new ways of collecting data for consumer price statistics. Web sites can be 'scraped' by computer programmes to automatically collect price quotes for a large number of items. 'Scanner' systems used by supermarkets and other large retailers at the point of sale create records of the price paid for products and the quantities purchased.

These alternative sources of data have the potential greatly to improve the quality of consumer price statistics. Leading countries are already making use of scanner data in their consumer price statistics, and several others are ahead of ONS in acquiring and experimenting with such data. These countries have faced difficulties in working with scanner data however, and ONS can catch up by learning from these experiences.

There seem to be particular challenges in persuading UK retailers to provide scanner data, which has not proved problematic in other countries. Retailers should work with ONS towards providing data that can serve the public good.

ONS has been 'scraping' data from a small number of supermarket websites over the last year, and is starting to analyse the prices it is collecting. Web scraping does not have quite the same potential as scanner data, as it does not collect information on quantities purchased. It does however have the potential to be a useful additional price collection tool for ONS, and work with web scraping should continue.

### Recommendations

11. **ONS should set out a transparent, regular and frequent process for reviewing which individual items in the basket are collected by local price collectors and which are collected from web sites, catalogues and brochures, to ensure this reflects how different items are purchased in practice.**

12. **ONS should review and publish its criteria for choosing how to combine price quotes at the lowest stage of aggregation.**

13. **ONS should give priority to developing the use of point of sale scanner data and web scraping techniques. ONS should set out a detailed plan for working towards greater use of these techniques in its consumer price statistics over the coming years.**

### Weighting of consumer price statistics

There are two fundamental inputs into a price index – the prices of goods and services, and the weights attached to them. Weights in consumer price statistics are based on relative expenditure shares to ensure that the price quotes have the appropriate impact on the final index.

The CPI and CPIH derive weights from the National Accounts. These draw on the best available source for each area of spending and as such would appear to be the best source of weights data. In some cases, these are business surveys (such as the Retail Sales Inquiry) or data from Government and industry associations.

However, the single biggest source of weights in the National Accounts is the Living Costs and Food Survey (LCF), ONS's household spending survey. The LCF is even more important in compiling the RPI, where it is used for almost all the weights. In common with similar surveys in other countries, the LCF suffers from low response rates and (often significant) under-reporting of household spending. Both of these problems have been getting worse over time.

In addition there have been long periods when weights for particular items (for example, internet subscriptions) have continued to be based on LCF data even when it has been clear that the LCF has been picking up only a very small fraction of overall spending. ONS has been slow to identify these issues and make appropriate changes either to the data collection or weights used in construction of the RPI.

To support **recommendation 2**, above, where we suggest that it would be useful to produce consumer inflation statistics for different population subgroups, it will be important to collect high quality data on consumption patterns for different groups of households.

National Accounts estimates are frequently revised. Price indices, on the other hand, tend not to be revised once published. At times this can lead to very big year to year swings in the weights used due to revisions. An example is the owner occupiers' housing component of CPIH between 2010 and 2014. This means that while the latest CPIH weights give the best estimates of how households on average spend their money, they do not support comparisons over time. This point could usefully be made clear to users.

The lag at which spending data are available means that the CPIH weights reflect spending patterns two years ago. This is unavoidable and in most cases tolerable. However, in the case of gas and electricity, this has the odd effect that the severity of the winter two years ago impacts the current weight. In such cases, the weights used in the CPI and CPIH should use an average of more than one year of National Accounts data.

One consequence of publishing the RPI and CPI using different data sources is that different weights are used. For important items of spending these can be quite different in each index, and indeed move in different directions. This can be highly confusing for users. ONS publishes an annual article on changes in the weights used in its consumer price statistics, and this provides useful information to users. However, it should include more explanation as to why the RPI and CPI/CPIH weights differ. Ideally, it would also be published alongside the introduction of the new weights; at present it usually follows later.

### Recommendations

14. **ONS should review the Living Costs and Food Survey (LCF) in light of the need to have good consumption data at a household level both to inform the National Accounts and to help with the creation of reliable estimates of the inflation experience of different population groups. External experts should be involved. More resource should be**

devoted to the LCF if ONS deems that necessary for the provision of high quality, reliable data on household spending.

15. **ONS should use more than one year of National Accounts data in cases where the weights are particularly volatile, or reflect particular circumstances in the latest year available (such as the weight for gas spending).**

16. **ONS should improve its commentary on the weights tables that accompany the RPI and CPIH, so that it explains why weights differ and/or move in different directions in the RPI and CPIH. ONS should aim to publish the annual article on the updated weights at the time the weights change.**

## Outlet substitution

In constructing a price index one considers the change in price of a good or service bought from a particular outlet – a supermarket, an independent retailer or over the internet for example. Month by month the price index is constructed by comparing the price of the same good bought in the same outlet. This is to ensure that the index does not create a price change across non-comparable items. However to weight the index at this level, first, we would want to know what weight to apply to purchases from each outlet and, second, the change in these weights.

Unfortunately ONS has little or no information about what proportion of goods are bought from outlets of different types. Shop type weights have not been reviewed since 2006, because the survey that provided them has been discontinued.

In addition it is clear that there have been very big changes in use of outlets. As consumers have moved from corner shops to supermarkets and from supermarkets to online providers the prices they will have paid for the same goods will have fallen. ONS's consumer price statistics will place increasing importance on outlets that account for more sales, but they do not take into account the compositional impact on prices paid.

There would be practical problems in producing a measure of inflation that reflected the average price paid for an item across outlets, rather than the current practice of aggregating changes in price across outlets. However, this is an area that merits further investigation, to determine whether the effect can be measured and how large it is.

### Recommendations

17. **ONS should review the stratification of consumer price statistics by shop type. The aim should be to introduce an appropriate stratification where weights for the different types of shops are available and can be updated.**

18. **ONS should assess the impact of outlet substitution on price indices and, in the light of that work, should consider whether substitution between different outlets (for example, from shops to the internet) should be reflected in any of its statistics.**

## The treatment of quality change and new goods and services

Goods and services change over time. A new car now is very different to a new car 20 years ago. Televisions available in shops now are quite different from televisions just a few years ago. And some products, such as smartphones and tablet computers, did not even exist 20 or even 10 years ago. How consumer price indices adjust for these changes is vital.

ONS has procedures for handling these issues. They comply with international best practice. There is, for example, a clear process for deciding what should be in the basket of goods and services, and ensuring that this remains representative of what consumers are spending their money on. This means that different years are not directly comparable with each other. This is dealt with by chain-linking years together.

Within years, quality adjustment is an issue when new products are chosen to replace products that are no longer available. The price collector must select a replacement product, and then make a judgement as to whether the replacement is close enough to the original to be considered comparable. If they do not consider it to be comparable then the price of the new model and the price of the old are not directly compared. Instead, the new model has a base price imputed using the price change of similar items.

For items that are being improved over time, such as technology goods, the impact is that average price actually paid for an item broadly defined ("a television", "a vacuum cleaner") will tend to rise more quickly than the price index for that good. In some instances we have shown in this report that the differences can be very substantial. For example between 1996 and 2013 the average observed price for a vacuum cleaner rose by about 50 per cent while the implied price index for vacuum cleaners fell by about 40 per cent. Implicitly, the difference between the average price of goods and services and the price index is attributed to differences in quality.

This is how in effect nearly all adjustment for quality actually occurs within years. Over time the index can be sensitive to exactly what counts as "comparable" for these purposes. Some products are sold at a discount towards the end of their life. When the product is no longer widely available it will be replaced by a similar one, often at an earlier point in its life cycle and not at a discount. The fall in the price of the discontinued product will be included in the price index. But if the discontinued and replacement products are not considered comparable, there is a risk that any price increase not due to quality differences between the two will be missed.

Clearly, the difference in price between two products should not enter the price index if the two products are not comparable. In the course of the review we have seen no evidence to suggest that there is a major problem in the way that goods and services are compared. However, further reassurance could be provided by ONS actively monitoring the use of the non-comparable marker in future. This would highlight goods and services where products were frequently found to be non-comparable, and be a starting point for further investigation.

### Recommendation

**19. ONS should introduce regular monitoring of the impact of quality adjustment on its consumer price statistics. This includes monitoring how often non-comparable replacements occur for each item in the basket of goods and services, and investigating**

**those items where this is frequent. ONS should particularly seek to understand cases where the relevant price index deviates substantially from the average price collected.**

## Owner occupiers' housing costs and council tax

Housing costs are among the most important of all consumer expenditures. But, for owner occupiers especially, taking account of housing costs in a consumer price index is uniquely challenging.

As we have already seen, from the perspective of an individual household, an approach based on the payments they make (excluding capital payments that increase their wealth) makes intuitive sense. It is useful for understanding the costs faced by households if there are accompanying measures of income that also reflect interest received. But the payments approach is not suitable as an overall measure of inflation.

The best approach available to ONS for measuring the price of owner occupied housing is to calculate what the occupier would have had to have paid to rent the property. This is the cost of the consumption part of owning the property, and is approximated by what the owner occupier would have to pay in rent for their home. This is the "rental equivalence" method used in calculating CPIH.

Unfortunately shortcomings have been identified with the processing of private rents data since the implementation of CPIH resulting in an understatement of owner occupiers' housing costs. This has led to the National Statistics status of CPIH being suspended by the UK Statistics Authority. ONS is working with the Valuation Office Agency (VOA) towards fixing the problems.

The price index for private rents has risen much less quickly than the simple observed average for private rents for a long period. The explanation for most items in the basket would be implicit quality change; that is, that the houses available on the market today are of higher quality than those several years ago. ONS and VOA are continuing to investigate. This work is essential in establishing the credibility of the data underpinning the estimate of owner occupiers' housing costs. ONS is expected to publish its findings in early 2015.

One element of what might appear to most to be part of housing costs is not taken into account at all in either the CPI or CPIH – namely council tax. The reason is that direct taxes (like income tax) should not appear in a price index and council tax is, for this purpose, classified as a direct tax. But one could equally see council tax as standing in place of VAT on housing – a view argued for strongly in the Mirrlees Review, for example. The UK cannot include council tax in the CPI but can include it in CPIH. There is space for disagreement over exactly how council tax should be treated in consumer price statistics. On balance our view is that it should be included in CPIH.

## Recommendations

**20. ONS should continue to produce CPIH using "rental equivalence" as the method for calculating owner occupiers housing costs.**

21. **ONS should produce a full explanation of the difference between the rise in the owner occupiers' housing costs component and the larger rise in private rents measured by the VOA and other sources.**

22. **The UK Statistics Authority should consult on including council tax in CPIH.**

## The treatment of discounts

UK retailers use an increasing array of discounts and incentives to encourage consumers to shop in their stores. Price reductions are included in consumer price statistics, but most other offers, such as multi-buy discounts, loyalty card schemes and vouchers are not included. If the take-up of such offers increases over time then inflation statistics will overestimate actual inflation. ONS has limited information on the degree to which this is happening.

Reflecting this accurately in a consumer price statistic is challenging. Consider a product on a "buy one, get one free" offer. ONS's current procedures effectively assume the customer wants only one item, and places no value on the second item at all; the price for the single item is collected. The other extreme would be to assume the customer always takes the second item, suggesting the correct price is half the price of the single item. The truth is likely to be somewhere in between, and will vary depending on consumer preferences.

Of course, many discounts are more complex than this. A deal where a product costs £2.50 individually but where two can be had for £4.00 will likely not be taken up by all consumers. The impact of loyalty card schemes and vouchers would be even harder to measure.

Ideally, one would produce a 'unit price' measure, where the price collected is the average price paid per item. However, such a measure would require detailed information on sales and transactions. Scanner data can potentially provide this, but this is not currently available to ONS. However, ONS's current data collection procedures could be adapted to reflect a wider range of discounts, particularly multi-buy discounts.

### Recommendations

23. **ONS needs to continue to examine the range and scale of different types of discounting and the extent to which this has been changing over time. It should publish estimates of the likely effects on CPIH of different ways of dealing with these discounts.**

24. **ONS should seek to reflect a wider range of discounts, such as multi-buy discounts, in its consumer price statistics, based on the outcome of its studies.**

## Conclusion

There is an unhelpful proliferation of price indices in the UK at present. The current situation is causing confusion, and as a result many users are still using the RPI, a statistic that is no longer fit for purpose.

There is a strong case for adopting CPIH as the main price index. Subject to some of the specific issues raised here, it is a good measure of price inflation across the economy. To ensure that it is durable and credible as a price statistic, a clear and strong governance structure needs to be built around it.

The UK Statistics Authority and ONS have important roles to play in communicating the primacy of CPIH, explaining what it is measuring and how it should be used. The Authority and ONS should also be very clear in explaining that the RPI is not a credible measure of consumer price change. They should make it clear that the RPI is not fit for purpose and should not be used except where existing legal contracts – for example index-linked gilts – demand it. If a way can be found to discontinue the production of the RPI while maintaining the integrity of these legal contracts then it should be pursued. In the course of the review we have not found a satisfactory solution to this conundrum.

Others, including government, also have a responsibility to use and communicate price statistics appropriately. No taxes, benefits or regulated prices should be linked to the RPI. While there are additional complications here, the government should aim to move away from selling gilts linked to the RPI, subject to consultation and assurance about the demand for CPI or CPIH linked gilts.

CPIH measures the changes in price of consumer goods and services, rather than changes in payments made by households or the change in spending required to maintain living standards. As a single economy wide measure of inflation, it does not measure the change in prices faced by specific groups of the population. These vary.

There is a strong case, therefore, for ONS to publish more information about what is happening to prices and costs faced by households, probably on an annual basis. This would provide, for different population subgroups, information on how the prices and costs had risen. A detailed consultation would need to be carried out over the precise contents of such a publication. It has the potential to add significantly to understanding of what is actually happening to prices faced by, and living standards of, different population groups.

Beyond that, there are important developments ONS should consider to some elements of its methodology and use of data. It needs to follow potential developments in the use and availability of data direct from retailers and from the internet, and be ready to respond to opportunities.

ONS needs to ensure that its data sources, such as the LCF, are as robust as possible for understanding spending behaviour and levels and for feeding in to the National Accounts. A specific review of these data sources is recommended.

There is also a series of specific areas where it would be useful for ONS to update, review or modify its procedures. Examples include monitoring quality change and "non-comparable" replacement products over time, incorporating a wider range of discounting into price statistics, instituting regular reviews of sources for price data on specific products, and reviewing stratification by shop type. ONS and the Authority between them should also have a more robust system for sense checking the impact of changes in the method for calculating, or the sources used for, important sub-components of the overall index. They should, for example, have been alert earlier

to problems in the measurement of rents which resulted in CPIH having its National Statistics status suspended.

# 1. An introduction to consumer price statistics

## 1.1 What is a consumer price statistic?

When we buy goods and services, we often find the price for a particular good or service has changed since the last time we looked. Over time, and over all goods and services, prices tend to rise. This is known as *inflation*.

Inflation happens across all sectors of the economy. However, this review is concerned specifically with *consumer price statistics*. These are measures of inflation in the household sector; that is, the overall rate of change of the prices of goods and services purchased to be consumed by households.

Consumer price statistics focus on household spending, not spending by businesses, government and other institutions. 'To be consumed' means spending on goods and services that households use. Savings, and spending on assets such as stocks and shares, are excluded as they are not consumed; the same is true for taxes that are not linked directly to consumption, such as income tax.

A consumer price statistic measures the change in the price of a basket of goods and services over time. The data needed for this are the prices paid by consumers for goods and services in the UK, as well as the amount spent on each good and service. The spending information is used to weight the prices of the individual goods and services, so that items that account for a lot of household spending contribute the most to the overall measure of price change.

Inflation is usually expressed as a percentage change, compared with the same month a year ago. If inflation is 2 per cent, it means that across all goods and services bought by households, prices (weighted according to how much is spent on each item) are on average 2 per cent more than they were a year ago.

## 1.2 What consumer price statistics does the UK produce?

The Office for National Statistics (ONS) produces the UK's official consumer price statistics. There are currently four main overall measures of inflation. Alongside these are measures of inflation for different groups of goods and services, and special analyses aimed at meeting particular user needs. The history of these measures, and the differences between them, are set out in Chapter 3 of this report. Here, we provide an overview of the four main measures.

The **Consumer Prices Index (CPI)** is the current headline measure of inflation for the UK. It is a measure of the overall change in price of consumption goods and services in the UK. The CPI is governed by EU regulations which require all EU member states to produce a comparable measure of inflation: the Harmonised Index of Consumer Prices (HICP). **Figure 1.1** shows the CPI 12 month inflation rate between 2004 and 2013.

**Figure 1.1: CPI 12-month inflation rate, 2004-2013**
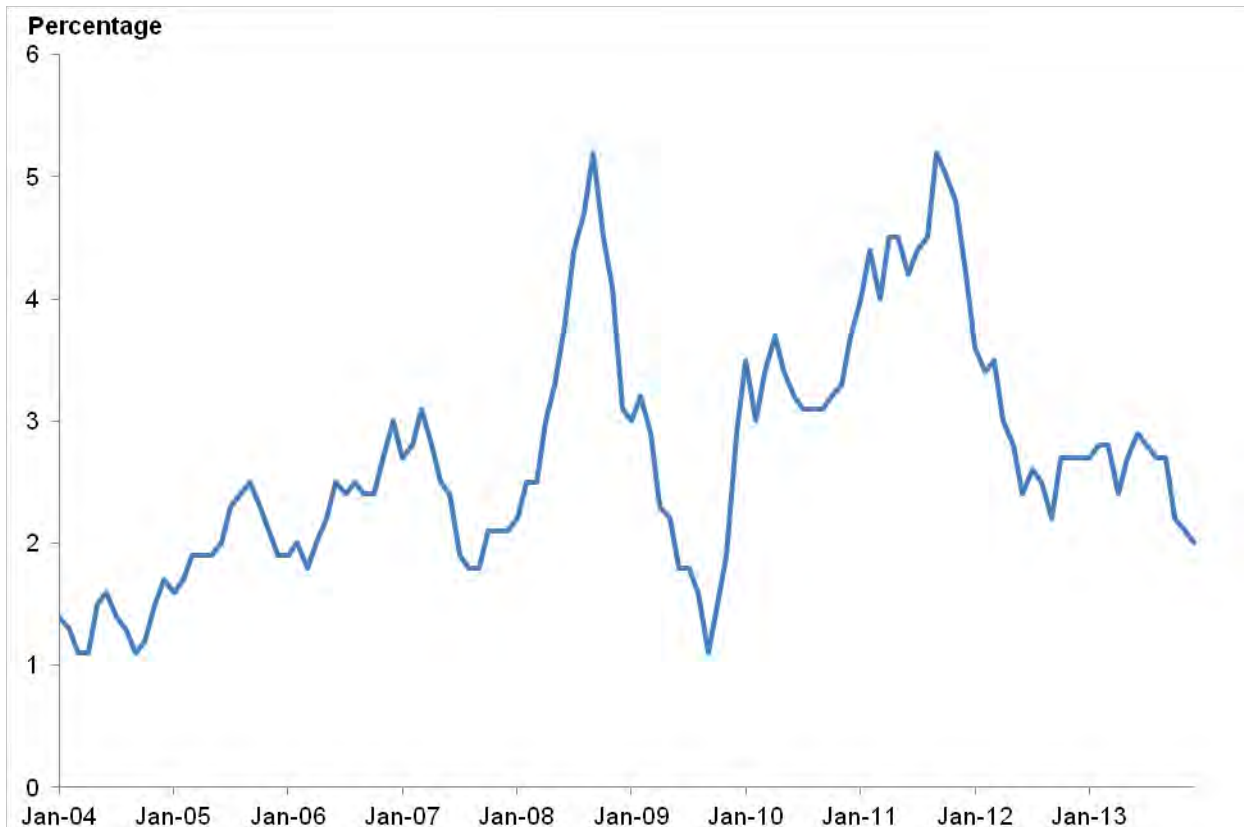


Source: Consumer Price Inflation, ONS

In December 2013 the 12-month CPI inflation rate was 2.0 per cent. That is, prices were on average 2.0 per cent higher in December 2013 than in December 2012. It is this number that receives the widest attention in the press. It is generally compared with the equivalent figure from a month earlier; in this case, the November 2013 rate of 2.1 per cent.

**CPIH** is a variant of the CPI introduced in 2013 to include owner occupiers' housing costs; that is, the costs particular to households that own the property they live in. It does this by including a measure of what it would cost owner occupiers to rent their own home, by using data from the private rental sector. In this way, CPIH is a broader measure of consumer inflation than the CPI. Otherwise, CPIH currently uses the same concepts and definitions as the CPI, but it is not bound by EU regulations.

The **Retail Prices Index (RPI)** is the UK's longest-running measure of inflation. The RPI is based on slightly different concepts and methods than the CPI. For example, the RPI relates to the spending of UK households (the CPI relates to spending in the UK) but excludes the spending of high income and some pensioner households. It includes owner occupiers' housing costs but uses a different approach to CPIH. The RPI makes use of a formula (the Carli index) that does not meet international standards to combine individual prices.

**RPIJ** is a variant of the RPI introduced in 2013. It uses the same concepts and methods as the RPI, with one exception. It replaces the Carli index with one that meets international standards – the Jevons index, which gives RPIJ its name.

**Figure 1.2** compares the CPI, CPIH, RPI and RPIJ over time. As can be seen, the CPI and CPIH have tracked each other closely over time. RPIJ is higher than both the CPI and CPIH, mainly due to the different way in which housing costs are treated. More recently, RPIJ has grown in line with the CPI and CPIH. The difference between the RPI and RPIJ arises because of the use of the flawed Carli index in the RPI.

**Figure 1.2: The four main measures of inflation, 1997-2013**
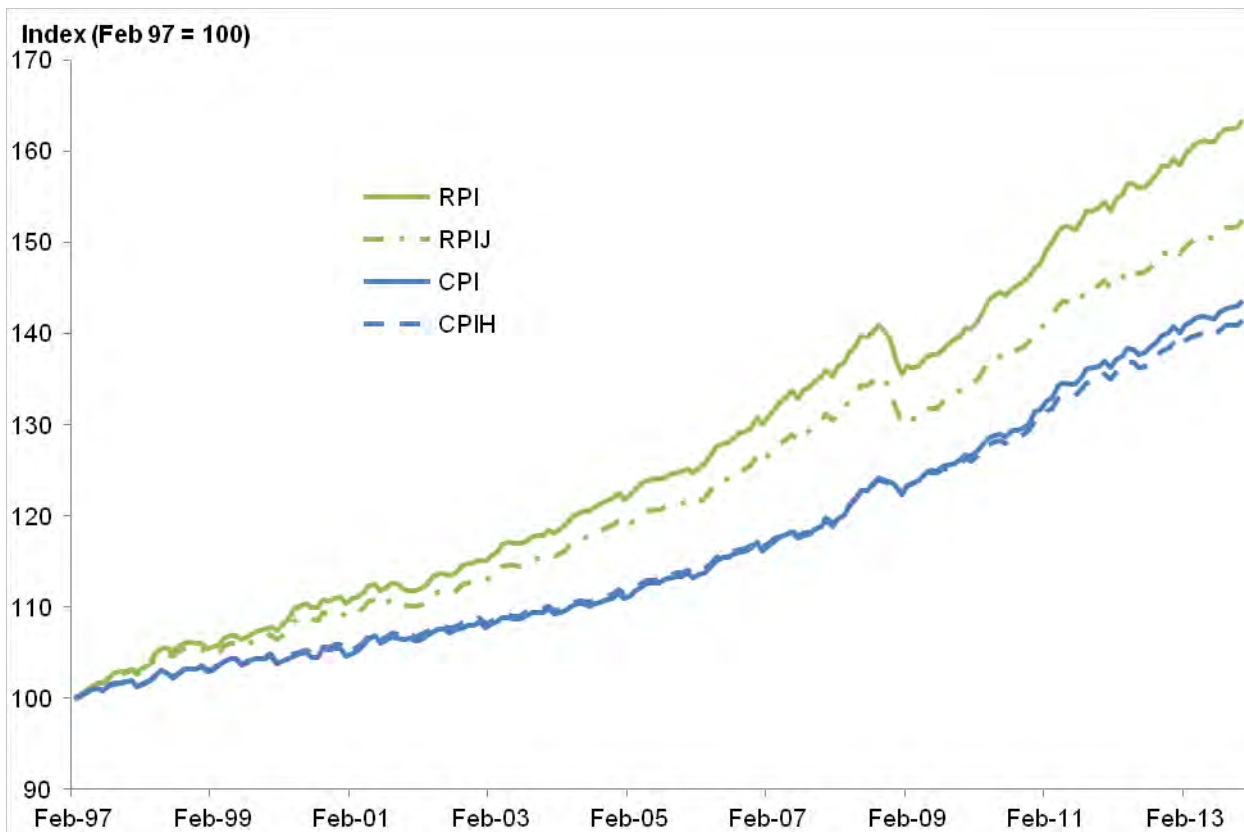


Source: ONS. CPIH prior to 2005 is not part of the official series. Indices have been re-referenced to February 1997 = 100.

## 1.3 What are consumer price statistics used for?

Consumer price statistics are put to a wide range of uses. It is the range and significance of these uses that makes consumer price statistics among the most important official statistics produced by ONS. These uses fall into five main categories.

- For the setting of interest rates through **inflation targeting**.
- As a **compensation index**, for increasing payments to compensate the recipient for increasing costs.
- As a **deflator** to express other financial data (such as earnings or economic output) in real terms.
- To **make comparisons** between inflation in the UK and in other countries.
- To **inform the public** as to the changes in costs they face.

Each of these uses is explored in turn.

### 1.3.1 Consumer price statistics in inflation targeting

One interpretation of inflation is as the rate at which prices change across an economy. This can be thought of in terms of the value that money has. When prices are rising, money will by fewer goods and services than it does now.

The UK Government, in common with many countries, targets a particular rate of inflation. The Bank of England is given responsibility for meeting this target. It does this chiefly through setting the base rate of interest, which directly impacts the rates of interest faced by millions of savers and borrowers.

In principle, all monetary transactions contribute to inflation in the UK. These transactions include not just consumer spending but transactions in the wider economy: government spending, investment and net exports. An overall measure of inflation would be based on the prices of all of these things. However, some of these prices are hard to obtain.

The prices of goods and services purchased by households for consumption, on the other hand, are relatively easy and quick to obtain; they can be collected directly from the shops and other outlets that provide them. The change in the prices of these goods and services is what consumer price statistics measure. For this reason, the Bank of England (along with other central banks) uses consumer price statistics as the target measure of inflation for monetary policy.

The current inflation target is to keep annual inflation, as measured by the change in the CPI, close to 2 per cent (see Bank of England, 2014). The Bank aims to meet this target over the medium term, as monetary policy takes time to feed through into the economy.

A criticism sometimes made of the CPI is that it does not include owner occupiers' housing costs and so is not a complete measure of inflation faced by households. CPIH was developed partly to address this shortcoming, and, in principle, is a more complete measure of consumer inflation.

### 1.3.2 Using consumer price statistics for compensation

We often want to know how much a particular payment needs to rise in order that the person receiving the payment is as well off as they were a year before. Consumer price statistics are often used to measure this. Information on inflation is often used to inform wage negotiations, and underlies many decisions over how state benefits, pensions and tax thresholds should be increased. For example, the basic state pension is currently uprated in line with the highest of CPI annual growth, average earnings annual growth, and 2.5 per cent (see House of Commons Library, 2014). At various times, state benefits have been uprated in line with measures of inflation. This direct link between consumer price statistics and payments received by the public is one reason why they have such prominence.

It is important to be clear what it is that employees, benefit recipients or pensioners are being compensated for. This will influence the choice of index. Uprating a payment by the CPI will compensate the recipient for changes in the price of buying consumer goods and services. It does not, for example, compensate recipients for changes in owner occupiers housing costs or council tax (both are excluded from the CPI). One might also consider whether a measure that more closely reflects costs faced by the recipient of the payment might be more appropriate. For example, one might ask whether a pension should be uprated based on overall change in consumer prices, or be based on what pensioners (as opposed to all households) spend their money on.

This has led some (for example, Leyland, 2014) to argue that a measure, or set of measures, designed for compensating households for the costs they face would differ from consumer price statistics currently produced. This issue is examined in detail in Chapter 5 of this report.

Consumer price statistics are not only used to compensate the recipients of wages, benefits and pensions for changing costs. They are extensively used in long-term contracts for the same purpose. In these cases, the goal is often to ensure that the payments made under a long-term contract retain their value over time. This could be a rental agreement, or a contract to provide a service worth millions of pounds.

One particular example of this is in the index-linked gilt market. Index-linked gilts are a form of debt issued by the UK Government, where the payments made to the holder of the gilt are uprated in line with movements in the RPI. So for about £470 billion (current market value at time of writing) of index-linked gilts, the amount of interest paid by the government is directly linked to the measured rate of inflation. Growth in the RPI therefore affects the cost of servicing UK debt to the UK taxpayer by billions of pounds.
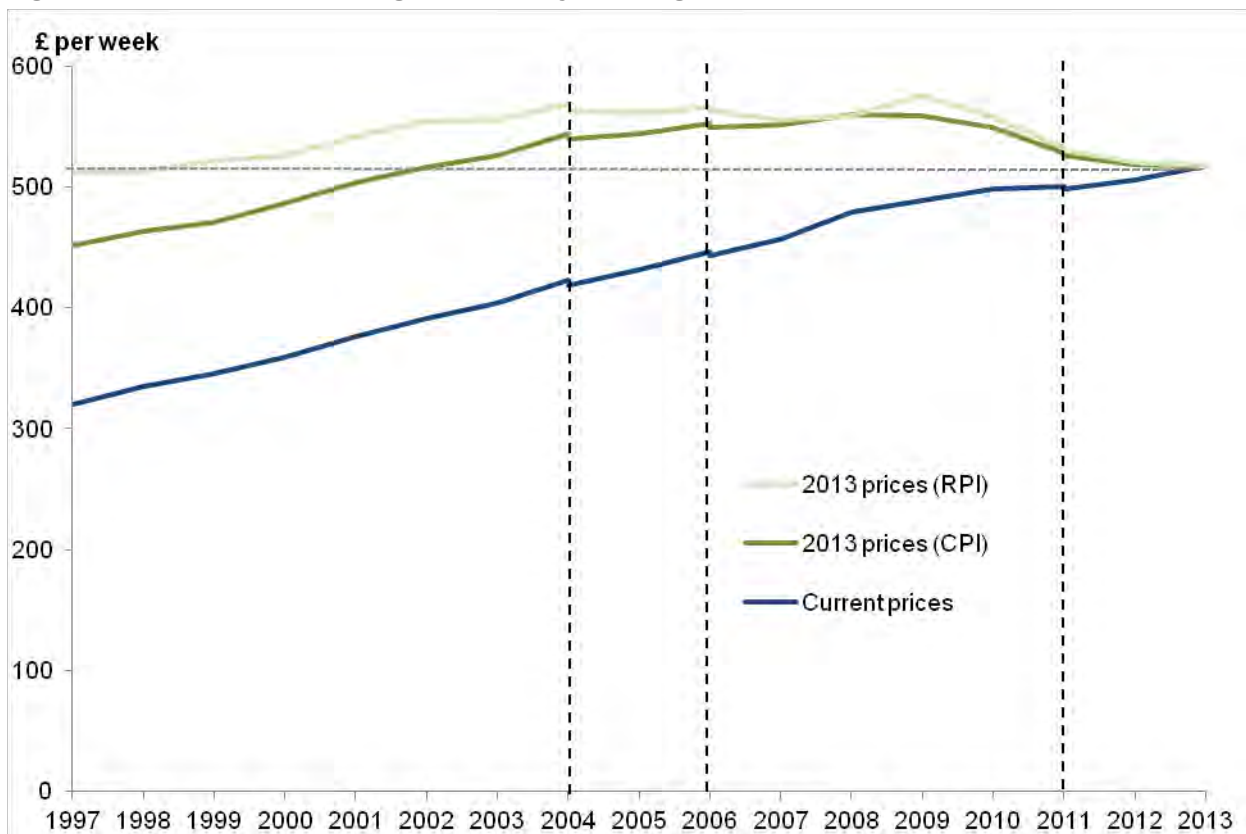
### 1.3.3 Consumer price indices as deflators

Consumer price statistics are also commonly used to work out the "real" change in an economic variable, such as earnings or expenditure. The change in real terms is how much that variable has changed once inflation has been taken into account.

For example, one of the major recent economic and political stories has been around the supposed 'cost of living crisis', one aspect of which has been a fall in the real value of average earnings. The cash level of earnings has increased year on year since 1997, as shown by the "current prices" line in **Figure 1.3**. However, in real terms (based on the CPI), median weekly earnings of full-time employees in 2013 were roughly where they were in the early 2000s. Real earnings have been falling since 2008.

As is discussed elsewhere in this report, the concepts, sources and methods used to measure inflation can have a significant impact on the measured rate. Figure 1.3 illustrates what the impact on real earnings would be if the RPI were used to deflate real earnings, rather than the CPI. In fact, RPI-deflated real earnings in 2013 were around the level of the late 1990s.

**Figure 1.3: Median full-time gross weekly earnings, 1997-2013**



Source: Annual Survey of Hours and Earnings, and Consumer Price Inflation, ONS. Dashed lines represent discontinuities in 2004, 2006 and 2011 ASHE estimates.

Consumer price indices are also used in the UK National Accounts for this purpose. The National Accounts show how the economic output of the UK has changed over time. To make consistent comparisons, it is often necessary to remove the effects of price change from the estimates. This creates estimates of volume, that is, whether the actual output is changing over time. The specification of the deflator should match the output it is being used to deflate.  For example, the change in prices at restaurants should be used to deflate spending in restaurants.

### 1.3.4 Comparisons with other countries

Users might want to compare inflation in different countries, for example to understand how economic conditions in different countries compare. In this case, the concepts and methods need to be robust, but it is also important to use the same methods in different countries.

It was with this purpose in mind that the Harmonised Index of Consumer Prices (HICP) was originally introduced. In the UK, the HICP is known as the CPI. The CPI is the appropriate index to use when comparing inflation in the UK to that in other countries.

### 1.3.5 Informing the public

The rate of inflation is of interest to the wider public for a whole range of reasons. Many people receive or make payments that are directly linked to a consumer price index (for example, the basic state pension). Savers and creditors alike depend on the rate of interest which, as discussed in Section 1.3.1, is set by the Bank of England in reference to an inflation target. It also helps consumers to understand whether their income is worth more or less than it was a year ago. From this, it is clear that whatever rates of inflation are being used by the Government will always be of interest to the public.

The public will also be interested in statistics that describe their own experience of inflation, or as close as possible to it. Individual households will experience a wide range of different rates of inflation according to their differing spending patterns. One tool that ONS provides is the Personal Inflation Calculator, which allows users to compute their experience of inflation based on what they spend money on.

## 1.4 Summary and overview of the report

Consumer price statistics matter more than almost any other official statistic. They matter because of the very real way in which they affect people's lives with millions of people making or receiving payments that are directly linked to consumer price statistics. In addition hundreds of billions of pounds worth of contracts, in particular index linked gilts, are linked to the measured inflation rate. Not only is the rate of inflation important in these circumstances but so also is certainty about the robustness and consistency of the measure used.

Much of this report is concerned with the concepts and methods used in consumer price statistics. Chapter 2 provides an overview of how the current headline measure of inflation, the CPI, is calculated, providing a background to the chapters that follow.

The UK has four main consumer price statistics – the CPI, CPIH, RPI and RPIJ. Each has been developed to meet slightly different user needs. It is useful to understand the development of these indices, and so the history of their development is discussed in Chapter 3.

Chapters 4 to 7 of the report discuss the first key question that we have addressed during this review: what measures of inflation does the UK need? Chapter 4 builds on Chapter 3 and considers the future of the existing main measures of inflation. Despite their different starting points, the existing main measures of inflation are similar in their concepts and definitions and therefore there is scope for being clearer about what they should be used for.

The following three chapters then consider the case for additional measures of inflation. Chapter 5 considers the case for an additional 'household' measure of inflation, which could potentially also be a main measure of inflation. Chapter 6 considers the case for measures of inflation for population subgroups. These measures would exist to support the measures of inflation for the whole of the UK. Chapter 7 considers the value in producing a so-called Cost of Living Index which, rather than measuring change in price, would measure the change in cost in reaching the same standard of living; a concept preferred by some economists and index number theorists.

The remaining chapters of the report discuss improvements that could be made to how inflation is measured in the UK. Chapter 8 considers alternative sources of data. Chapter 9 discusses housing costs, Chapter 10 the use of unweighted averages, and Chapter 11 a variety of weighting and design issues. Chapters 12 and 13 consider the treatment of quality change and discounts respectively.

# 2. An overview of the Consumer Prices Index (CPI)

## 2.1 Introduction

In principle, consumer price statistics are quite simple. They seek to measure the overall change in the prices paid by households for the goods and services they consume. To create a consumer price statistic, one has to collect prices for a selection of goods and services regularly, and then combine them together to form an overall measure.

This simple overall statement hides a considerable amount of complexity. Some of the individual stages of the calculation are large topics in themselves, and indeed several chapters of this report are given over to considering them.

This chapter provides an overview to the current main measure of inflation, the Consumer Prices Index (CPI), as a reference point for the rest of this report. The Consumer Prices Index Technical Manual (2014), published by ONS, provides a more detailed explanation of how the CPI is calculated.

## 2.2 What does the CPI measure?

The CPI measures the change in price of a basket of goods and services selected and weighted to be representative of what households are buying in the UK to consume. The basket and weights change each year but remain fixed within years; hence the CPI is sometimes called a **fixed-basket index**.

At present, the UK CPI is also the UK's Harmonised Index of Consumer Prices (HICP). The HICP is defined in large part by EU regulations, and all EU member states have to produce their own HICPs. Eurostat (2013) describes the HICP as a "pure price index"; a measure of the change of prices of consumer goods and services.

An alternative approach favoured by some is to measure the change in the spending required to maintain the same standard of living. This still measures price changes for representative goods and services. However, consumers are assumed to shift their spending towards items that experience price decreases, or slower price rises, in order to maximise their living standards. This approach leads to a **Cost of Living Index (COLI)** and is discussed in Chapter 7 of this report.

## 2.3 What does the CPI cover?

The CPI, in theory, includes all spending on goods and services purchased by households for consumption. There are a small number of items that are purchased and consumed by households that are still excluded from the CPI, mainly on practical grounds. Such items currently include games of chance, some financial services and illegal activities (such as the purchase of illegal drugs).

The biggest element missing from the CPI is **owner occupiers' housing (OOH) costs**. These are the costs that people who own the house they live in incur from consuming it. Owner occupiers' housing costs are difficult to conceptualise. Some costs, such as regular repair and maintenance, are part of the cost of consuming housing, and so potentially within the scope of a consumer price index. However, the houses themselves are a significant asset, and can be expected to hold or appreciate in value, and assets are excluded from consumer price statistics.

Owner occupiers' housing costs are currently excluded from the EU regulations that define the CPI, because of the difficulties in measuring them. ONS has developed a variant of the CPI called CPIH that includes these costs. Owner occupiers' housing costs and CPIH are discussed in many parts of this report, and Chapter 9 is dedicated to housing costs.

This still leaves a very large range of goods and services within the coverage of the CPI. It is not practical to collect prices for all of them. Instead, ONS defines a representative basket of goods and services, for which it collects prices.

There are around 700 distinct items in the basket, covering everything from a loaf of sliced white bread to a plain coloured T-shirt, from a laptop computer to a haircut, and from a package holiday to a second-hand car.

Every year, ONS reviews the items in the basket. This is to ensure that the items reflect the purchases made by consumers in the UK, while keeping costs manageable. For example, for 2014, video "on-demand" services were added to the basket, as the amount of money being spent on these services was increasing. The timing of when items are added to the basket is important, and ONS has rules to ensure that a new item represents a substantial amount of spending before it can be added. The treatment of new goods and services is discussed in greater detail in Chapter 12 of this report.

## 2.4 What data are collected for consumer price statistics?

Consumer price statistics are essentially formed from two distinct sources of information: prices and weights. Weights come from a variety of sources and are described in more detail later; this section focuses on the collection of prices.

### 2.4.1 Where are the prices collected from?

Prices for around 560 of the 700 items are collected locally – that is, in shops and premises around the country. The local price collection is carried out by a field force employed by a contractor on behalf of ONS.

The contractor's field force visits around 140 towns and cities across all parts of the United Kingdom, with a proportion of the locations changing every year. The locations tend to be areas with a lot of shops in them, so that the majority of the items that prices are needed for can be found. **Figure 2.1** gives an indication of the number of price quotes collected from each country and region of the UK.

**Figure 2.1: Price quotes collected locally, by UK country and region, February 2014**

| Country / Region | Number of price quotes |
|---|---|
| London | 13,200 |
| South East England | 15,300 |
| South West England | 10,000 |
| East of England | 10,700 |
| East Midlands | 8,400 |
| West Midlands | 9,100 |
| Yorkshire and the Humber | 9,800 |
| North West England | 11,600 |
| North East England | 5,800 |
| Wales | 6,100 |
| Scotland | 9,500 |
| Northern Ireland | 5,000 |

Source: ONS

Within each location, the shops being visited are randomly selected, with the chance of selection being proportional to the size of the shop in question. This process excludes some large chain stores (such as supermarkets) which would otherwise dominate the sample. Some such chains have national pricing policies and prices can be collected just once for the whole country, either from a store or the retailer's website. In those cases where there is no national pricing policy, price

collectors visit one store per region, and shop replication factors (see Section 2.5.1) are used to account for the other stores in the region.

A local price collector visits a shop (selected by random sampling) that sells the item of interest. They then find a product that meets the specification. The aim is to find a product that is typical of what consumers buy in that area, and is regularly in stock so that a price can be collected each month. This is determined by speaking to shop staff, and by the amount of shelf space a product takes up. The price collector then notes the details of that item so they can find it again in future.

When visiting the shops, the price collectors use hand-held computers to log prices for individual products. The prices are validated by the device as they are collected. The device stores the item specification and the description the collector has previously entered about the product. It also holds previous prices for the product.

The remaining 140 items are collected centrally by ONS staff. Some prices are provided directly to ONS; for example, petrol and diesel prices are provided by the Department for Energy and Climate Change. Some are collected from web sites; for example, most high-technology goods are collected this way. Prices for some items are collected from catalogues and brochures (particularly clothing and holidays), whilst others are collected over the telephone.

### 2.4.2 When are prices collected?

The majority of prices are collected once a month. The CPI is intended to reflect prices in at least one working week around the middle of the month. ONS aims to collect as many prices as possible on Tuesday (referred to as "Index Day"), although in practice prices are collected throughout the week Index Day falls in. Local price collectors aim to collect prices on the same day of the week (for example, Tuesday) each month.

A few items are collected less than once a month, because the price is known to change infrequently, and the item has low weight in the index; trades union subscriptions and dating agency fees are two examples. In some cases, changes are known only to occur once a year; football admissions and university tuition fees are two examples. Petrol and diesel prices are provided for more than one day a month in the CPI (but not the RPI) because they are known to be volatile. ONS has been exploring whether this practice should be extended to fresh fruit and vegetables.

### 2.4.3 What prices are being collected?

Every item for which a price is collected has a specification associated with it. The specifications help to ensure that over time, price collectors are comparing like with like. The item specifications have to be sufficiently narrow that working out an average price for the item makes sense. However, if a specification is too narrow, it can be difficult to find products that meet the specification. **Box 2.1** shows some example item specifications.

> **Box 2.1 – Some item specifications**
> - **Baked beans:** 400-420g tin – must not contain extras (such as sausages)
> - **Draught bitter on licensed premises:** per pint, 3.4 – 7.5% ABV
> - **Liquid soap:** 200-300ml with pump dispenser, do not price refill packs
> - **Vacuum cleaner:** not hand held, do not include price of warranty

The specifications also have to reflect what is being bought by consumers. A narrow specification might lead to bias. For example, specifying a particular brand of TV might not be representative of all TVs. The specifications need to be kept up to date in order to reflect what is available in the shops and what consumers are buying. ONS reviews specifications annually, as part of the review of the contents of the basket of goods and services.

The item specification usually stipulates that the price is for a single item or service – for example, a tube of toothpaste, or a restaurant main course for one. Many businesses offer discounts that are either based on buying more than one product (such as "3 for 2" offers), or involve some sort of voucher (such as "25% off your total bill"). These forms of discounts are not included in ONS's price collection. The subject of discounts is discussed in more detail in Chapter 13 of this report.

## 2.4.4 What if the item is unavailable?

Once a product has been chosen, the ideal situation is that the price for this same product can be collected every month. This means that any change in the price change would reflect a real change in price, rather than a change in the item being bought.

Sometimes, products are temporarily unavailable. In this case, the last price for the product can be carried forward for up to two months before a replacement must be sought. Replacing a product comes in two parts. First, the price collector chooses a replacement product, and second, they decide whether the new product is directly comparable to the one it is replacing. This matters when it comes to calculating the change in price of individual items; see the next section of this chapter and Chapter 12 (quality change and new items).

The item specification provided by ONS to price collectors provides guidance on whether products are comparable. As an example, **Box 2.2** returns to the items specified earlier and sets out the guidance provided to price collectors on comparable and non-comparable replacements.

> **Box 2.2 – Guidance on comparability for some items**
> - **Baked beans:** Weight must be same; own label and branded beans not comparable
> - **Draught bitter on licensed premises:** Keg and cask beers not comparable; changes of up to +/- 0.5 ABV are comparable
> - **Liquid soap:** Same or similar brand of same quality
> - **Vacuum cleaner:** Must be same brand. Upright and cylinder cleaners are not comparable, bag and cyclone cleaners not comparable

### 2.4.5 How are price quotes checked?

As discussed earlier, some data validation takes place on the prices as they are collected in shops. Further checks are performed by the contractor before the data are supplied to ONS. ONS then re-checks the data, as well as identifying and removing outliers, and checking individual cases flagged by the field collectors as problematic. The prices for centrally-collected items are validated as they are entered into ONS's systems.

ONS employs a team of auditors to perform checks of the work carried out by the field force. These auditors check a random selection of price quotes in each region, to see if they obtain the same prices as the price collectors. Some differences are permitted, as prices can change between the price collector's visit and the auditor's back-check.

## 2.5 Constructing the index

Once prices have been collected and checked, they are aggregated to form the CPI. **Figure 2.2** illustrates the overall process. The following sections describe the ways in which the data are combined, starting at the bottom of Figure 2.2, with the individual price quotes.

**Figure 2.2: Diagram illustrating the structure of the CPI**
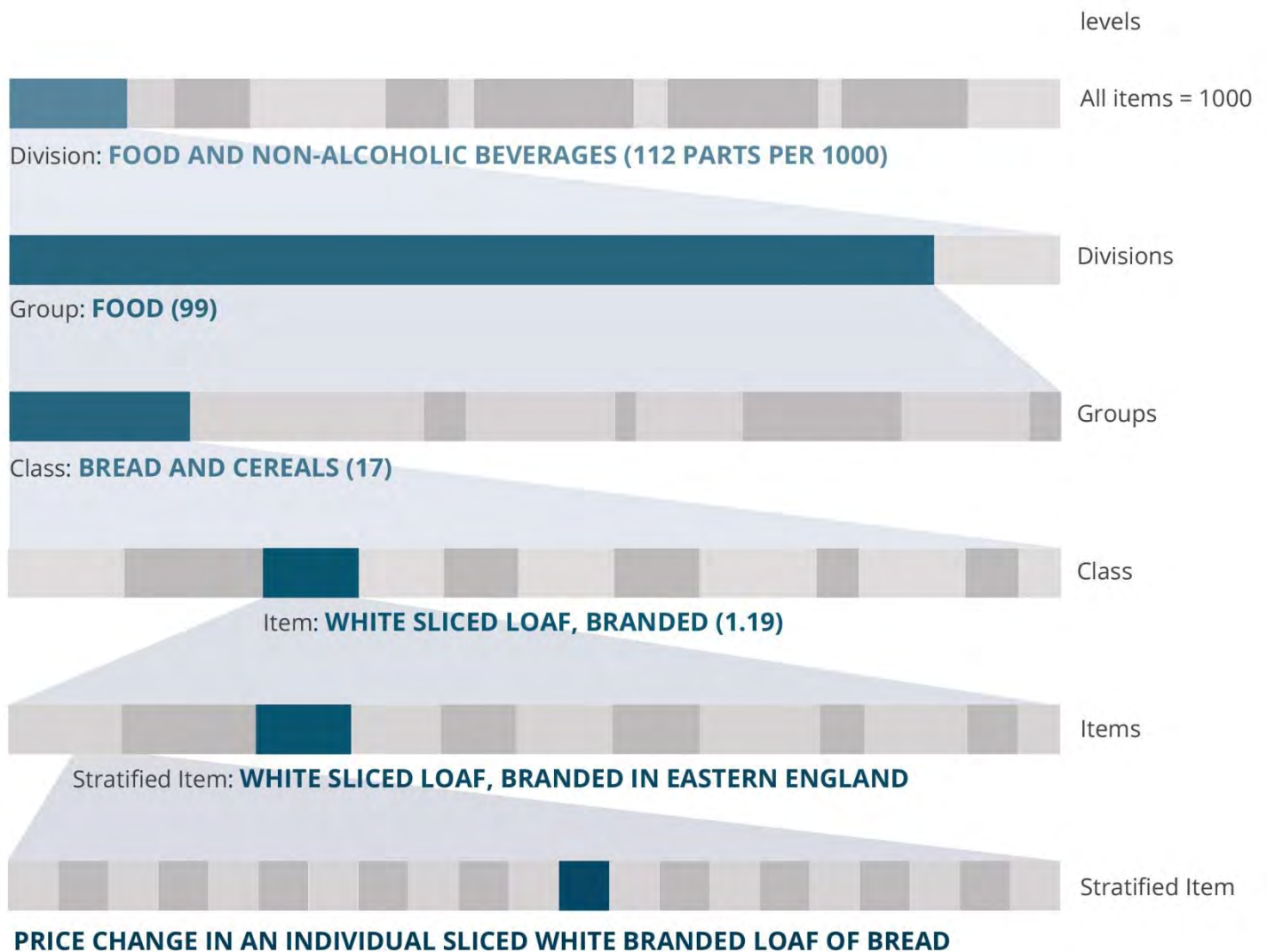


### 2.5.1 Aggregating average price quotes into an average price change

Starting with the individual price quotes collected from shops and other outlets, the first step in constructing a price index is to combine those prices into what statisticians call an **elementary aggregate.** For some items, this is the average price change for that item, across all stores. For some items, this is done separately by region, for others separately for independent and chain stores, and for some items by both region and shop type.

When combining price quotes in an elementary aggregate, the price for each product in the current period must be comparable with the price in the base period. If the product has not changed between the base period and the current period, this is not an issue. However, products are often withdrawn from sale and ONS needs to decide whether the new product is comparable to the old one. If they are not, ONS has to estimate what the price of the new product would have been in January. Product replacement and other quality adjustment issues are discussed in Chapter 12.

At this lowest level of detail, ONS has individual price quotes. There is often no information with which to weight the data. For example, ONS has price quotes for a loaf of white sliced bread in different shops, but no information on how much bread is sold in each shop. As such, the averages used to calculate the average price change are unweighted.

In most of these cases, the CPI uses an unweighted geometric average of price changes, called a Jevons index. This is explained in **Box 2.3**. A small number of items use an alternative called a Dutot index. The use of unweighted index number formulae is discussed in detail in Chapter 10 of this report, and the formulae for all the indices referred to in this report can be found in Annex C.

The Dutot and Jevons indices are widely used by other national statistics institutes (NSIs) to aggregate price quotes where no weighting information is available. The Retail Prices Index (RPI) makes use of a third unweighted average, the Carli index, which is no longer used by other NSIs in their consumer price statistics.

As discussed earlier in this section, certain large chain stores (such as supermarkets) are designated as "regional" or "central" shops. If a chain is designated as "regional", price quotes are collected from one store per region, while for "central" shops; price quotes from a single store represent the whole country. This means that such shops would be under-represented in elementary aggregates. This is adjusted for by using **shop replication factors.** These essentially create copies of the prices collected from the regional and central shops to counteract the fact that they are under-represented in the sample.

**Box 2.3: The Jevons unweighted geometric average**

To calculate an unweighted geometric mean for an elementary aggregate::

- Start with the **base price** (in January) and the **current price** (the month in question)
- Calculate **price relatives** – the current period index value divided by the base period value.
- Multiply the price relatives for each product together
- Take the nth root, where n is the number of items.

**Figure 2.3** gives example data for four products, which will be combined into an elementary aggregate using the Jevons formula:

**Figure 2.3: Illustrative data for four products**

|  | Jan | Jun | Price relative |
|---|---|---|---|
| **Product A price** | 0.50 | 0.50 | 1.00 |
| **Product B price** | 1.00 | 0.80 | 0.80 |
| **Product C price** | 1.20 | 1.50 | 1.25 |
| **Product D price** | 1.00 | 1.02 | 1.02 |

The Jevons index in June is $(1 \times 0.8 \times 1.25 \times 1.02)^{1/4}$ = 1.00496... By convention, the index is expressed so that the January value is 100, so the index value (to one decimal place) is 100.5. In other words, in this example, the average price of bread (using the Jevons index) increased by 0.5 per cent between January and June.

## 2.5.2 Aggregating elementary aggregates to items

Some items are stratified by UK region and country. This happens where historically there has been evidence that prices are different in different parts of the UK (for example, in the south east of England, or in Scotland). Some items are stratified by the type of shop. There are two shop types, "independent" stores and "multiple" stores (chains). Again, this takes place where there is evidence that price changes are different in different types of shops. These are combined to form the item index. Some items are stratified by both region and shop type, and some are not stratified at all.

Where there is no stratification, the elementary aggregate calculated in the previous stage is the item index. In cases where there is stratification, the elementary aggregates are combined using a weighted average to form the item index. **Box 2.4** gives an example of a weighted average at the class level, but the process of using a weighted arithmetic average is the same at other stages of aggregation.

After this stage, ONS has one index per item in the basket; around 700 in total. The indices are defined to be 100 in the price base period (January), so they are not continuous. ONS makes these item indices available on their website as part of the microdata that accompanies the CPI.

### 2.5.3 Aggregating item to class

Each class of expenditure is made up of one or more representative items. In the example above, the 'Bread and Cereals' class currently consists of 22 different items, of which "branded white sliced loaf" is one. ONS aggregates these items together to form a class index. The mapping from items to classes is provided by the Classification of Individual Consumption according to Purpose, commonly known as COICOP. It is an internationally recognised classification system, used by all European Union member states for constructing consumer price statistics.

ONS uses the weighted arithmetic mean to calculate class indices. Box 2.4 shows an example of how a weighted arithmetic mean is calculated in practice.

The weights to aggregate items into classes come from a variety of sources. For example, in the case of food detailed data are available from the Living Costs and Food Survey. For some other commodities, the detail comes from sources that inform the National Accounts. In cases where neither of these sources are available, ONS uses data from consumer research organisations on market share. If no data at all is available, ONS assumes equal shares of spending on each item.

As described earlier, the basket of goods and services is intended to be representative; it would be impractical to collect prices for every good and service available. The weights are intended to reflect items that are not collected, as well as those that are. For example, the item specifications for white sliced and wholemeal sliced bread both exclude loaves of bread that mix white and wholemeal flour. But consumers buy mixed flour loaves. Spending on these is allocated to the bread and cereal products in the basket. The weights are for the latest year available, and the information might be from different years for different items.

**Box 2.4: Weighted arithmetic averages**

To calculate a weighted arithmetic mean for a class (a group of items):

- Start with price indices and expenditure share weights for each item
- Calculate price relatives – the current period index value divided by the base period value.
- Multiply the price relative for each item by the expenditure share for each item
- Add these together to get the weighted average.

**Figure 2.4** gives illustrative data for four items, which are to be combined into a class index. The average price for each item has already been calculated from product price quotes, as described in Box 2.3 earlier. At this stage, weights (expenditure shares) are available and so a weighted average is used.

**Figure 2.4: Illustrative data for four items**

|  | Expenditure share (%) | January | June |
|---|---|---|---|
| Item A index | 50 | 100 | 99.5 |
| Item B index | 20 | 100 | 102.0 |
| Item C index | 25 | 100 | 101.5 |
| Item D index | 5 | 100 | 107.2 |

The June price index is formed by multiplying each June index value by its expenditure share (the proportion of total sales) and adding up the results:

Class index    = (Item 1 index × Item 1 weight) + ... + (Item 4 index × Item 4 weight)

           = (99.5 × 50/100) + (102.0 × 20/100) + (101.5 × 25/100) + (107.2 × 5/100)

           = 49.75 + 20.4 + 25.375 + 5.36

           = 100.885 = 100.9 (to 1 decimal place)

### 2.5.4 Chain-linking at class level

When the class indices are formed from the item indices, they are not yet continuous; the index value for each class index each January is still 100. One also has to take account of the fact that the weights change between the years. It is at this point that ONS chain-links to create continuous time series.  This procedure is explained in **Box 2.5**.

**Box 2.5: Chain-linking in CPI**

The objective of chain-linking is to produce a continuous price index at the class level – for example, for bread and cereals. The chain-linking process also takes into account the fact that the weights are different before and after the link is made.

In simple chain-linking (as used in RPI), the weights and basket updates occur in the same month. The index for change each year (January to January the following year) is calculated, using the basket from the start of that period. These are multiplied together to form the chain. The last step is to calculate the change between January in the current year and the current month, using the latest basket and weights.

CPI is based to the year 2005 = 100. If CPI were chain-linked simply every January, the calculation for November 2014 (for example) would be (where $I$ is a weighted arithmetic average of the items in the class, as explained in Box 2.4):

$$I_{Nov\ 2014/2005} = \frac{I_{Jan\ 2006/2005}}{100} \times \frac{I_{Jan\ 2007/Jan2006}}{100} \times ... \times \frac{I_{Jan\ 2014/Jan\ 2013}}{100} \times I_{Nov\ 2014/Jan\ 2014}$$

In CPI, chain-linking is complicated by the fact that the class level weights are updated in January, while the item weights are updated along with the basket in February. This means the index has to be double-linked.

The index is calculated as before, but up to December rather than January. The double-link is created by calculating an index of change between December (using the outgoing basket and weights) and January (using the incoming basket and weights). So where a (single) chain-linked index would be (where $I_{Jan2014/2005}$ is the chain-linked index up to Jan 2014):

$$I_{Nov\ 2014/2005} = \frac{I_{Jan\ 2014/2005}}{100} \times I_{Nov\ 2014/Jan\ 2014}$$

The double-link formula is:

$$I_{Nov\ 2014/2005} = \frac{I_{Dec\ 2013/2005}}{100} \times \frac{I_{Jan\ 2014/Dec\ 2013}}{100} \times I_{Nov\ 2014/Jan\ 2014}$$

This is calculated as follows:

1. Start with the (chained) class index up to December of the previous year
2. Calculate the weighted average index value for December, using the <u>old</u> basket and weights
3. Calculate the weighted average index value for January, using the <u>new</u> basket and weights
4. Divide the results of step 3 by step 2 and multiply by 100 (this is the index for January based on December), the second term in the double-link formula above.
5. Multiply the results of step 1 and 4 together (and divide by 100) to get the January index
6. For months after January, multiply the result of the previous step by the unchained class index for the month in question, and divide by 100.

## 2.5.5 Aggregating class indices to the CPI

To form the all items CPI, or other higher level aggregates, one or more classes of expenditure have to be combined together. ONS uses a base-weighted arithmetic mean to do this, with weights based on the household sector of the National Accounts.

The weights are based on household spending on consumption in each COICOP class. A true base-weighted average would use weights that refer to the price base period; that is, January each year. Such an index would be a Laspeyres index. In practice, data are only available at a considerable lag, and a year of data is required to ensure the weights are sufficiently robust. This means that the CPI, in common with similar indices published by other countries, is actually a Lowe index (see **Box 2.6**).

In the example above, bread and cereals spending in 2012 is price-updated to December 2013 using the CPI for the Bread and Cereals class. After price-updating, household spending on bread and cereals is 1.7 per cent of all spending within the scope of the CPI. By convention, weights are expressed in parts per thousand, so the weight for bread and cereals is 17 parts per thousand.

> **Box 2.6: The different forms of weighted average and price updating**
>
> Arithmetic indices that combine price relatives and expenditure shares are **Young** indices. Usually, if an index is described as a Young index, the expenditure shares generally refer to some time period <u>before</u> the price base period (January in the example above). In the special case where the expenditure shares refer to the price base period, this is a **Laspeyres** index.
>
> A **Lowe** index is a weighted arithmetic average of prices and quantities, with the <u>quantities</u> taken from some weight base period, usually before the price base period. In the special case where the weights reflect the base period for the prices, this is also a Laspeyres index.
>
> When a Lowe index is expressed in terms of expenditure shares rather than quantities, the expenditure shares are the (weight) base period spending multiplied by the price change between the weight base period and the price base period. This calculation is sometimes referred to as **price updating**, as it can be interpreted as accounting for inflation between the period the weights refer to, and the period the prices are collected in.
>
> For example, the 2014 weights for CPI are based on household expenditure in the National Accounts in 2012. Spending on each part of the basket is increased in line with inflation observed for those items between the period the weights refer to, and the start of the period the prices are collected for. The expenditure shares are calculated from these price-updated expenditures.
>
> At lower levels of aggregation (for example, at the item level, or when combining regions and shop types), price updating is not relevant and so the indices used are Young indices.

This process of aggregation continues through the upper levels of the CPI. White sliced bread is part of the 'Food' Group and the 'Food and Non-Alcoholic Beverages' Division. There are twelve Divisions in total; these are combined to form the all items CPI. This is the current headline measure of inflation, covering price change across almost all consumer goods and services.

# 3. A history of consumer price statistics in the UK

## 3.1 Introduction

This chapter sets out a short history of the development of consumer price statistics in the UK. This starts as far back as the First World War[5]. However, the focus of this chapter is on the last few years and the events that led to the development of the current set of consumer price statistics. This chapter goes on to set out what the four current main measures of inflation are, and what their current status is.

## 3.2 The Cost of Living Index, 1914 to 1947

The history of consumer price statistics in the UK starts in earnest in 1914. At this time, the Government started to monitor changes in prices of the main items purchased by working-class households. These changes were weighted according to spending on the different items to produce an overall index. The index was intended to measure the costs faced by working-class households, and was called the Cost of Living Index.

The Cost of Living Index was used to help protect workers from the economic consequences of the First World War. This index continued to be produced in the 1920s and 1930s. However, the weights were not changed despite spending patterns changing, and so the weights became more and more out of date. The index also made judgements as to how working-class households should spend their money; beer was excluded and the weight for tobacco did not reflect how much was actually spent on it.

Data were collected to update the weights in the late 1930s but the work was deferred due to the outbreak of the Second World War. Following the war, the Cost of Living Advisory Committee was set up by the Minister of Labour and National Service, and the Committee was asked to consider the future of the Cost of Living Index. The Committee responded by stopping the index in 1947, and replacing it with the Interim Index of Retail Prices, using weights obtained from the 1937-38 study.

The new name of the index reflected the fact that the 1947 Committee felt calling it a "Cost of Living Index" was misleading. A Cost of Living Index, as understood by economists, would reflect consumers changing their expenditure to maximise their standard of living. The 1947 Committee clarified that what the UK was producing was a measure of change of retail prices, not a Cost of Living measure. Cost of Living Indices are explored in detail in Chapter 7 of this report.

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[5] The main sources for the early history are the set of reports from the Cost of Living Advisory Committee, later renamed the Retail Prices Index Advisory Committee, and appendices 1 and 2 of the 2014 ONS CPI Technical Manual.

## 3.3 The 1956 Index of Retail Prices

Further development took place in the late 1940s and early 1950s. In 1956 the Interim Index of Retail Prices was stopped and replaced by the Index of Retail Prices. This measure was to evolve in time to become the Retail Prices Index (RPI).

The item weights in the new 1956 measure were derived from a large-scale survey of household spending carried out in 1953-54. The Cost of Living Advisory Committee recommended that this survey continue. The household expenditure survey has evolved over time into the Living Costs and Food Survey and is still carried out by ONS today.

The weights used in the 1956 Index of Retail Prices excluded the spending of certain households. The principle, established by the 1951 Committee but refined in 1956, was that households with particularly high or low incomes were likely to have different spending patterns to those of the majority of wage and salary earners. The 1956 measure excluded the spending of households earning over 20 pounds a week. In 1956, the previous lower limit was removed; instead the Index of Retail Prices excluded pensioner households where over three quarters of household income was paid by the state.

The weights produced in 1956 corrected for under-reporting of alcohol and tobacco consumption, and were price-updated to account for changes in price between 1953-54 and January 1956. **Figure 3.1** below reproduces weights for the 1956 Index of Retail Prices, compared with its 2014 equivalent, the RPI.

**Figure 3.1: Index of Retail Prices weights (1956) and Retail Prices Index weights (2014)**

|  | 1956 weight | 2014 weight |
|---|---|---|
| **Food** | 350 | 127 |
| **Alcohol** | 71 | 65 |
| **Tobacco** | 80 | 32 |
| **Housing** | 87 | 286 |
| **Fuel and light** | 55 | 54 |
| **Household and other goods** | 125 | 131 |
| **Clothing and footwear** | 106 | 50 |
| **Transport and Vehicles** | 68 | 159 |
| **Services** | 58 | 96 |
| **All items** | **1000** | **1000** |

Source: CSO (1956), Consumer price inflation, ONS. Weights have been adjusted to be broadly comparable over time

There are several differences in coverage between 1956 and consumer price indices today. Most forms of insurance, holidays, financial services, medical fees and union subscriptions were excluded from the 1956 Index of Retail Prices. Restaurants and catering were deemed too difficult to price at constant levels of quality, and so spending on these was apportioned between other categories. Owner occupiers' housing costs were included in both 1956 and 2014, but using different methods; this is likely contributing to the difference in the housing weight.

Nevertheless, some things are clear. In 1956, spending on food, clothing and tobacco was a much more significant proportion of the Index of Retail Prices. Even excluding clear differences in scope, the 2014 weights place much more emphasis on housing, transport and vehicles, and services.

There were around 350 items in the 1956 basket of goods and services. Prices for most food and alcohol items, durable household goods and some services were collected by the local offices of the Ministry of Labour and National Service. Other prices were collected through correspondence with retailers such as clothing, footwear and books. Some information was held by central or local government, such as the price of postage. The actual index was produced by the Statistics Department of the Ministry of Labour and National Service.

## 3.4 Development of the RPI, 1956 – 1995

The RPI continued to be developed in the 1960s, '70s and '80s. 1968 saw the introduction of a measure of the price of food and drink purchased in restaurants, sandwich shops, canteens and cafes. 1968 also saw the Cost of Living Advisory Committee – now reporting to the Department of Employment and Productivity – recommend that it be renamed the Retail Prices Index Advisory Committee (RPIAC).

In 1975 the method for calculating the costs faced by people who own the home they live in was reviewed and changed. Mortgage interest payments were included in the RPI for the first time, replacing the rental equivalence approach used since the 1950s.

It was during the 1960s that variants of the RPI started to be produced to meet specific user needs. In 1968, the Committee was asked to consider special indices for different groups. The Committee looked at the case for producing indices for regions of the UK, pensioners mainly dependent on state pensions (excluded from the main RPI) and households with children. The Committee concluded that the state pensioner indices should indeed be produced and these were introduced in 1969.

Later, in 1979, the Tax and Price Index (TPI) was introduced. Rather than measuring the change in price of a representative basket of goods and services as the RPI does, the TPI measures the change in the average person's gross income (after income tax and national insurance) needed to buy the basket. An increase in income tax, all other things being equal, would cause the TPI to rise more quickly than the RPI. A shift from direct tax to indirect tax (such as VAT) would cause the RPI to rise but leave the TPI relatively unaffected.

In the 1980s, the Rossi index was introduced. This excluded most housing costs and was used to uprate state benefits. It was also around this time (1981) that the UK started to issue index-linked gilts, using the RPI.

## 3.5 Further development of the RPI, 1986 – 1997

The 1986 Retail Prices Index Advisory Committee made a range of recommendations for changing the RPI. These included changing from excluding households whose head earned more than a certain amount to excluding the top 4 per cent of households based on their total household income. Again, this was because the spending patterns of these households differed significantly from the rest of the population. These changes gave the RPI the population coverage it has today.

The subsequent years saw the coverage of the RPI extended to include several items that had previously been out of scope. Holidays started to be included from 1993, and a measure of the cost to owner occupiers of house depreciation was added in 1995. This work was overseen by the RPIAC, which continued to meet until 1994.

In 1992, the Government set its first explicit inflation target, based on RPI excluding mortgage costs (known as RPIX). At this time, HM Treasury controlled base interest rates, the main operational tool in meeting this target. In 1997, it delegated this responsibility to the Bank of England.

This period also saw significant reorganisations in the responsibility for consumer price statistics. The RPI passed from the Employment Department to the Central Statistical Office (CSO), which became part of the ONS in 1996. Local price data collection continued to be carried out by Employment Department staff until 1995, at which point it was contracted out to a private company. At the same time, hand-held computers were introduced to allow local price collectors to record prices electronically.

By 1997, the basket of goods and services had grown to include around 650 items. ONS staff collected prices for around 120 of these items centrally, whilst the remainder were collected locally by the field force (Haworth et al, 1997)

## 3.6 The introduction of the Consumer Prices Index

The 1992 Maastricht Treaty required member states of the European Union to develop a harmonised measure of consumer price inflation. This was in order to assess whether EU member states met the criteria for joining the European Monetary Union. The national statistical institutes of member states worked together with the central European statistical office (Eurostat) to develop the Harmonised Index of Consumer Prices (HICP).

The UK first published its HICP in 1997. There were several gaps in the early scope of the HICP. These gaps were steadily addressed between 1997 and the mid-2000s, with health, education and some financial services charges all added.

By 2003, the main remaining gap in the HICP was a measure of owner occupiers' housing costs. Eurostat had decided in principle that the net acquisitions approach to these costs should be used. However, many member states experienced difficulties in developing measures using this approach, meaning these costs remained outside the scope of the index.

In 2003, HM Treasury changed the Bank of England's inflation target; with the new target set in reference to the HICP rather than RPIX (ONS, 2003). At the same time, the ONS changed the name of the UK HICP to the Consumer Prices Index, or CPI. The RPI continued to be used by the Government for pensions, benefits uprating and index-linked gilts. The following years saw no major changes to the scope or coverage of either the CPI or RPI, although variants of the CPI were developed to show the impact of indirect taxes (CPIY and CPI-CT).

## 3.7 Owner occupiers' housing costs and CPIH, 2009-2014

Progress on incorporating the housing costs faced by owner occupiers into the HICP remained slow. Therefore, in 2008 ONS commenced work on its own measure of these costs, and in 2009 came under the supervision of the new Consumer Prices Advisory Committee (CPAC). The development of measures of owner occupiers' housing costs is described in detail in Chapter 9 of this report.

In 2012, ONS consulted on two approaches to measuring owner occupiers' housing costs (ONS, 2012a). These were the net acquisitions method proposed by Eurostat, and an approach that uses private rents to estimate owner occupier's housing costs, known as rental equivalence. In September 2012, the Board of the UK Statistics Authority accepted the National Statistician's recommendation that the rental equivalence method be used in a new measure, CPIH (ONS, 2012b).

The ONS published CPIH for the first time in March 2013, and it was accredited a National Statistic in November 2013. CPIH uses the CPI framework, except that it also includes owner occupiers' housing costs, using the rental equivalence basis. In this way, it is not governed by the HICP regulations, meaning that CPIH could in theory depart further from the HICP framework in the future.

In August 2014, ONS and VOA determined that there were shortcomings in the way the owner occupiers' housing component was being calculated from the VOA's data. In the light of these findings, the National Statistics status of CPIH was suspended (Dilnot, 2014). ONS and VOA have continued their investigations and are due to publish their findings in early 2015.

## 3.8 The formula effect, the RPI and RPIJ

In 2010, another development started to cause concern for users. This was a substantial increase in the size of the "formula effect" between the RPI and CPI. The formula effect arises because the way that prices for similar products are combined together at the lowest level (sometimes called the elementary aggregate level) is different in the RPI and CPI.  One of the formulae used in the RPI – known as the Carli index – consistently produces higher results for measured inflation than the others (the Jevons and Dutot indices).

The formula effect was well-known as one of the sources of difference between the RPI and CPI. In 2003, when the Bank of England target rate was changed from RPIX to the CPI, the target rate was also lowered from 2.5 to 2.0 per cent. This lower rate reflected the fact that the CPI gave lower values than RPIX (ONS, 2003).

There had been concerns among price statisticians with the Carli index as far back as the late 1970s (Bird, 2013, p2). In the subsequent years, several other countries moved away from using the Carli, and European regulations effectively banned its use in the HICP. However, the Carli continued to be used in the RPI.

In 2010, ONS made what seemed to be routine improvements to the way prices for items of clothing were collected. When these changes were implemented, they caused the formula effect to widen from around 0.5 percentage points to around 0.9 percentage points

At this point, ONS began an urgent programme of work to understand the formula effect, again with the guidance of the Consumer Prices Advisory Committee. An early finding (ONS, 2012c) was that of over 30 countries considered, the UK was the only country still using the Carli index in its consumer price statistics. Indeed, only one other country, Slovenia, was using different unweighted averages for different inflation measures.

ONS carried out further work to understand whether the Carli formula remained an appropriate way of combining prices when weights were not available. ONS also consulted with external experts. The outcome of this work was that ONS felt the use of the Carli in the RPI had to be reconsidered, and in 2012 the National Statistician began a public consultation on options for the RPI (ONS, 2012d).

ONS's position following the consultation (ONS, 2013) was that the Carli index did not meet international standards, and that if ONS were to create a new price index in future, the Carli would not be used. Some members of the Consumer Prices Advisory Committee argued that the Carli formula should be replaced with the Jevons in the official RPI, with a legacy RPI created to provide continuity.

However, the consultation had made clear that many users wanted the RPI to continue unchanged. In all likelihood some of this will have reflected simple self interest among those who would have lost out. Perhaps more importantly, it reflected the central role of consistency and certainty in the construction of price indices. With hundreds of billions of pounds worth of contracts linked to the RPI, especially index linked gilts, changing the way in which it was calculated was argued to be detrimental to those on one side of the contract.

On 10 January 2013, the National Statistician recommended that the current method of producing the RPI be retained, noting the value to users in providing a consistent long-run time series. The National Statistician recommended in addition that ONS produce a variant of the RPI that used an unweighted average that met international standards. This was to be called RPIJ, the "J" signifying the use of the Jevons index in place of the Carli. The UK Statistics Authority Board approved these recommendations, with RPIJ eventually introduced in March 2013.

According to Financial Times (2013a), the decision to retain the RPI led to the biggest one-day rally in the index-linked gilt market since 1987. The market had priced in a change which did not materialise. The impact on a particular index-linked gilt is shown in **Figure 3.2**.

**Figure 3.2: Yield of 0.125% Index-Linked Treasury Gilt 2044, November 2012 – January 2013**
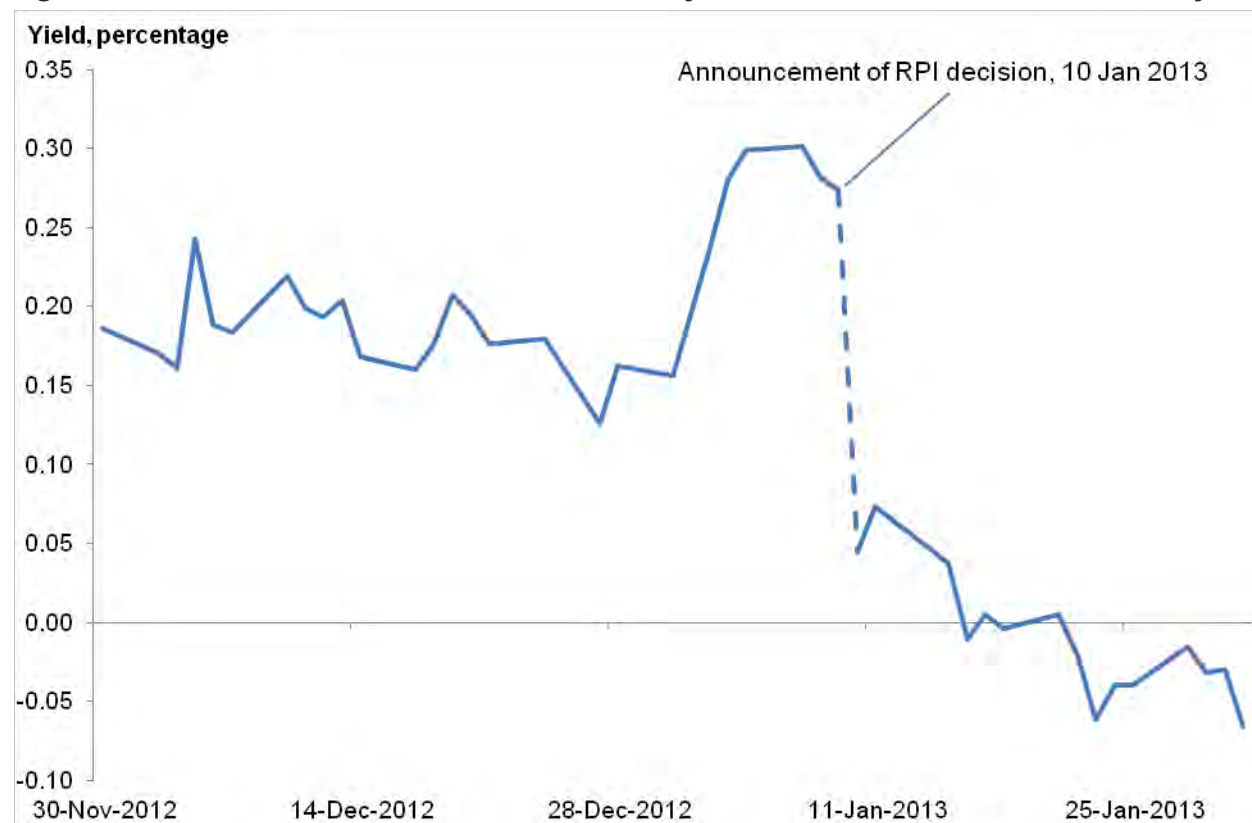


Source: Debt Management Office. A decrease in the yield of the gilt indicates increase in the value to the holder of the gilt.

The decision to retain the RPI unchanged was not endorsed by all. For example, Financial Times (2013b) argued that the RPI should have been improved by replacing the Carli with a more acceptable method.

The decision to retain the RPI unchanged meant that RPI-linked costs, which would have seen smaller increases had the Carli been replaced, would continue to increase at their elevated level. For example, the RPI was approximately 0.6 percentage points higher in 2013 than it would have been, had the Carli been replaced by the Jevons (as in RPIJ). Using the OBR debt interest ready-reckoner (OBR, 2014, Table 2.21) for the 2015-16 financial year, this would translate into a reduction in the debt interest bill of around £2bn.

ONS (2013) set out what has become the formal position with respect the RPI. Specifically, paragraph 5iii recommended:

*That the basic formulation of the RPI is accepted as currently defined and that any future changes should be limited to issues such as the annual update of the basket and weights, improvements to data validation and quality assurance etc.*

This was cited in March 2013 when the UK Statistics Authority stripped the RPI of its National Statistics status (UK Statistics Authority, 2013). Indeed, this decision was made partly because of the use of the Carli index in the RPI, but partly because this statement prevented the RPI from evolving to reflect international best practice.

## 3.9 Consumer price statistics in 2014

As a result of the introduction of CPIH and RPIJ, the ONS now publishes four main measures of inflation: CPI, CPIH, RPIJ and RPI. **Figure 3.3** summarises how the four measures differ from each other.

**Figure 3.3: Characteristics of CPI, CPIH, RPI and RPIJ**

| | CPI | CPIH | RPIJ | RPI |
|---|---|---|---|---|
| **Population** | • all private & institutional households<br>• foreign visitors to the UK | | • excl. top 4 per cent of households by income and pensioner households that derive at least 75 per cent of total income from state benefits<br>• excl. institutional households<br>• excl. foreign visitors to the UK | |
| **Commodity Coverage** | • incl. university accommodation fees, foreign students university tuition fees, unit trust & stockbrokers charges | | • incl. housing costs e.g. mortgage interest payments, depreciation, buildings insurance and council tax<br>• excl. university accommodation fees, foreign students university tuition fees, unit trust & stockbrokers charges | |
| | • excl. owner occupiers' housing costs and council tax | • incl: owner occupiers' housing costs (rental equivalence)<br>• excl: council tax | | |
| **Product Coding** | • standard international classification system (COICOP), consistent with National Accounts | | • long standing system not used except for the RPI and RPIJ | |
| **Weighting Framework** | • draw on full range of sources from National Accounts | | • Living Costs and Food Survey only | |
| **Unweighted average formulae used** | • Jevons and Dutot | | | • Dutot and Carli |
| **National Statistics status** | • National Statistic | • National Statistic status suspended | • National Statistic | • No longer a National Statistic |
| **Responsibilities & Mandates** | • produced under European regulation (as the HICP) | • Scope and coverage has been approved by the UK Statistics Authority | | • Required by the Statistics and Registration Service Act 2007 |

Within these four main measures, ONS produces a range of sub-measures for specific purposes. The largest set of these are the component indices that make up the main measures, for example CPI for food and non-alcoholic drinks. Similarly, ONS publishes special aggregates of these indices; for example, CPIH for all services. ONS publishes component indices and special aggregates for the CPI, CPIH and RPI, but not RPIJ.

ONS also publishes some specific variant price indices to meet specific user needs. These variants are summarised in **Figure 3.4**:

**Figure 3.4: Variant consumer price indices published by ONS**

| Index | Based on | Description |
|---|---|---|
| **CPIY** | CPI | CPI excluding indirect taxes (such as VAT and fuel duty) |
| **CPI-CT** | CPI | CPI at constant taxes; holds indirect taxes constant at base period rates |
| **CPIHY** | CPIH | CPIH excluding indirect taxes |
| **RPIX** | RPI | RPI excluding mortgage interest payments |
| **RPIY** | RPI | RPI excluding indirect taxes |
| **TPI** | RPI | The Tax and Price Index, which measures the change gross incomes needed to purchase the fixed basket of goods and services, allowing for the average amount of after income tax and National Insurance paid |
| **Pensioner Price Indices** | RPI | Price index based on RPI prices but weighted using spending patterns of households mainly dependent on the state pension (those excluded from the main RPI). |
| **Rossi Index** | RPI | Defined by the Secretary of State for Work and Pensions to uprate income-related state benefits, but since 2011 CPI has been used instead. Currently defined as RPI excluding mortgage interest, rent, council tax and housing depreciation. |

To summarise, the CPI is the current headline measure. It is the measure most often quoted in the media when the figures are published each month. It is used to uprate many government benefits and the state pension, and the measure targeted by the Bank of England when setting interest rates. However, it excludes the costs faced by people who own the home they live in, a major item of consumer spending.

CPIH includes a measure of owner occupiers' housing costs, and therefore overcomes the greatest objection to the CPI. In principle, CPIH is a superior measure of inflation, compared with the CPI. However CPIH is not used explicitly for any significant purpose, and is not the main focus of ONS's briefing and analysis. Further, it has recently lost its National Statistics status due to concerns regarding the private rents data underlying the owner occupiers housing costs component.

Similarly RPIJ is not widely used despite replacing the Carli with a better formula. This may in part reflect the fact that ONS only provides the headline RPIJ measure; there is no RPIJ excluding mortgage interest payments for example, nor does the ONS publish the component indices of RPIJ.

The RPI, in contrast, still attracts widespread attention despite it no longer being accredited as a National Statistic. In part, this reflects the wide range of uses still made of the RPI. A significant proportion of UK government debt is linked to the RPI, and it is used for uprating rail fares, utilities and other contracts, as well as many index-linked private sector pension schemes. It does not,

however, meet international standards. Legislation and the National Statistician's 2013 decision not to change it constrain its development.

Having established the current position, the next chapter discusses how the four main measures should develop in the future to best meet user needs.

# 4. The future of the four main consumer price statistics

## 4.1 Introduction

At present, ONS produces four main measures of consumer inflation: the CPI, CPIH, RPI and RPIJ. This chapter considers the future of each of these measures in turn. It discusses how, and when, users should move towards the best measure in principle - a slightly modified CPIH. The chapter concludes by considering what the main measures could be a few years from now.

## 4.2 The future of CPIH and the CPI

CPIH is the best, most comprehensive, measure of consumer price inflation currently produced by ONS.  This is because it is a pure price index based on best international practice. CPIH has a broadened scope that includes owner occupiers' housing costs. It covers the spending of all consumers on products that are within scope and, therefore, no households are excluded. The National Accounts is used as the data source of CPIH's weights and this is the most comprehensive source available. Finally, the UK has control of the production of CPIH.

However, there are some changes that should be made to CPIH so that it best meets user needs. Firstly, ONS must continue to work on ensuring that private rents are captured correctly and hence that the owner occupiers' housing costs component of CPIH is being correctly measured. CPIH must be an accredited National Statistic before it becomes the main measure of inflation. A full explanation of this work is available in Chapter 9.

Secondly, the UK Statistics Authority should consult on including council tax in CPIH. Direct taxes (like income tax) would not appear in a price index and, currently, council tax is classified as a direct tax. But one could equally see council tax as standing in place of VAT on housing and people generally perceive it as an expenditure on housing. This is discussed in detail in Section 9.15.

Thirdly, CPIH's continued production and consistency would be more trusted if it were protected by domestic legislation. Currently, the production of CPIH is flexible. This flexibility allows for improvement of the index, such as the inclusion of council tax. However, this flexibility may be an important disadvantage for potential users who are dependent on its consistency.

As a result of the 2014 review of governance of price statistics, CPIH will be supported by two new Advisory Panels on Consumer Prices. However, CPIH would meet users' needs more fully if stronger, perhaps legally binding, arrangements were put in place. The requirement to produce

CPIH could be established in law, alongside an outline of the process for making major changes to it.

Subject to these changes being made, CPIH should become the main headline measure of inflation.

At present, the CPI is not distinguishable from the Harmonised Index of Consumer Prices (HICP) - the two statistics are identical in scope, coverage and methods as outlined in Chapter 3. However, the two may diverge in future; for example, if OOH costs are included in the HICP using the net acquisitions approach (see Chapter 9). If, or when, the HICP diverges further from approaches best suited to measuring UK inflation, ONS should consider separating the CPI from the HICP. Under such circumstances, the HICP would be specifically for the purpose of making comparisons with other countries, and would not be a headline measure of inflation.

## 4.3 The future of the RPI

The RPI was the main measure of inflation in the UK for a long time. It is still used by a wide range of users, despite it no longer being the main measure of inflation, and its loss of National Statistics status in early 2013. The background to this is discussed in Chapter 3, and unweighted averages are discussed in detail in Chapter 10.

The National Statistician's response in March 2013 was correct: the RPI does not meet statistical best practice (ONS, 2013). The use of the unweighted arithmetic average of price relatives (the Carli index) to combine individual price changes is unsuitable in a National Statistic. The commitment to contemplate only 'routine' changes and accept the basic formulation of the RPI is the logical consequence of not changing the unweighted average formula. It is possible that the RPI could drift further from best practice. As we argue below, this is the best way of dealing with this problem – even though further clarification about what constitutes a routine change is needed.

In fact, there are further weaknesses in the RPI beyond those identified when its National Statistics status was revoked. For example, the expenditure that insurance premiums and second-hand car sales weights are based on include transfers back to the household sector. The RPI excludes certain households – pensioners mainly dependent on state benefits, and the top 4 per cent of earners – based on analysis that was last considered in the 1980s. The treatment of owner occupier housing costs in the RPI is also not the best available. Addressing any of these would arguably breach the National Statistician's commitment to not change the RPI.

The UK Statistics Authority has a duty in UK law to produce the RPI (Statistics and Registration Service Act 2007, Section 21). Some of the current uses of the RPI will be very hard to unpick. For example, index-linked gilts currently link to the RPI. Some of the index-linked gilts currently in issue will mature as late as 2068. Some gilts allow the holder to redeem the gilt in the event of a 'fundamental and detrimental' change to the RPI. The last of these mature in 2030[6]. Many other statutory and contractual uses of the RPI will be difficult, and potentially costly, to change. It seems impossible to discontinue the RPI in the short term.

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[6] The change is outlined in *Index-Linked Gilt Re-design: Response to Consultation* (DMO 2002, p.3)

This reliance on the RPI, as already discussed, led to the National Statistician to commit to not changing its coverage or basic calculation. This commitment leaves considerable room for interpretation. When withdrawing the RPI's National Statistics status, the Authority referenced a paper prepared by ONS for the January 2013 Consumer Prices Advisory Committee meeting. This paper clarifies what no change to coverage or basic calculation means:

> *That the basic formulation of the RPI is accepted as currently defined and that any future changes should be limited to issues such as the annual update of the basket and weights, improvements to data validation and quality assurance etc.* (ONS(2013), paragraph 5 iii).

By not changing the calculation of the RPI to make it a more "correct" measure of inflation in the face of evidence that the current methodology is flawed, the Authority has set a clear precedent. The RPI should not be improved except for those changes that ensure its continued production. Changes that are within the scope of this recommendation need to be clarified. For example, a new approach to adjusting for differences in quality between items might be considered a change to the basic formulation and so not allowed. On the other hand, updating the basket each year in the RPI is necessary to keep the selection of goods and services relevant and is therefore allowed.

ONS may wish to propose changes that are important for maintaining the quality of the CPI and CPIH.  As much of the production process of the RPI, CPI and CPIH is common, the default position would be to make changes to all measures. Consider the new quality adjustment approach mentioned above. This would have to be made to the CPI and CPIH to ensure the indices conform with best practice, and possibly to conform to European legislation. This change could not be made to the RPI within the National Statistician's commitment. The best outcome would be to split the production of the CPI and CPIH away from the RPI, although this would likely increase production costs.

The priority should always be to make the main measure of inflation – ultimately CPIH – as good as possible. It would clearly be unacceptable to not change CPIH because of worries about the impact on the RPI. Different processes should be used in the RPI and CPIH when this occurs. Improvements to the methodology of CPIH will not be carried over to the RPI.  Only changes that ensure the continuation of the RPI should be made, such as updating the basket and expenditure weights annually.

This would emphasise that the RPI is a legacy index and as its production diverges from CPIH, its usefulness will diminish. The logical outcome must be the eventual discontinuation of the RPI. As many long term contracts use the RPI this will obviously need to be carefully managed over an extended period.

The UK Statistics Authority has a role to play here. The Authority should monitor use of consumer price statistics, and should speak out against inappropriate use, particularly of the RPI. The Authority should encourage users to move to CPIH when it is reinstated as a National Statistic. However, the RPI is still the most widely recognised consumer price statistic in the UK, with the longest history. While it continues to be produced, some users will continue to use a substandard measure of inflation regardless of the advice provided by the ONS and the UK Statistics Authority.

The RPI also has an accompanying 'family' of indicators that are based on the RPI. These include the Rossi index, the Tax and Price Index and the Pensioner Price Indices. It makes little sense to continue to produce these measures on an RPI basis, when the RPI is not fit for analytical purposes. Therefore, we recommend that the UK Statistics Authority consults on discontinuing the production of analytical variants of the RPI. It is anticipated that users may wish to see some of these recreated on a CPI or CPIH basis, where they do not already exist. The publication of indices for subgroups of the UK population proposed in Chapter 6 may meet some of this user need.

## 4.4 The future of RPIJ

As discussed earlier, RPIJ was created as part of the decision not to replace the Carli unweighted average in the RPI. RPIJ is the same as the RPI in all regards except one: the inadequate Carli index is replaced with one that meets international standards - in this case, the unweighted geometric average or Jevons index.

One impact of RPIJ is that there are now two different estimates of the 'formula effect':

–  The difference between the RPI and RPIJ;
–  The difference between the RPI and CPI attributed to the different formula used in the RPI and CPI.

The difference arises in part because the RPI makes significant use of a third unweighted average, the ratio of average prices or Dutot index. RPIJ makes less use of the Jevons than the CPI. Both series in **Figure 4.1** can make a valid claim to represent the formula effect, but they are different, and this difference is causing confusion amongst users. ONS could usefully undertake further work on the formula effect to understand why different approaches to estimating the formula effect yield different answers.

**Figure 4.1: Different interpretations of the formula effect, 1998-2013**
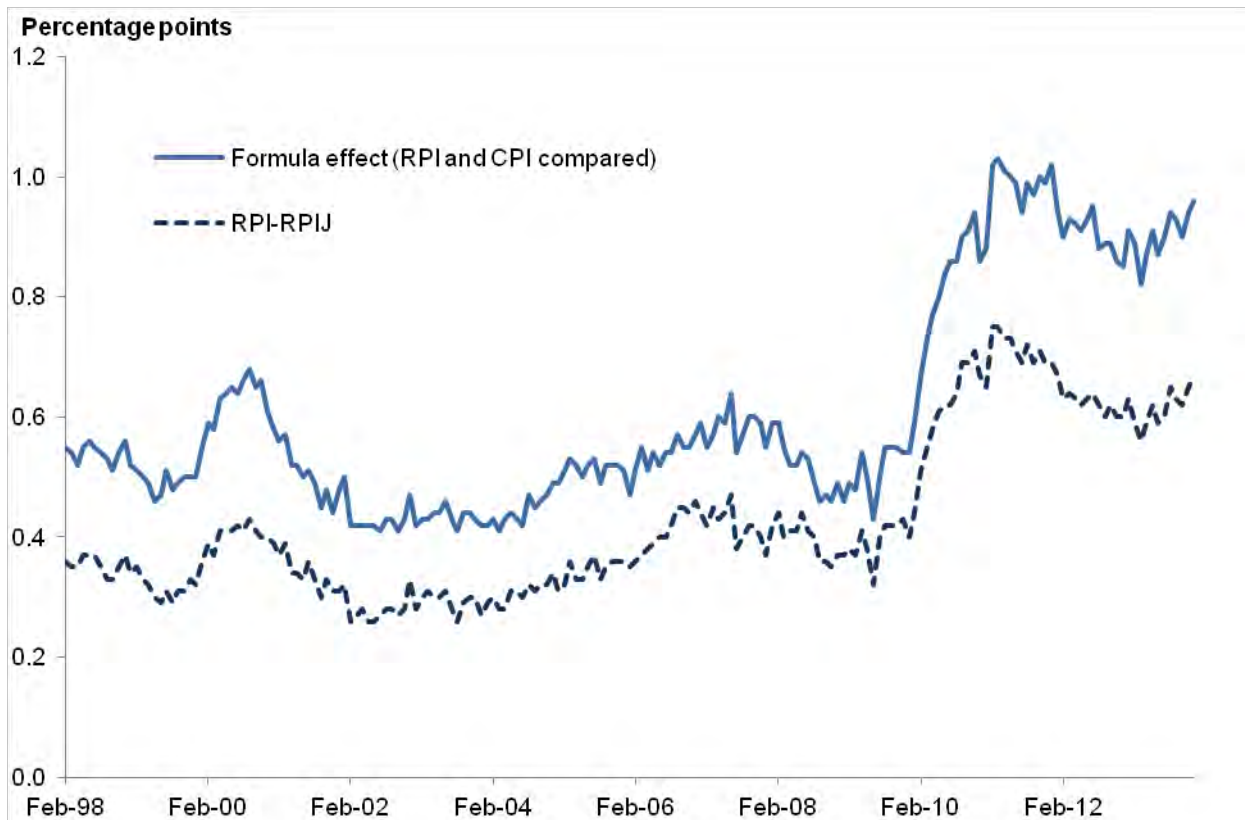


Source: ONS

As discussed in Section 4.3, the shortcomings of the RPI go beyond the use of the unweighted arithmetic average to combine price quotes. These additional weaknesses – the exclusion of the top 4 per cent and pensioner households mainly dependent on state benefits, the treatment of insurance and second hand cars, and so on – apply equally to RPIJ.

Finally, there is currently relatively little use of RPIJ. This may be in part because ONS does not publish all the individual components of RPIJ as it does with the other three main measures. It may also reflect the fact that, since its introduction, it has produced similar annual growth rates to CPI and CPIH

For these reasons, RPIJ is adding to the number of main measures of inflation, without adding very much value to users. We therefore recommend that the UK Statistics Authority consult users on discontinuing RPIJ. It would be logical to reconcile the RPI with CPIH once CPIH becomes the main measure of inflation.

## 4.5 Conclusions

We are not in an ideal situation in terms of the range of price statistics currently produced. Firstly, the RPI is known to be statistically flawed but needs to be produced because of the range of contracts which use it.  Secondly, RPIJ is simply a corrected version of the RPI, and is also a

highly idiosyncratic inflation measure, not being based on the whole population and not being a pure price index given the way it measures housing costs, insurance, and so on. The CPI is governed by EU rules and currently ignores owner occupiers housing costs entirely. CPIH includes those costs and, once concerns over current measurement of rents are dealt with, will be the best and most comprehensive inflation measure we have. But it will also lack the sort of governance arrangements which might encourage users, especially those entering legal contracts, to have confidence in it. To confuse things further, it is possible that in the not too distant future, ONS will be required by Eurostat to publish a version of the CPI including OOH on a different basis to that which is used to calculate CPIH.

Given where we are starting from, the best way forward would appear to be as follows:

- **ONS should move towards making CPIH its main measure of inflation. In the meantime, the CPI should continue to be the main measure of inflation.** The Authority should make it clear that it believes that CPIH is the best available measure of consumer price inflation. It should put strong governance arrangements around it so as to assure users of its robustness. **The Authority should consider making the case for legislation governing the production of CPIH, guaranteeing its production and setting out the process for making major methodological changes.** In saying this, we recognise that only when current problems associated with calculating OOH costs are sorted out will this transition be feasible;

- **ONS and the UK Statistics Authority should re-state its position that the RPI is a flawed statistical measure of inflation which should not be used for new purposes and whose use should be discontinued for all purposes unless there are contractual commitments at stake.**

- **Government and regulators should work towards ending the use of the RPI as soon as practicable. Where they decide to keep using it the UK Statistics Authority should ask them to set out clearly and publicly their reasons for doing so. Where the Authority judges the continued use of the RPI to be inappropriate, it should say so.**

- Given this position on the RPI, users should also stop using special analyses of RPI as well. **ONS should consult users on discontinuing the analytical series it publishes that are based on the RPI, such as the pensioner indices and the Tax and Price Index. Where there is a strong user need for such analyses to continue, the series should be recreated using the CPIH framework.**

- **We have noted that producing the CPI and CPIH to the best possible statistical standard is the first priority. The UK Statistics Authority should ensure that this priority is reflected in a work programme for the CPI and CPIH that allows each to be improved with best statistical practice.**

- **The logic of the National Statistician's recent decisions is that the RPI should be considered a legacy measure to be used only where contractually required. No further changes should be made to the RPI. If a change is made to the CPI and CPIH that would affect the RPI, the production of the indices should be spilt to retain the best practice of the CPI and CPIH and the constancy of the RPI. Over the long term the Authority should**

**look to phase out production of the RPI in consultation with users, amending the law (the Statistics and Registration Service Act 2007) as necessary.**

- **ONS should consult on discontinuing RPIJ. ONS should continue to publish an estimate of the "formula effect" between the RPI and the main measure of inflation.**

- If, and when, the EU mandates the production of the HICP including OOH on a net acquisitions basis this should be produced, but not given prominence alongside CPIH and should be used only where international comparability is required.

By way of concluding this chapter, it is useful to describe how we see the future of the four main measures of inflation a few years from now.

CPIH, possibly under a new name, would be the main measure of inflation. It would be the headline measure of inflation reported in the media, and would be widely used for understanding changes in price. CPIH would also be the starting point for uprating wages, benefits and other payments, although for some purposes it may be appropriate to concentrate on a subset of the full basket of goods and services. The process by which changes can be made to CPIH would be clear and transparent to users, and potentially backed by UK law.

This is not to say that CPIH will be a perfect measure of inflation, in a few years time or, indeed, ever. CPIH will continue to evolve to reflect better data sources and methods as they become available. Crucially, it will be under the control of the UK statistical system, so changes can be made to serve the needs of UK users.

ONS would publish a series that fully complies with EU regulations. It may include an estimate of owner occupiers' housing costs using the net acquisitions method. It would be the appropriate measure for just two purposes: complying with EU legislation, and for comparing inflation with other countries producing the HICP. It would not be the best possible measure of inflation available to UK users, and would not be a headline measure of inflation.

The RPI would be appropriate for one purpose; the indexation of contracts specifically linked to the RPI, where renegotiation is either impossible or impractical. The RPI would be far less widely used than it is today. It would no longer be considered a main measure of inflation. RPIJ would no longer be produced, with a reconciliation of the RPI and CPIH providing an estimate of the impact of the formula effect.

# 5. The case for a 'household' measure of inflation

## 5.1 Introduction

In previous chapters, we have seen how consumer price statistics are used in many different ways. From these uses, we identified two main purposes for which a consumer price statistic could, in principle, be designed:

- A measure of the change in prices of consumer goods and services.
- A measure of the change of the amount households need to spend in order to achieve the same level of consumption.

As discussed in Chapter 4, most users agree that CPIH is in principle a good measure of the first concept, and that this concept is in fact useful for a wide range of purposes. The second concept is what is sometimes referred to as a 'household' index, and could potentially differ from CPIH in several important ways.

This chapter develops a working definition of a 'household' measure of inflation, based on the literature and the contributions received by the review team. It then examines the proposed differences in order to determine which would be of most value to users, and where possible to assess the actual difference they might make. The chapter concludes by suggesting a way forward that delivers the maximum benefit for users.

## 5.2 Purpose, design and use of a household index

Two main justifications have been offered for what we refer to here as a household index. The first is that an index should be designed specifically for the purpose for compensating households for rising costs. Such an index, it is argued, would then be the natural index to be used for uprating wages, state benefits and pensions. This is the approach taken by Leyland (2014), which is described as an 'uprating' index.

The second justification is in terms of what is being measured. The household index would have a modified scope and coverage compared to existing consumer price indices in order to better reflect costs as households understand and experience them. This is the approach taken by Astin (2014). Astin goes on to suggest that the index would be suitable for use as an 'uprating' index, as well as other situations where a measure of household living costs is seen as desirable.  Astin also suggests such an index would naturally become the main reported measure of inflation as it would accord more closely with people's everyday experience.

The two justifications both lead to an index designed to measure inflation as experienced by households. One of the major intended purposes of the index would be for the indexation of wages, benefits and pensions, and this would in turn potentially affect the design of the index.

## 5.3 The literature on household and uprating indices

There is no set definition of a household index. However, there has been some consideration of what methods would be used in an index designed for uprating purposes.

Chapter 2 of the ILO CPI Manual (ILO, 2004, pp33-37) discusses how the purpose of a consumer price index may affect its design. It suggests that a measure designed for uprating wages and/or benefits may relate specifically to the expenditure of these groups (i.e. wage earners or benefit recipients), rather than to all households. It suggests that certain "luxurious" or "frivolous" expenditures might be excluded. The Manual also suggests that a measure designed for uprating could either aim to preserve the purchasing power of the payment or aim to preserve the standard of living, the latter allowing for consumer substitution. In Chapter 10 of the ILO CPI Manual, and in the 2003 ILO Resolution on Consumer Price Statistics (ILO, 2003), there is support for using the payments approach, for example, to price insurance and owner occupiers' housing costs.

Schultze and Mackie (2002) also raise the issue of whether the aim should be to compensate households for rising prices or the rising cost of maintaining the same standard of living. Schultze and Mackie were considering the United States, where (as discussed in Chapter 7 of this report) measures of maintaining the standard of living – Cost of Living Indices – had been heavily discussed in the previous years.

The same authors also suggest that it may be more appropriate to use the average inflation experience of households – what is sometimes referred to as a democratic index – when compensating households. This would be in contrast to the expenditure-weighted or plutocratic approach used more generally in measures of inflation.

The Australian Bureau of Statistics (ABS) produces the Pensioner and Beneficiary Living Cost Index (PBLCI), which has been used for uprating pensions in Australia. PBLCI differs from the main Australian CPI in that it refers to a subset of households, and uses the payments approach to housing and insurance.

Leyland (2014) and Astin (2014) argue that a household index would differ from CPIH in a number of ways. They propose that UK households should be the target population, and that the index should be democratic, as also proposed by Schultze and Mackie. They propose the use of the payments approach, and both suggest that the index could include capital repayments on property[7]. Leyland (2014) also suggests that quality changes that are "forced" onto consumers should be treated as price changes rather than quality changes, and hence should contribute towards measured inflation.

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[7] Leyland and Astin both also propose including council tax as this is not currently included in CPIH. However, as mentioned in Chapter 4 and discussed in detail in Section 9.15, we recommend that council tax should also be included in CPIH.

## 5.4 A working definition of a 'household' index

The concept of a consumer price index that seeks to measure the overall change in price of consumption goods and services is well-defined in the literature. There are still choices which producers of consumer price statistics face, and much of the rest of the report considers some of the more difficult choices. However, as discussed in Section 5.3, there is no ready definition of a household index, so one is set out here.

The household index would be designed with the intention of measuring the change in costs faced by UK households. A core purpose of the measure would be to be used for uprating payments when the goal is to compensate households for rising costs.

In this chapter, we will take CPIH as our point of reference. As set out in Chapters 3 and 4 of this report, CPIH is the best available measure of change in the prices faced by households. We consider a set of possible, specific, differences between CPIH and a household index:

1.  Making the target population of the household index **UK households,** rather than UK domestic spending as is currently the case in CPIH.

2.  Weighting the index to be **representative of the average household**, rather than treating all transactions equally, as in the CPIH.

3.  Whether the target concept is changes in price (as in CPIH) or the **cost of maintaining a given standard of living**, the target concept of a Cost of Living Index.

4.  The use of the **payments approach** to compile the household index, rather than the acquisitions approach used in CPIH (with the exception of owner occupiers' housing costs). This would have implications for owner occupiers' housing costs, credit costs, insurance, second-hand cars and student tuition fees.

5.  The inclusion of **capital repayments on homes** in the household index, which are excluded from CPIH.

6.  The **exclusion of certain purchases** from the household index on the grounds that they are not essential.

7.  To regard **enforced quality changes** as price changes (and so included in the household index) and not quality changes (which are excluded in CPIH).

## 5.5 The target coverage of the household index

CPIH currently measures inflation in the household sector in the UK. As such, it includes the expenditure of foreign visitors to the UK, and excludes the spending of UK households abroad. This is because CPIH has inherited this coverage from the CPI, which follows the Harmonised

Index of Consumer Prices (HICP) definition of the geographic coverage of the index. Eurostat requires that the HICPs that member states produce take consumption spending in their countries as their target, in order to prevent double-counting.

A household index, on the other hand, would likely aim to cover UK households rather than UK domestic expenditure. In other words, such an index would include UK spending overseas, and exclude the spending of visitors to the UK.

The Household Sector Accounts - the source of weights for CPIH - are compiled according to the UK domestic concept. An estimate of total spending by UK households is made by applying adjustments based on the spending of UK households overseas, and overseas visitors to the UK. These adjustments are not currently broken down by what the money is spent on. Thus it is not currently possible to adjust the existing weights to reflect the spending of UK households.

The aggregate numbers do provide some indication of the likely impact this would have had historically. These are shown in **Figure 5.1**:

**Figure 5.1: UK household and UK spending, 2013**
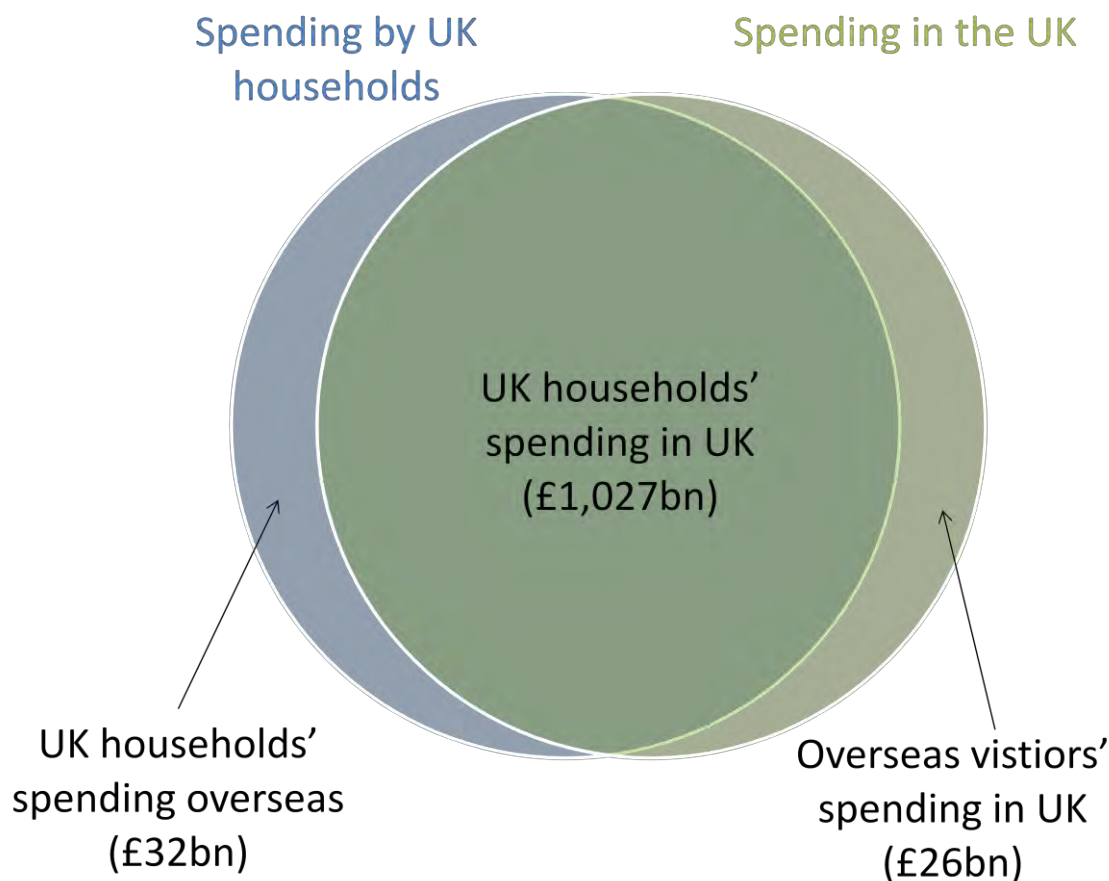


Source: Table 6.2, UK National Accounts Blue Book 2014, ONS

According to the UK National Accounts Blue Book 2014 (ONS, 2014a), £1,059bn was spent by UK households in 2013. Of this, £1,027bn was spent in the UK, and only £32bn (3 per cent) was spent overseas. In other words, around 97 per cent of spending by UK households is within the scope of

CPIH. The figure varies a little over time; for example, spending by UK households overseas was as high as 3.7 per cent in 2008. This leaves relatively little scope for UK household weights to differ from the UK domestic concept in CPIH, and may help to explain why this has not previously been seen as a priority.

In contrast to the Household Sector Accounts, the Living Costs and Food Survey (LCF) does collect information on the spending patterns of UK households. The LCF could be used to weight a household index, but doing so would also introduce a difference in data sources between the household index and CPIH. One cannot distinguish how much of the difference would be because of the disparity in the concept covered, and how much would be due to the other differences between LCF and the National Accounts, our preferred source of weighting information (see Chapter 11 for more details).

Using spending by UK households to weight a price index has another drawback. ONS only collects prices from UK sellers, meaning that a UK household measure would not currently have prices to cover the 3 per cent of 2013 spending that took place overseas. Some items could perhaps be collected centrally; in other cases, one would either seek to use published data by other national statistics institutes or assume that the price changes were the same as in the UK.

In summary, a household index would, almost by definition, naturally refer to UK households. This is currently a difference between the household index and CPIH. Calculating a UK household index would at this point in time mean using the Living Costs and Food Survey, which is not the best available source of weighting information. It would also mean that around 3 per cent (currently) of total spending would be associated with spending abroad; collecting prices for overseas spending would be a significant challenge. The UK domestic concept is easier to measure consistently with currently available methods.

## 5.6 Weighting by households

CPIH is weighted by expenditure. Each item in the basket is weighted based on how much money is spent on the products that item represents. The price changes of items that represent a lot of spending will have more impact on CPIH than the price changes of those items with little spending and so little weight. Weighting by expenditure is standard practice for consumer price indices produced around the world.

Seen from the perspective of households, CPIH implicitly gives more weight to higher spending households. The more a household spends, the larger the share of total spending that household will represent. Thus the inflation experience of high-spending households makes a larger contribution to CPIH than that of low-spending households.

An alternative approach is to weight by households rather than expenditure. In the literature (for example, Schultze and Mackie, 2002), this is referred to as the *democratic index*. The democratic index concept aims to calculate the average inflation rate experienced by households. Ideally, this would involve calculating inflation rates for a representative sample of households and then aggregating these up to reflect all UK households.

Advocates of the democratic index have suggested that such a measure would be more representative of inflation experienced by UK households than an expenditure-weighted index (sometimes termed a *plutocratic index*). As such, it is argued, the democratic index would be more suitable for purposes such as uprating than an expenditure-weighted index.

Fundamentally, a household-weighted (democratic) index is answering a different question to an expenditure-weighted index such as CPIH. CPIH aims to measure the average change in price across all consumption goods and services purchased by households. Uprating a payment by this measure could be considered to be compensating the recipient for changes in the general level of prices. A democratic index, on the other hand, aims to measure the average inflation rate experienced by households. Uprating a payment by a democratic index could then be thought of as aiming to compensate the recipient based on an estimate of the average inflation rate experienced by households.

A true democratic index involves calculating an inflation rate for a representative sample of households, and then combining them to get an average across all households. Such an index is not possible with current sources of data. It would require information on the expenditure patterns of individual households over a long enough period for these to be considered representative. The LCF, in common with similar surveys, only collects detailed information for households over a two-week period. A consumer panel survey could provide this data but would be expensive. Ideally, a democratic index would also reflect the prices faced by the individual households. The data requirements may help to explain why other countries do not calculate democratic consumer price statistics.

Even so, there are approaches that can be taken that get closer to the democratic index concept. One approach is to calculate the average expenditure share on each commodity, across all households, as suggested by Schultze and Mackie (2002, pp78-79). This is the approach taken by ONS (2014b), using the LCF for the household expenditure data.

The results are shown in **Figure 5.2**. Over the period 2002 to 2013, the household weighted index grows by 0.3 percentage points a year more than the expenditure weighted average. This is because low-income households generally faced higher inflation than high income households for most of the period.

**Figure 5.2: Expenditure and household weighted consumer price indices, 2002-2013**
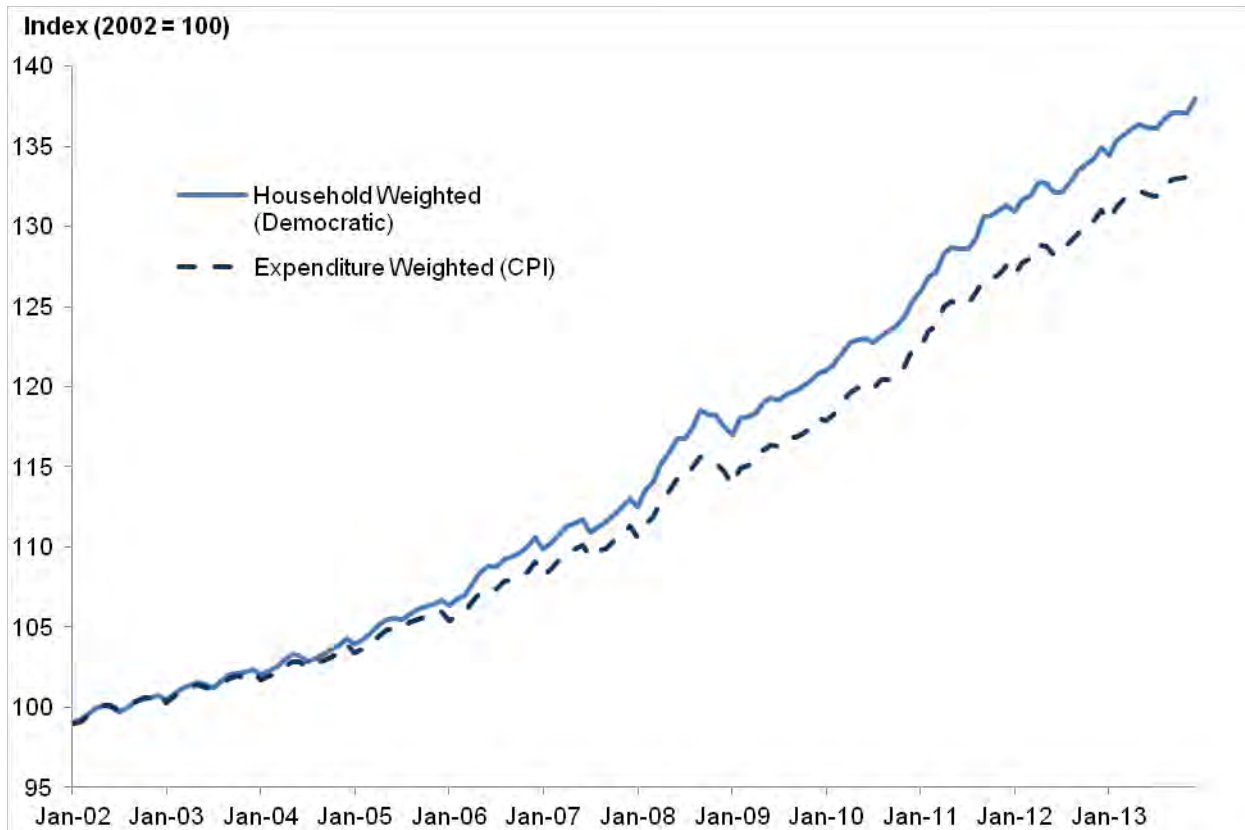


Source: ONS (2014b). Weights for both series have been benchmarked to reconcile with the CPI.

This is not to say that a household-weighted index will always exceed an expenditure-weighted index. Analysis by IFS (2002) suggested that between 1976 and 2000, their plutocratic (expenditure-weighted) index was sometimes equal to, or higher than, their democratic (household-weighted) index. Schultze and Mackie (2002, p239) report a small range of studies of democratic indices, suggesting that the relationship between household-weighted and expenditure-weighted indices will vary depending on which commodities are experiencing the largest change in price.

Astin (2014) puts forward another way of approximating the democratic concept which involves trimming the sample of households to exclude very high and very low income households. A variant of this approach is already well-established in the RPI, which excludes the top 4 per cent of households by income and pensioner households mainly dependent on the state pension. As described in Chapter 3, the original rationale behind the RPI was to estimate inflation experienced by working households, and to exclude households whose expenditure patterns were significantly different.

The discussion of the democratic index opens up the question of whose income an "uprating" index is being used to uprate, and whether that should be a factor in the design of the index. For example, it could be argued that if the aim in uprating a pension is to leave the pension recipient no worse off, then the pension would more appropriately be uprated in line with the average inflation

rate faced by pensioners, rather than all households. Similar arguments could be made for wage earners, or benefit recipients.

Information on the inflation experienced by subgroups of the population would be helpful to many users of consumer price statistics. This idea is returned to in Section 5.13 and is discussed in detail in Chapter 6 of this report.

In summary, the democratic index concept answers a slightly different question to traditional measures such as CPIH. It is arguable whether a democratic index would be better for uprating purposes than an expenditure-weighted index. This would depend on what uprating was intended to achieve. For some situations it could be argued that a subset of the whole population would be more appropriate. ONS cannot calculate a true democratic index but could go some way to approximating it, as shown by ONS (2014b). This work suggests that over the last ten years, a democratic index would have shown greater inflation than an expenditure-weighted index, but other studies suggest this may not always be the case.

## 5.7 The cost of maintaining standards of living

CPIH, like all consumer price statistics produced by ONS, measures the change in prices of goods and services purchased to be consumed. There is an alternative concept, which seeks to measure the change in costs to attain the same standard of living. The main difference between this concept and CPIH is that it assumes consumers change their spending patterns towards goods and services whose prices are increasing relatively slowly. A measure which targets this standard of living concept is known as a Cost of Living Index (COLI).

Chapter 7 of this report considers the case for producing a COLI for the UK in detail. Here, we consider whether the COLI approach is more or less applicable to a household index than for a measure of price change such as CPIH.

Whether the COLI or a measure like CPIH would be better for uprating payments would depend on what uprating was intended to achieve. Compensating a household based on changes in price (the concept measured by CPIH) would be appropriate if the aim was to preserve the purchasing power of the payment. Compensating a household based on a COLI would be appropriate if the aim was to allow the household to maintain the same standard of living.

A measure that takes into account people substituting towards goods experiencing lower inflation will, by definition, show smaller (or equal) increases in price than one that does not. Compensating by a COLI would therefore result in smaller increases in payments than a measure of pure price change. In addition, as discussed in Chapter 7, a significant practical issue in constructing a COLI is that one can only be produced at a lag of at least two years. This is not sufficiently timely for an index designed to uprate benefits.

## 5.8 The payments approach

There are three fundamental ways of collecting prices for a consumer price index. One can collect prices when goods are *acquired*, when they are *used*, or when *payments* are made. In many cases, there is little or no difference between the three. For example, if one acquires and pays for an apple at the same time, and uses it shortly after, then the price of the apple is the same from all perspectives. However, for some goods and services the approach taken makes a significant difference.

CPIH follows the acquisitions approach, except in the case of owner occupiers' housing costs where a use-based approach, rental equivalence, is used (see Chapter 9 for details). The proposal from advocates of a household index is that such an index should follow the payments approach.

The payments approach seeks to measure gross household spending on consumption goods and services. The prices are based on the prices actually paid by households, and the weights based on shares of household spending. In contrast, the acquisitions approach seeks to price the good or service provided at the point at which the consumer acquires it, with weights reflecting the net impact on the household sector as a whole.

When might this make a difference? One case where the payments approach makes a difference is when the overall payment for a good or service includes an element that is returned to households, such as insurance. Another case is where the amount actually paid may differ from the originally agreed cost; student tuition fees are an example of this. Actual payment of the costs of tuition also occurs at a very different moment from acquisition. Owner occupiers' housing costs are perhaps the most significant example of where the payments approach makes a difference; considering these costs leads to a broader consideration of the treatment of credit in the index.

### 5.8.1 Why use a payments approach?

The payments approach is considered by some to be particularly appropriate for compensating households. The theoretical support for this comes from reasoning that the total income (from all sources) that households receive can either be spent on consumption, or saved. The payments approach considers all consumption spending within the scope of the index, and that the appropriate price measure is the price actually paid by the consumer.

With this definition, the total payments made by households have to be met by the household's after tax income from all sources, with savings as a balancing item. The 2004 ILO CPI Manual (Chapter 10, paragraph 10.22) states: 'It is for this reason that a payments-based CPI is commonly considered to be the best construct for assessing changes in net money incomes over time'.

The 2003 Resolution concerning consumer price statistics passed by the Seventeenth International Conference of Labour Statisticians has been cited (for example, Leyland, 2014 p5) as supporting the use of the payments approach. The resolution states:

> *In determining the scope of the index, the time of recording and valuation of consumption, it is important to consider whether the purposes for which the index is used are best satisfied*

*by defining consumption in terms of "acquisition", "use", or "payment". The "acquisition" approach is often used when the primary purpose of the index is to serve as a macroeconomic indicator. The "payment" approach is often used when the primary purpose of the index is for the adjustment of compensation or income. Where the aim of the index is to measure changes in the cost of living, the "use" approach may be most suitable (ILO, 2003).*

Note that the statement says "often used" in respect of both the acquisitions and payments approaches. In fact, this use appears to be quite rare. Relatively few countries compile a measure designed to be used for compensating households. Germany produces an index with this stated purpose but, in the case of housing at least, does not appear to follow the payments approach (they use rental equivalence).

Ireland currently uses the payments approach to owner occupiers' housing costs in their main measure of inflation; the only country identified in ONS (2012) as doing so. However, their most recent review (CSO Ireland, 2010, pp9-10) considered moving to a rental equivalence or net acquisitions approach, suggesting that this is a pragmatic choice rather than driven by purpose.

Australia employs a payments approach to producing its Selected Living Cost Indices (SLCIs). One of these, the Pensioner and Beneficiary Living Cost Index (PBLCI), has been part of the system used to uprate pensioner incomes in Australia. However, Klapdor (2014) suggests this role is to come to an end in the near future.

The UK RPI shares some characteristics with the payments approach. It uses the gross price, gross weight approach to insurance and second-hand cars. Its treatment of owner occupiers' housing costs shares some characteristics with the payments approach, although the depreciation element (included to represent the amount of money put aside for structural repairs and updating) is not within the scope of this approach.

To understand whether the use of the payments approach is indeed appropriate, one must consider the individual differences in turn. While the impact of the payments approach on insurance is perhaps not the most significant difference, it provides a helpful introduction to the concepts involved.

### 5.8.2 Insurance

This section refers to insurance for property, such as car, house or buildings insurance. Life insurance is generally regarded as a financial asset and is therefore outside the scope of consumer price statistics entirely. It is not considered here.

In simple terms, one can consider an insurance premium paid by households as being made up of two components. The first is a service charge paid to the company providing the insurance, sometimes referred to as the *net premium*. The second is a payment into a pool from which insurance claims are met. In this discussion, the total payment (net premium plus payment into the claims pool) is termed the *gross premium.*

In CPIH, the service charge element is in scope but the contribution to the claims pool is not. The service charge measures the actual cost of insurance, while the payment into the claims pool is a transfer from one set of households (all those paying premiums) to another set (those receiving claims). In practice, most countries can identify the total service charge paid (for the weight), but not the price. Therefore countries, including the UK in the CPI and CPIH, follow a "gross price, net weight" approach.

Under the payments approach, households pay the gross premium. No allowance is made for claims returned to households, because these would be included as income. In the same terms as above, the payments approach is "gross price, gross weight".

One can get some idea of the difference this makes to the weight from ONS (2014b, p16). They compare the weights they derive from the Living Costs and Food Survey with the CPI. The LCF measures gross household expenditures and therefore can be considered compatible with the payments approach (gross weight), whilst the CPI uses the net weight approach. In the case of transport insurance, the CPI expenditure total (net weight) in 2011 is around one-fifth of the LCF (gross weight).

The CPIH approach makes sense when the objective is to calculate the overall change in the prices of goods and services. The payment into the pool used to pay claims is a transfer between households, and not buying a service.

However, seen from the perspective of the individual household, the price appears to be the gross premium; this is what they have to pay to obtain insurance. They may or may not receive a payout in the event of an accident, but from the individual household's perspective, this would add to their income, not reduce their costs.

At which point, it is worth considering what might drive a rise in the part of the insurance premium that goes into the claims pool. One possible driver is that the cost of what the claims pool has to repair or replace might rise. If cars become more expensive, car insurance premiums would also have to rise to meet the cost of replacing cars damaged in accidents, other things being equal. This could be considered double counting; car purchases are already accounted for in the index.

Another possible cause of higher premiums is an increase in claims. This could be because of some external cause, such as floods or storms damaging housing. It is hard to see such an increase as anything other than an increase in the costs faced by households.

In both cases however, some households (those that make claims) will receive more income as a result. If one is to include the full cost of insurance in a household index, one would want to include the impact of the additional income as well. One can do this in an analysis of incomes and expenditure, but not when deflating a single element of income, such as wages or benefits.

From this, we draw the following conclusions. There is nothing intrinsically wrong with the gross price, gross weight approach to insurance; it measures the change in what households spend on insurance. However, it is only conceptually consistent if compared to a measure of income which includes payouts from insurance claims. In an analysis of changing living standards, this is something that could be done. However, in the context of a standalone measure that is used for the purpose of uprating, a net measure such as CPIH would be more appropriate.

### 5.8.3 The purchase of second-hand cars

The treatment of second-hand cars has parallels with insurance. The weight for second hand cars in CPIH reflects the net expenditure by households on second-hand cars. This includes the full cost of cars sold from outside the household sector, such as from business fleets. It also includes any margin earned by car dealerships in trading in second hand cars.

The payments approach simply measures the gross spending of households on second-hand cars. ONS (2014b, p16) provides some indication of what difference this makes; in 2011, CPI expenditure on second-hand cars was approximately 20 per cent lower than LCF spending.

One way of looking at second-hand cars is that they are transferred between households; these transfers make households overall no better or worse off, regardless of the change in price. This would support the net concept used in CPIH. Car dealers do impose a cost (the margin between the price they buy the car for, and the price they sell for), but this is included within the net concept.

Another way to consider second-hand cars is to consider a household selling their old car to buy another second-hand car. They are not exposed to the full cost of the new car as the money received for the old car is put towards the cost of the new one. A general increase in price in second-hand cars increases both the cost of the car they are buying but also the value of the one they are selling. This mitigates the household's exposure to inflation. An index that uprated by gross payments would reflect the gross cost of the car, and over-represent the cost of second-hand cars.

### 5.8.4 Owner occupiers' housing costs and the cost of credit

CPIH uses the rental equivalence approach to estimate owner occupiers' housing costs. This estimates the cost of the housing services provided by one's own home by asking 'how much it would cost to rent an equivalent property?' The rental equivalence approach is considered in detail in Chapter 9 of this report.

The payments approach is described in Chapter 10 of the 2004 ILO CPI Manual. It seeks to measure the outlays made by households when consuming housing. As described in Section 5.8.1, the payments approach to consumer price statistics makes a distinction between saving and consumption spending. Under this approach, payments that add to a household's assets are regarded as a form of saving, and so are regarded as outside the scope of a consumer price index.

In the case of payments for housing, the costs excluded are down payments on a purchased home, the capital element of mortgage repayments, and alterations and additions to the home (such as building an extension). The case for more fully including house prices in a household index is discussed in Section 5.9.

The owner occupiers' housing costs that fall within the scope of the payments approach are:
  – Mortgage interest payments
  – Dwellings insurance

- Repairs and maintenance
- Ground rent
- Transaction costs, such as estate agency fees and legal fees

Most of these payments are not contentious. With dwelling insurance, the question of net or gross premiums arises; this is covered by the discussion of insurance in Section 5.8.2. Council tax is not included because it is not a cost faced only by owner occupiers; those who rent pay it as well.

Repairs and maintenance pose a practical difficulty because some major works carried out on homes go beyond returning the property to its original condition and therefore are a form of investment. This would be excluded from a consumer price index. Disentangling the repair element (which is consumption spending) and the investment element (which is not) is difficult to do. However, this is not a fundamental objection to the payments approach; the data sources may become available in the future.

The RPI is sometimes said to use the payments approach. However, the RPI includes house depreciation, an imputed cost, to deal with the major works problem described above. In fact, because it includes depreciation, the approach used in RPI is in some ways closer to a user cost approach, as is explained in more detail in Chapter 9.

Mortgage interest payments, or MIPS, pose a different challenge. The price of MIPS (as currently calculated in the RPI) is the average payment per index household per week. It is calculated by multiplying the debt per household by the average effective interest rate, expressed as a payment per household per week. The size of debt depends in part on house prices, but over a long period of time. Some mortgages will have been taken out as a result of house purchases made many years ago, and reflect the cost of the house at the time of the purchase. This is the only part of a pure payments approach to owner occupiers' housing costs that uses house prices.

For the interest rate faced by households, the RPI uses the Bank of England's data on the Average Effective Rate (AER). The AER is compiled from a mix of fixed, discount and variable-rate mortgages drawn from a range of providers. This would be the starting point for including MIPS in a household index.

An increase in interest rates (for example, following an increase in the Bank of England's base rate of interest) would lead to an increase in the AER and hence an increase in mortgage interest payments. However, the interest rate increase would have other impacts on the finances of households. It would increase the cost of accessing credit (usually regarded as outside the scope of consumer price statistics), and also increase income received from savings.

It might therefore also be worth considering MIPS as one element of a more general treatment of the cost of credit.  Section 3.62 of the 2004 ILO CPI Manual suggests that all credit costs should be treated consistently, as the purpose of the loan should not affect the treatment. Both Leyland (2014) and Astin (2014) propose a more general treatment of credit costs in a household index.

One way to consider the cost of credit is to note that a proportion of the cost is paid directly to depositors in the form of savings interest. In the case of savings held by households, this is a

transfer between creditor and debtor households, and leaves households, as a whole, no better or worse off.

In the National Accounts, part of the cost of providing banking services is derived from the difference between interest paid out to savers and interest charged to borrowers. This concept is known as financial intermediation services indirectly measured, or FISIM. This margin is the implicit price of the services being provided to savers and borrowers.

FISIM is currently outside the scope of the consumer price statistics produced by ONS. During the review, we have looked at the possibility of including FISIM in CPIH, but to calculate a robust price measure would be difficult. It is excluded from the HICP, and very few other countries attempt to measure it.

A second way of considering the cost of credit is to look at the impact a change in interest rates has on different households. This is an argument made by Weale (2014). Households with mortgages will experience an increase in the costs they face. However, households with savings would experience an increase in income. The payments approach would include the costs imposed on households by a rise in interest rates, but not the increase in income received.

As with insurance previously, it is consistent to include the gross cost of credit if one is comparing the cost measure to an income measure which includes interest income. In this case, the overall impact of changes in interest rates is captured in a coherent way. It is not consistent to include mortgage interest, or the gross cost of credit, without including the impacts on income.

This becomes important when one considers that the household index is intended to be used for uprating payments. Looking at the household sector as a whole it would not be appropriate to conclude that an increase in interest rates, resulting in an increased cost of credit, should result in any payment being uprated by that amount. For the household sector as a whole may have been fully compensated for the increase in credit costs by an increase in interest income. By neglecting the impact on incomes, households as a whole would be over-compensated for a rise in interest rates. Similarly, a cut in interest rates would result in lower increases to payments uprated by the household index, even though income received from savings has fallen.

The issues become particularly acute when one considers the impact on particular payments. Pensioners tend to be more likely to be net creditors (see ONS, 2014c, Table 5.21); a rise in interest rates would generally leave them better off. If pensions were to be linked to a measure that included MIPS, that rise in interest rates would also lead to an increase in pensioners' income. As pensioner households tend not to have mortgages, such a rise would compensate for an increase in costs they largely do not face. At the same time, any income from savings would also rise.

Similarly, a fall in interest rates would represent a fall in costs for households with mortgages, and leave them better off. Pensioners would not receive this windfall; indeed, their income from savings would fall, leaving them worse off. If the index used to uprate their pension included MIPS, their incomes would also increase by less.

In summary, the most problematic part of the payments approach to owner occupiers' housing costs is mortgage interest payments. Once one accepts mortgage interest payments as part of a household index, it is preferable to include credit costs more generally. The payments approach

measures the gross cost of credit. However, it neglects the impact on household incomes of savings, which are also affected by interest rates. Including interest income received and credit costs paid out would result in a consistent treatment of credit costs. However, including one but not the other means that an aggregate household index used for uprating would over-compensate households for interest rate rises, and under-compensate them for interest rate cuts. These issues would be exaggerated for net savers.

### 5.8.5 Student tuition fees

University tuition fees are somewhat different to the other examples considered in this section. In CPIH, they currently appear in full at the point at which the fee is paid to the university, not the point at which students eventually pay them. This is consistent with the treatment of other goods and services that are bought with a loan. The upfront price is a measure of the changing price of goods and services.

A significant difference between university tuition fees and other goods and services bought with loans is that a large proportion of the fees are not expected to be paid back. The government calculates the "RAB charge" on the current system to be in the region of 40 per cent. In other words, about 40 per cent of the cost of the loans in total will never be repaid. However, this is very sensitive to assumptions of future economic performance. IFS (2014) estimated that up to three quarters of loans will not be repaid in full.

This raises some tricky issues. The price of university tuition is clear. It is made clear when the student chooses to enrol on the course. The price can be anything up to £9,000 a year. Students who are not eligible to take out loans, such as those with previous degrees, have to pay the fee in full.

Under the payments approach, one would want to measure the actual price paid by the student, not the price paid up front. As it is generally accepted that loans will not be paid back in full, the price actually paid by households would be lower. The timing of payment would also be different; the cost to households would only arise when the loan is being repaid. The full cost of a change in tuition fees would only be experienced over a period of many years. Clearly, the cost and weight of student tuition fees under the payments approach could differ significantly from CPIH.

### 5.8.6 Summary of the payments approach and the relationship to income

The payments approach is a recognised way of compiling a measure of consumer prices. It is based on estimating the gross expenditure of households. It is considered by some to be particularly suitable for assessing changes in income received. A household index compiled using the payments approach would differ from CPIH in several ways.

The payments approach includes the full payments made by households towards insurance, second-hand cars, mortgage interest, and potentially the cost of credit more generally. However, it does not include the increase in income that households receive as a result. Using such a

household index to uprate a payment would reflect the costs, but not the income, and therefore not be the most appropriate means of compensating households. It would make little sense to use such a population wide measure to uprate benefits or to increase wages for example.

If, however, one has in mind a measure of income which includes interest income, insurance claims and the sale of cars, then using an inflation measure based on the payments approach would give one a good sense of what has happened to real incomes across the economy. It could also be used to offer a coherent approach to student loans. These could either be netted off from income, in the same way as taxes, at the point they are paid. Or they could be counted as a cost at the point paid.

## 5.9 The inclusion of capital repayments on houses

The scope of consumer price statistics is restricted to goods and services consumed by households. Financial assets (such as shares and life insurance) are excluded from a consumer price index. One does not consume a financial asset; one is making an investment. We are not aware of any argument that financial assets should be included in a consumer price index.

The purchase of property is clearly different. Some forms of property ownership, such as buy-to-let, or purchasing to renovate and sell at a profit, are forms of investment activity as well and not consumption. However, people who buy a property in order to live in it are not doing so solely as an investment. They also do so because they want somewhere to live, security of tenure, and to be able to make their home look the way they want it to.

It is generally accepted, amongst producers of consumer price statistics at least, that houses are a combination of an asset and a consumable good. The various methods of measuring the costs of owner occupiers that exist all acknowledge this distinction in some way and try to disentangle the two, with the goal of excluding the asset element. In the context of the payments approach, this is achieved by excluding payments that create an asset (or reduce a liability) on household balance sheets. These include down payments, the capital element of mortgage repayments, and alterations and additions to the property.

Some advocates of a household index challenge this consensus. Leyland (2014, pp9-10) argues that the purchase of a property satisfies the needs and wants of an owner occupier. The fact that it is also an investment should not stop it from being included in a consumer price index. Astin (2014, p3) suggests that, viewed from the perspective of the household, there is little difference between payments made on mortgage interest and mortgage capital; households look at the total, and it is this that affects their living costs.

Including the full cost of housing in a price index would mean departing from the established framework of consumer price statistics, and producing a hybrid consumer / asset price index. We are not aware of any country that is producing a price index which combines consumer prices and the full cost of housing. However, this in itself is not a conclusive argument against producing such an index.

The purchase of a house creates a substantial asset. If properly maintained, the house will likely hold, or even appreciate in value over time. Even after having owned the house for a period of time, the owner can sell it if they wish and expect to get back the money they invested in the property.

Home owners gain from house price inflation. With almost all other goods and services purchased, inflation is unambiguously a rise in the cost faced by households. Existing homeowners are actually made better off by house price inflation. Leyland (2014) argues that this gain is only realised when the house is sold, and even then, some or all of the gain might be used to finance the purchase of another house. However, this remains an increase of the wealth of the homeowner; they are not facing this inflation, but are benefiting from it.

One might argue for including just that element of house price inflation faced by people who are buying a house for the first time, or are moving up the 'housing ladder'. These people could indeed be said to be facing house price inflation. However, the household index is intended to refer to households as a whole. A would-be purchaser of a house faces house price inflation, whilst the seller is directly gaining from that same inflation. Taken as a collective, house price inflation leads to the assets held by households becoming more valuable. It would seem odd to devise an index to compensate households for becoming better off.

## 5.10 Luxuries and essentials

Chapter 2 of the 2004 ILO CPI Manual suggests that for some indexation purposes, it may be appropriate to exclude certain purchases if they are deemed "frivolous or luxurious". Closely related to this is the concept of an 'essentials' index. The idea is that certain commodities, such as food, fuel, and shelter, are vital to everyone's survival. People facing tough economic times can cut back on other items of spending, but remain exposed to inflation on essentials. ONS does not produce an essentials index, though others have; for example, Tullett Prebon (2013)

Any attempt by statistical institutions to define what is 'essential' would likely be widely questioned, although this problem is probably solvable. The Joseph Rowntree Foundation, for example, addressed this problem through a mix of expert knowledge and focus group research to agree on "a minimum socially acceptable standard of living" (JRF, 2013).

However, the strength of the ONS approach is that indices are weighted according to what people actually buy. This appears to be a much more defensible position for a widely used index than picking a set of essential items. Any household index would therefore follow CPIH in being based on the expenditure of households, not value judgements.

## 5.11 Forced quality change

Measures of consumer price statistics usually aim to measure "pure" price change. This means that price changes resulting from products becoming bigger, smaller, better or worse should not

contribute to the price index. This becomes an issue when a product is no longer available, and a replacement is needed. It also becomes an issue when the items in the basket are updated.

Leyland (2014, p10) argues that specification changes are sometimes forced upon the consumer. The examples given are of items whose specifications improve when new models are introduced, such as cars, televisions and computers. The improvement of the product often coincides with a price increase, or at least the prevention of a price fall, while the old, unimproved product often ceases to be available. The consumer has to buy the improved product, often at higher cost. The argument is that this could be regarded as inflation in an index for the purpose of maintaining standards.

Quality differences, and the procedures to deal with them, are discussed in detail in Chapter 12.  In summary, quality change arises as an issue in two ways in a consumer price index. Firstly, when an individual product is no longer available during the year, a replacement is sought. If the replacement is of comparable quality to the original, then the prices are compared directly. If not, a base price for the new product has to be estimated; ONS uses a range of techniques to do this.

Secondly, quality change also arises between years. ONS reviews the specifications of the items it collects prices for, to ensure they continue to be representative of what consumers are buying. It also changes some of the locations it collects prices from. This leads to some or all of the products being priced changing between years. This difference is removed from price indices by chain-linking.

One way of measuring this implicit quality change is to look at the difference between the average price paid for an item, and the movement of a chain-linked price index for the item. In these terms, Leyland argues that for some goods and services, a proportion of this difference is forced on the consumer, and should not be removed from the price index by quality change procedures.

Consider a case where a television is no longer available, and a replacement is selected. The new television has a high-definition screen and costs £300; the old one does not and costs £200. ONS guidance states that these two TV sets should not be compared directly. Under the procedures in CPIH, the difference in price between them would not affect the price index. The forced quality change approach suggests that, if the consumer was being forced to accept the high-definition television, then some or all of the change in cost should enter into the price index.

The first problem is that one has no idea whether the change has been forced or not. The same shop may sell a standard definition TV in a different size, or a different brand, or some other specification. Another shop may sell the same television.

One must also take into consideration that manufacturers and retailers have an incentive to provide products that people want to buy. If standard definition televisions do indeed cease to be available, it may be because there is little or no demand for them. It would be difficult to describe such a change as forced. It would also, in many cases, be extremely difficult to determine for certain whether a quality change had been forced or not.

Even if one could establish that a change in quality had been forced, should it be reflected in the price index? The guidance ONS develops is based on a judgement as to what the typical consumer values. If statisticians judge that a typical consumer would not regard the difference

between two products as a change in quality, the two products will be deemed comparable to each other.

To continue the earlier example, the fact that standard and high-definition televisions are deemed non-comparable reflects a judgement that consumers value the improvement. Even if the unimproved version is no longer available, the consumer is getting something they consider better for their money. It would be wrong to consider the two items as directly comparable.

The situation is slightly different with the small proportion of items that are hedonically adjusted, such as laptop and tablet computers. In these instances, a model is developed based on the characteristics of the item that determine its price, such as screen size, on-board storage or processor speed. New models replace old ones fairly rapidly. Implicitly, one makes the assumption that manufacturers and retailers are providing products that consumers want to buy. This assumption could be questioned. However, the alternative is not to not value the specification improvement at all. If a new tablet computer can store twice as much data, performs tasks more quickly, and has a better picture, it is surely unreasonable to ignore this when forming a price index.

The arguments are similar for changes to the specification of goods and services between years, and the way these are linked together. Consider TVs once again as an example. Since the 1990s, the specification for TVs given to price collectors has changed to reflect changes in the TVs available for sale. In the late 1990s, the specification for a small TV in the CPI was between 14" and 22" in size; in 2014, it is difficult to find a TV smaller than 19". It could be argued that consumers have been forced to buy larger televisions. But the only alternative would be to directly compare 14" TVs to 19" TVs, and ignore any difference in the benefit the consumer gets from having the larger television. Again, this does not seem reasonable.

In summary, the principle of forced quality change suggests that when an unimproved product is no longer available, the change in cost between the unimproved and improved products should be reflected in a household index. This would mean comparing two different products as if they were the same, and no benefit was derived from the improvement, which seems unreasonable. It would also be almost impossible to establish forced quality change in most situations.

## 5.12 Summary of the household index

In the preceding sections, we have considered the main differences between what a 'household' index might look like, and CPIH (identified in Chapter 4 as the best available main measure of inflation).

Such a measure would naturally take UK households as its reference population. CPIH uses UK domestic expenditure due to a combination of its heritage as an extension of the CPI, and to make use of the best available data. An index that took UK households as its coverage would currently need to use the Living Costs and Food Survey to weight the data, which would not make full use of the data on consumer spending available to ONS (see Chapter 11 for more details). Some of the difference between such a measure and CPIH would reflect the source of the data, not the

difference in concept. In practice, if consistent data were available, one would not expect there to be a measurable difference between an inflation measure based on spending by UK households and one based on spending in the UK, so big is the overlap between the two measures.

A household index could reflect the average experience of inflation of households, either by weighting by household (the democratic index), or by trimming a proportion of high and low earners. We can certainly see some value in producing such a measure. It answers a slightly different question to CPIH. It is not self-evident which of these would be more appropriate for compensating households; it would depend on what uprating was intended to achieve. All approaches to making such an index would also currently require the Living Costs and Food Survey to be the source of the weights, with the issues relating to this mentioned in the previous paragraph.

It could be argued that a household index should aim to measure the cost of maintaining the same standard of living, rather than purely changes in costs. This would lead to a Cost of Living Index (COLI), reflecting consumer substitution behaviour. At present, such measures would be experimental and can only be produced at a significant lag (see Chapter 7 for details), although this is a question that one might return to as the theory and data available develops.

The payments approach is an accepted way of producing a consumer price statistic. However, in our view such a measure is only appropriate when compared to a measure of household income that includes all sources of income. This would mean that, for example, changes in interest rates would be reflected both in the change in costs faced and incomes received by households. Uprating a payment such as salary or pension by a measure compiled using the payments approach would fail to include these other impacts on household living standards.

One could regard the inclusion of some or all of capital spending on houses as simply outside the scope of a consumer price index. Such payments are an investment that households can expect to get back, rather than consumption spending. While an increase in house prices represents a cost for some, the household sector as a whole becomes wealthier. Therefore, house prices should not be included in ONS's consumer price statistics.

A household measure should include all the goods and services that households buy to consume; no items should be excluded on the grounds that they are not essential. Excluding price changes due to quality change is a fundamental principle of consumer price statistics. The quality of a product is only considered to have improved in a consumer price statistic if it is judged that a typical consumer would value the improvement. It is unreasonable to seek to disregard these quality improvements when considering the change in price paid. Forced quality change should not be treated differently in a household index.

In summary, a measure of inflation experienced by UK households that sought to measure the average experience of UK households might meet some user needs. Such a measure could also follow the payments approach, but only if accompanied by a comparable measure of income. For this reason, it would be less appropriate as an uprating index than CPIH.

## 5.13 The household index and inflation for subgroups

Where the household approach can add value is in the analysis of inflation as it affects different groups of the population. UK households (and subgroups of them) would be the appropriate target population. Measures could use the payments approach to describe the costs (rather than the prices) faced by households.

If produced annually, these measures could be accompanied by comparable measures of income. This would ensure that changes in costs faced by households that also affect the income they receive – such as those caused by interest rate changes – would be fully reflected in the measure. The combined income and inflation measures would provide information on the changing standard of living of different types of households. This concept is discussed in detail in Chapter 6.

## 5.14 The value of one main measure of inflation

Having established that a measure of inflation experienced by UK households would differ from CPIH in some ways, this chapter now considers the question as to whether producing such a measure would best meet user needs.

There are distinct advantages in having a single, main measure of inflation. Firstly, the process of inflation adjustment is more transparent if all users reference the same rate of inflation. A company might both borrow money and receive income linked to inflation. The financial planning of such a company is eased if both debt and income use the same index; they are no longer exposed to the spread between inflation rates changing.  The same is true of households, as, for example, their rail fares or their mobile phone charges may rise in line with inflation. There is an advantage to their wage negotiations using the same measure.

This is true for policy-makers in government as well. The Bank of England sets interest rates in order to meet an inflation target over the medium term. Some inflationary pressures are directly linked to inflation; for example, state benefits are generally (but not currently) uprated in line with inflation. In some cases, the link is indirect; for example, pay negotiations are conducted in reference to pressures in the cost of living. Policy is more effective if all users reference the same rate of inflation; something which does not happen at the moment.

This leads to the second point: the current situation allows users to pick and choose the inflation rate that gives them the answer they want, rather than the measure most fit for purpose. For example, in 2014 RPI growth was higher than other measures of inflation, primarily because of the formula effect. A user might want to argue that a payment has increased in real terms, that is, after inflation has been taken into account. Using the RPI as the inflation measure will make the real terms increase smaller than it would otherwise be.

There is a public perception that Government engages in such 'inflation rate shopping'. In particular, there is a belief (see, for example, articles in The Guardian (2014) and The Telegraph (2011)) that when the Government is paying out money, the lower CPI is used, whilst the higher RPI measure is used when the Government is receiving money.

Such "inflation rate shopping" is highly undesirable and undermines public trust in the statistics. It is a reason for avoiding additional measures of inflation, unless these can be fully justified. It is also a reason for reducing the number of main measures of inflation if at all possible, as discussed in Chapter 4 of this report.

## 5.15 Conclusions

There are coherent arguments in favour of a "household" measure of inflation. But there are real practical difficulties in operationalising some aspects of this approach. More importantly there are conceptual problems with the idea of using the payments approach for the household population as a whole, especially if the "household" measure is to be considered synonymous with an "uprating" measure. There are additional risks associated with publishing more than one headline rate of inflation.

There does not seem a case, therefore, for publication of a single "household" measure of consumer price inflation alongside CPIH. However, measures of how inflation affects different groups of households would provide useful additional information to users. The available weights for such groups naturally support the payments approach, although there would be challenges in devising appropriate treatments for credit costs, house renovations and student tuition fees. Producing such a publication annually would allow income measures to be published alongside them, so that changes in costs that also affect income (such as interest rate changes) are fully reflected. This idea is developed further in Chapter 6 of this report.

Based on the currently available data, CPIH should remain the main measure of inflation. The measures discussed here and in Chapter 6 would be designed to supplement and support CPIH, not to challenge its primacy as the UK's main measure of consumer price inflation.

# 6. Measuring the inflation experience of individuals and groups

## 6.1 Introduction

We have, so far, considered measures of inflation for the population as a whole. Individuals and different groups of individuals will experience different levels of inflation depending on the goods and services they purchase. These differences can be significant and persistent. In this chapter we consider evidence on the extent to which different groups experience different rates of inflation and whether it might be useful to capture these different experiences in published inflation statistics.

## 6.2 Creating measures of inflation for subgroups

Any measure of consumer inflation seeks to be representative of its target population. The products and outlets chosen, and the prices collected, should be representative of what the target households are choosing and paying. These prices are weighted according to their share of total spending of the target population.  In CPIH, the prices, choice of goods and services and expenditure weights are all designed to be representative of all consumer spending in the UK.

This is necessary for producing an inflation measure for the whole economy, but is also relevant when producing indices that represent subgroups. An international comparisons program paper by Biggeri and Leoni (2010, p7) referred to this property of indices as *characteristicity*: the extent to which the items, prices and weights in the index are typical of the group the index is representing. Ideally, an index referring to a group should be based on weight information and prices that are specific to each group.

For example, pensioner households may purchase different goods and services to other households as a whole. Where they buy the same goods and services, they may purchase at a different level of quality. They are likely to buy goods and services in different quantities to households as a whole, and they may use different shops. They may even face different prices for some services, for example, they may receive a discount on some goods and services. By implication, producing indices that are fully representative of different groups of society would be very data intensive, and would involve a major expansion of price collection; this is not proposed here.

However, a broad approximation to these indices can be made using the existing collection of prices and tailored weights to reflect the group in question. In other words we can know broadly how much weight to give to the consumption of various items by different population groups, but we cannot – without very substantial additional data collection – know whether they are paying different amounts for those items. This is the method used by ONS's existing group indices

(outlined in Section 6.5) and the international group indices (discussed in Section 6.8) looked at in this review.

## 6.3 Differences between CPIH and measures of inflation for groups

When creating a group index measure, it is important to consider how it relates to the headline measure. A general aggregate measure of inflation - CPIH, and measures of inflation for groups might have differences in measurement depending on their construction. A lot of these differences echo those between CPIH and a 'household index' and have, therefore, been outlined in Chapter 5.  Indices for groups could be aggregated together to create a whole economy measure; the choice of aggregation method could also create differences when compared with CPIH.

### 6.3.1 Differences in sources

Group measures would have to use data on the actual spending patterns of the group, most likely based on a household diary survey, whereas CPIH uses National Accounts household expenditure.

National Accounts household expenditure information is comprehensive, and balances different sources to create the most accurate picture of aggregate consumer spending. It is, therefore, the preferred source for the expenditure weights of consumer price indices. However, as it is an aggregate measure, producing expenditure information for groups is impossible as there is no information about the distribution of spending amongst households. To obtain weights for a group of UK households it is necessary to use the Living Costs and Food Survey (LCF).

### 6.3.2 Differences in coverage

CPIH covers all consumer spending in the UK. That is, it excludes what UK residents spend abroad and includes foreign spending in the UK. An index covering a group of the UK population would ideally use the UK household concept - expenditure weights, products and prices that cover UK households' spending rather than all the spending in the UK. The coverage of CPIH and the group indices would therefore be slightly inconsistent.

### 6.3.3 Differences in definition

Inflation measures for groups might treat some types of expenditure differently to National Accounts (and therefore CPIH), particularly housing costs, but also second-hand cars and insurance. This depends on the objective of the measure. For example, in the National Accounts interest and insurance are treated as 'net' concepts, with transfers between households being excluded:

- Aggregate insurance premiums minus aggregate insurance pay outs are included in expenditure measures,

- Income in National Accounts includes interest income excluding interest paid.

This represents the collective experience of the household sector and is the appropriate treatment in an aggregate measure. However, households individually will pay the whole cost of interest and insurance.  This is reflected in how they are captured in LCF where the whole cost of both is recorded as expenditure. This is discussed in detail in Chapter 5.

Housing is a specific cost that might differ in measurement between aggregate and group indices. In aggregate indices, price changes are best measured using a rental equivalence approach. The payments approach could be used when measuring the changing costs facing particular groups of households. The payments approach includes the impact of mortgage interest rate changes. Measures that reflect this impact on the standard of living of renters, mortgagors and those that own their home outright are clearly of interest. Housing costs are discussed further in Chapter 9.

From a practical point of view, the payments approach may be the only way of measuring housing costs for groups. This is because if based on the LCF, ONS would not have the relevant data for rental equivalence. There are difficulties, however, in pricing structural repairs, which would be part of a full payments measure of owner occupier housing costs. It would also impact on the choice of an appropriate income measure to compare to.


### 6.3.4 Aggregation and Benchmarking

Groups could be defined in such a way that all households will fall into one of the groups; for example, income quintiles, or pensioner households compared with non-pensioner households. In these cases, a natural question to ask would be 'what would inflation be for all groups combined?'.

One possible answer would be "CPIH", as CPIH measures inflation as experienced by all households. However, differences in the sources, population coverage and definitions mean that the measure may not reconcile with CPIH. A measure of the household experience of inflation that includes gross payments is likely to be inappropriate if aggregated across the whole economy. It may also confuse users and impact on the primacy of CPIH.

One possibility would be for the weights based on expenditure patterns of groups from the LCF to be scaled to expenditure in National Accounts. Such a benchmarking procedure would allow estimates for groups to be aggregated in a way that yielded CPIH. ONS (2014b) tested such an approach on the CPI and a more detailed explanation is available in that paper. This is likely to be more difficult if the target is CPIH due to the inclusion of owner occupiers' housing costs following the rental equivalence approach.

## 6.4 Inflation measures for regions and countries of the UK

The approach for estimating inflation for different groups of households can also be applied to different regions and countries. What distinguishes regions and countries from other possible groups is that the location from which the price has been collected is known. Therefore, it should in theory be possible for regional price indices to be constructed that not only reflect differences in household spending patterns, but also reflect differences in regional price growth or price level over time.

ONS already produces Relative Regional Consumer Price Levels (RRCPLs) for the UK (ONS, 2011). These are produced every six years and show the difference in price levels, but not price change, within the regions.

From engagement with stakeholders, there has been some user interest in the production of regional consumer price statistics. For these indices to be robust, price collection may have to be altered as it is optimised for an aggregate UK measure of inflation. The RRCPLs, for example, are made using a supplementary data collection.  Sample sizes in some areas may need to be expanded as they may not be adequate.

As regional household expenditure estimates from National Accounts are not available, LCF would currently be the best source for the expenditure weights. The RRCPLs are weighted with LCF data smoothed over three years (ONS 2011, p6).  **Figure 6.1** shows the average number of households that respond to the LCF questionnaire annually, by country or region, over the years 2010 to 2012. The distribution of households sampled is based on the relative population of the areas. Some regions, particularly Northern Ireland and Wales, have a small sample to base an index on.

If ONS were to create robust, regular, regional price statistics, it would require additional resource. It is not clear whether the user need is strong enough to justify the cost.

**Figure 6.1: Average annual response to LCF by UK countries and regions, 2010-2012**

| Region / Country | Average annual number of sampled households |
|---|---:|
| England | 4,613 |
| North East | 267 |
| North West | 623 |
| Yorkshire & the Humber | 510 |
| East Midlands | 430 |
| West Midlands | 503 |
| East | 540 |
| London | 500 |
| South East | 740 |
| South West | 500 |
| Wales | 260 |
| Scotland | 483 |
| Northern Ireland | 160 |
| **United Kingdom** | **5,517** |

Source: Living Cost and Food Survey, ONS, 2013. Figures may not sum due to rounding

## 6.5 Other measures of inflation for groups

Currently, ONS produces some measures of inflation for groups. The RPI was the headline measure when these indices were developed and the household expenditure surveys were the most appropriate data source for weights. Therefore, these are currently on an RPI basis.

The Pensioner Indices measure inflation rates for pensioner households that are mainly dependent on the state pension (and are excluded from the RPI). This is separated into two measures depending on whether households consist of one or two pensioners. The Rossi Index was created to uprate state income-related benefits and, therefore, aims to show the inflation rate experienced by those in receipt of such benefits.

Both the Pensioner Indices and the Rossi Index exclude items that the target groups are unlikely to spend money on, for example: benefit recipients are expected to not have owner occupier housing

costs, whilst pensioners are expected to have free bus passes and TV licences. This is not proposed for the group measures discussed here. The expenditure of the group would determine what is included, rather than making judgements about what people in the target group do, or do not, purchase.

As they are based on RPI methodology these indices suffer from the problems associated with the RPI and should be discontinued in their present form, as is discussed in Chapter 4 of this report.

## 6.6 Empirical evidence

Work at the ONS carried out over the past year (ONS, 2014) has created indices for many different groups, comparable to the CPI for the period between 2002 and 2014.

**Figure 6.2: Inflation rates for households by expenditure quintile UK, 2003-2013**
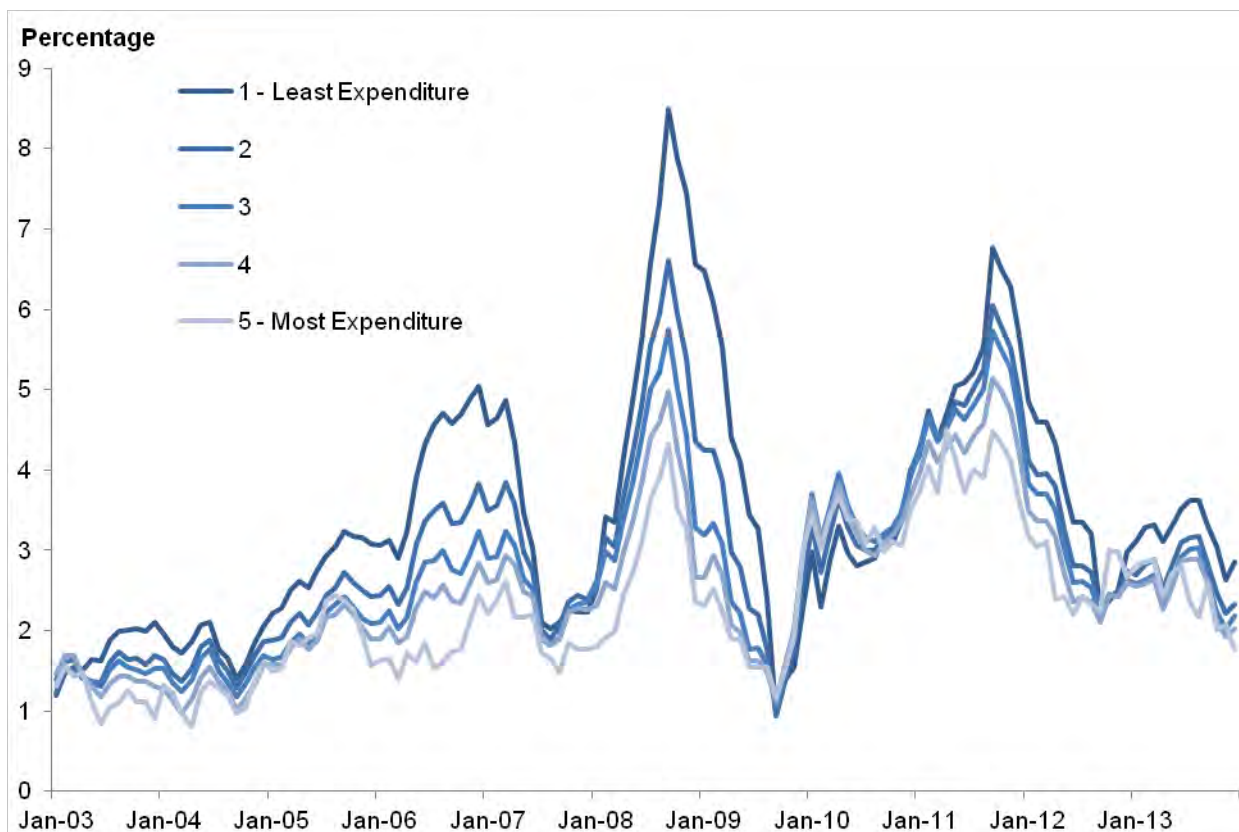


Source: ONS (2014)

**Figure 6.2** is based on the work in ONS (2014). It shows the inflation rates experienced by households split into equivalised expenditure[8] quintiles. If one ranks all the households in the UK by their equivalised expenditure, the list would start with the households that have spent the least in that year and finish with those that have spent the most. Splitting this list into quintiles yields five

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[8] Equivalised expenditure accounts for how many people the expenditure supports in the household.

groups, with the lowest quintile of households having the lowest expenditure in that year. These inflation rates have been benchmarked to be consistent with the CPI, and so do not include owner occupiers' housing costs.

In most years since 2003, the inflation experienced by households with low expenditure has been higher than that experienced by those with higher expenditure. This reflects the households' different expenditure patterns, with households in the lowest quintile spending proportionately more on food and energy than households in the higher expenditure quintiles. Food and energy prices have risen more quickly than other prices, leaving households at the bottom of the expenditure profile facing higher inflation than those at the top. In 2010, households in the higher expenditure quintiles tended to experience higher inflation because the largest price increases were seen in transport costs, such as cars and petrol, which made up a higher proportion of the budgets of higher expenditure households.

This pattern is much less marked when households are ranked by income rather than by expenditure, as illustrated in **Figure 6.3.**  This replicates the analysis of Figure 6.2, but shows the inflation rates experienced by the quintiles of households based on equivalised incomes. Similarly to expenditure groups, in most years, poorer households have experienced higher inflation than richer households. However, it is not always the case that low income households experience higher inflation than higher income households, as shown by the 2010 results.

**Figure 6.3: Inflation rates for households by income quintile, UK, 2003-2013**
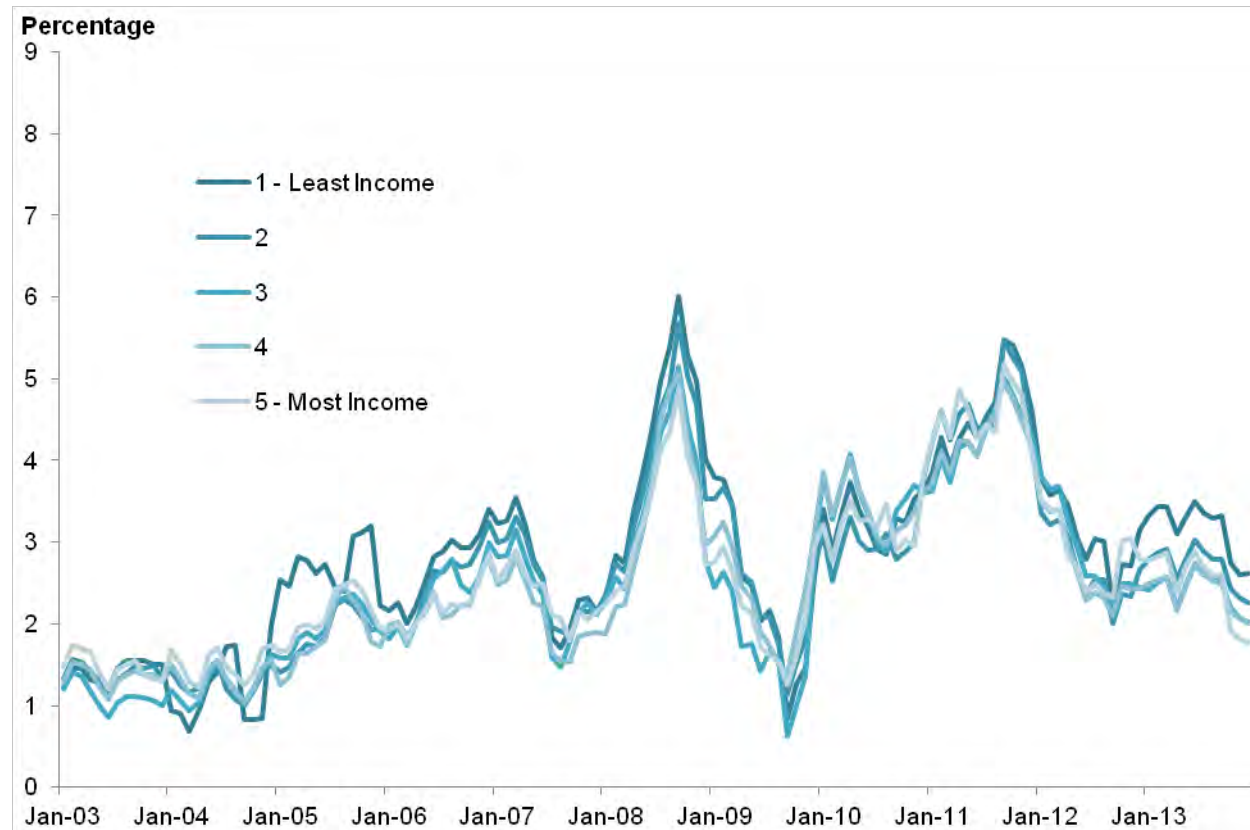


Source: ONS (2014)

These results are consistent with work carried out at the Institute for Fiscal Studies (2002, 2014), by Which? (2014) and by the New Economics Foundation (2014).

It is important to note that households are likely to move within the income distribution over time. Students, for example, are likely to have temporarily low income. This point is also made by Stephen Jenkins in *Changing Fortunes* (2011) through his work on income-age trajectories.

ONS (2014) also analysed inflation of households by whether they are renters, have mortgages or own their homes outright. This analysis includes mortgage interest payments as a cost and is therefore not consistent with the CPI, CPIH or the analyses in Figure 6.2 and 6.3. **Figure 6.4** shows how inflation experience of these households differs over the period if mortgage interest payments are taken into account. Unlike Figure 6.2 and 6.3, these series are not benchmarked to the CPI and so uses UK household expenditure and gross payments (including transfers to households).

**Figure 6.4: Inflation rates for households with mortgages, renters and outright owners UK, 2003-2013**
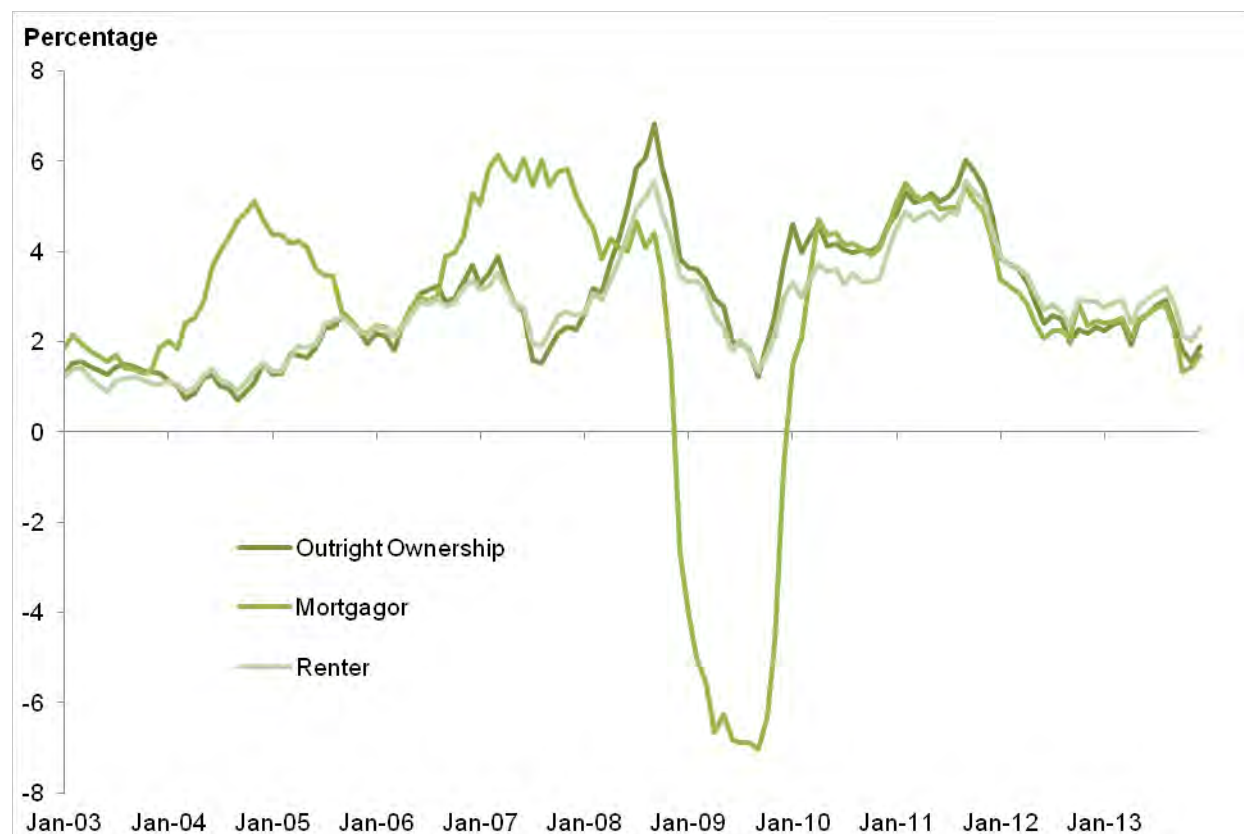


Source: ONS (2014)

As discussed in Section 6.3.3, simply including the cost of mortgage interest payments does not reflect all price rises experienced by consumers. Other costs of credit, such as loan interest repayments, are not included but will also affect the costs faced by households over the period.

Interest rates would also be contributing to household incomes. This analysis therefore does not show the full impact of changing interest rates on households.

## 6.7 Use of subgroup indices

Subgroup indices can be used to highlight differences between the changing costs faced by different groups of households and are useful for understanding the cost pressures these households face. However, there is an issue with interpreting these measures if the gross payments approach has been used.

This is well illustrated by the home ownership example in section 6.6. It demonstrates how different households are affected by changes in interest rates on mortgages. But it doesn't show the impact of changes of other costs of borrowing, nor does it reflect the fact that households with savings receive more income when interest rates rise.

Ideally, gross payment measures should be presented alongside gross income measures, so the full impact of such changes are captured. Users of gross payments measures would need to be aware of this, if using the inflation measures without the compatible income measures.

As discussed in Section 6.3.4, an alternative would be to benchmark the weights so they reconciled with an overall measure of inflation, such as CPI or CPIH. However, such measures would be different conceptually and may not be as useful for understanding the costs that households face.

## 6.8 International Analyses

The Australian Bureau of Statistics (ABS) produces a range of group inflation measures called the Selected Living Cost Indices (SLCIs) (ABS, 2014). These cover four specific groups: employee households, age pensioner households, other government transfer recipient households and self funded retiree households. ABS also publishes the Pensioner and Beneficiary Living Cost Index (PBLCI), which combines pensioner households and other government transfer recipient households. These are produced quarterly and are not combined to make an aggregate figure.

The PBLCI is currently used in the uprating of Australian pensions and benefits. The benefits are indexed to the higher of the PBLCI and the CPI. This was introduced as the SLCIs were designed to check whether beneficiaries' disposable incomes have kept pace with price changes. This 'double lock' of PBLCI and the CPI will be removed, as stated in the 2014-2015 Australian Budget (Klapdor, 2014), in which it was decided that indexing rates to the CPI maintains their real value over time.

Statistics New Zealand is currently developing inflation rates for household groups (SNZ, 2013). These will comprise of a suite of eight household living-costs price indexes (HLPIs). These will be for five income quintiles and three further groups: beneficiaries (those in receipt of state benefits),

Māori and superannuitants (those in receipt of a pension). The HLPIs will be released in early 2016 and were developed to provide greater insight into the inflation that these groups of households experience.

## 6.9 Conclusions

Different population groups experience different rates of inflation depending on what they buy. Measures that show these differences can be constructed from existing data. These can be used for understanding what is happening to living standards for different groups.

There is a strong case for ONS to produce subgroup indices. This would be best done annually and in conjunction with appropriately comparable income figures. Its precise content should be the subject of consultation. The publication could also include an analytical Cost of Living Index (see Chapter 7) and other indices that improve the understanding of how inflation affects different households.

**ONS should develop an annual analytical publication that produces inflation indices as experienced by a range of different household types, along with appropriate advice on what income measures these analytical indices can be compared to.**

# 7. Consumer price indices and Cost of Living Indices

## 7.1 Introduction

The UK, along with almost all other countries, produces consumer price statistics that measure the increase in the price of a representative basket of goods and services. They capture the change in the price of consuming that basket of goods. They do not measure the change in the cost to consumers of achieving the same level of welfare, something consumers might do by substituting their spending towards goods and services which have become relatively cheaper.

The Cost of Living concept provides a framework for allowing for this substitution behaviour in consumer price statistics. Such measures seek to answer the question: "How much more do households have to spend on consumer goods and services to attain the same standard of living as a year ago?"

The Cost of Living concept has a specific meaning in economic and price index theory. This can be confusing, as the term "cost of living" is widely used in the media and elsewhere when discussing the inflation measures published by ONS, despite the fact that they are not Cost of Living measures. This chapter refers to the Cost of Living concept using capital letters to signal this distinction.

This chapter discusses the Cost of Living concept and how it differs from measures currently produced by ONS. It discusses the practical issues that would arise when producing an approximate Cost of Living Index. It reports on research work carried out into the main differences between what ONS produces and a Cost of Living Index. It concludes by considering the merits of producing a Cost of Living Index.

## 7.2 Cost of Goods Indices, Cost of Living Indices and current consumer price statistics

The traditional approach to calculating a consumer price index is to choose a representative basket of goods and services. The contents of the basket are then fixed for a period of time, as are the relative expenditure shares of these goods and services. Prices of these goods and services are collected every month, and price indices are calculated at the upper levels using a base-weighted average of price relatives. This is known as a **fixed basket** or **Cost of Goods** approach. A measure produced following this method is called a **Cost of Goods Index** or **COGI**. Despite the name, services are also included in a Cost of Goods approach.

A pure Cost of Goods measure would hold the representative basket fixed over time. In a dynamic economy, the goods and services on offer change, as do consumer preferences and relative prices. A pure Cost of Goods measure would miss all these changes, steadily becoming less relevant over time. Such a measure would not be useful for most users.

As a result, statistical agencies do not produce pure Cost of Goods measures, but rather make a series of adaptations. To ensure the index remains relevant, both the commodities in the basket and the relative expenditures on these items are adjusted annually in the UK. Quality adjustment procedures (see Chapter 12) are used to deal with products that are no longer available.

An alternative approach is the **Cost of Living** approach. This is designed to take account of changing behaviour by consumers within years. For example, if the price of apples doubles and the price of pears remains the same, consumers might not simply carry on buying the same quantity of apples; they might buy fewer apples and more pears, thus adapting their spending patterns to maximise their welfare in the face of changing relative prices.

A **Cost of Living Index (COLI)** can be defined as the ratio of the minimum expenditure needed to reach a reference standard of living in the current period, and the minimum spend required to reach the same standard of living in the base period. A COLI can be thought of as answering the question: "how much more do households have to spend on consumer goods and services to attain the same standard of living as a year ago?"

This approach does not require the goods and services to be the same between the two time periods. It considers all the possible collections of commodities that would achieve the reference standard of living and selects the combination that is lowest in cost. In this approach, prices and quantities are not independent. Prices are imposed on consumers who respond by adjusting the quantities of goods and services that they buy.

## 7.3 How a COLI would differ from the UK's current consumer price statistics

In theory, a COLI could include all factors that affect the standard of living, not just purchased goods and services. For example, reduced pollution and improvements in health care both increase an individual's overall standard of living, meaning that the individual has to spend less money to maintain their overall standard of living. This makes aiming for a COLI very difficult in practice. Instead, statisticians calculate a *conditional* COLI, by holding these environmental and societal effects constant.

A COLI allows for the combination of goods and services purchased by households to change within each year. In a COLI, consumers are assumed to *substitute* towards goods and services that are increasing in price more slowly (or falling in price) and substitute away from goods and services where prices are rising quickly. The different forms of consumer substitution are described in **Box 7.1**.

**Box 7.1: Forms of substitution in a Cost of Living index**

There are several ways in which consumers might substitute in order to maximise their standard of living at a given level of income.

- **Upper-level substitution (between items):** Consumers switch between goods and services, towards those that are becoming relatively cheaper. This can be to a similar product (between apples and pears), or something very different (apples to tablet computers).

- **Lower-level substitution (within items):** Consumers switch between varieties of the same item, for example between Royal Gala and Golden Delicious apples.

- **Outlet substitution (between shops):** Consumers switch between shops or types of shop – for example, corner shop to supermarket, or high street to internet.

In a COGI, the quantities purchased are assumed to remain constant through the year. This is also true of the consumer price statistics published by ONS and the headline measures of other statistical institutes. Such measures do not reflect within-year substitution by households. Put in COLI terms, the current consumer price statistics assume that consumers do not substitute at all in response to price change between updates to the basket of goods and services.

The natural outcome of this is that COLI measures would show lower increases in inflation than both pure COGI measures and the ONS's current consumer price statistics, all other things being equal. This makes intuitive sense; if consumers are assumed not to change what they buy as prices rise, they are exposed to the full impact of those rises. The COLI measure assumes that consumers switch to goods and services that are increasing in price less rapidly, which mitigates the impact of rising costs.

The comparison of the two approaches has been discussed widely in the literature (for example, Triplett, 1999). Advocates of the COLI approach note that the COLI concept has a foundation in economic theory and accommodates the real world effect of substitution in response to relative price change. It can also offer guidance on aspects of index construction.

Opponents point out that it is a theoretical index and it cannot be easily calculated in practice. As described in the following section, the methods that do exist can currently only be employed at a lag of several years, making the index unsuitable for many uses. It also requires some quite strong assumptions about consumer behaviour that may not hold in practice. In addition to this, it is less easy to explain than the fixed basket approach used by ONS and most other countries.

## 7.4 Calculating a Cost of Living Index in practice

The major drawback of a COLI is that it relies on measuring individuals' standards of living. This depends on how much *utility* they derive from the goods and services they consume. This utility cannot be measured directly. The challenge has been to devise means to estimate a COLI indirectly. As set out by Bruer and Von Der Lippe (2011), three approaches to applying the concept in practice have been developed:

- Laspeyres and Paasche indices (see **Box 7.2**) can be shown to provide upper and lower bounds to (an unknown) Cost of Living Index under normal economic conditions.
- A demand systems approach, which uses econometric analysis to derive cost functions.
- The superlative index approach of Diewert.

The first approach is important in that it links the COLI to the established Laspeyres and Paasche indices. However, it does not in itself produce a single, defined, Cost of Living Index. The second approach is complex, requiring a significant amount of econometric analysis and is unlikely ever to produce uncontroversial answers. The third approach only requires the application of a different index number formula (see Box 7.2). As always, a number of assumptions are required and there is no one superlative index, rather a family of them.

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**Box 7.2: Base weighted, current weighted and symmetric indices**

All consumer price statistics are weighted combinations of price changes between the base period (period 0) and current period (period 1), where the weights are shares of expenditure:

- A **Laspeyres** index is a weighted arithmetic average of price change, where the weights are the expenditure shares in the <u>base</u> period (period 0).
- A **Lowe** index is a weighted arithmetic average of price change, where the weights are the expenditure shares in some other period b (usually before period 0), price updated to account for price changes between period b and period 0.
- A **Paasche** index is a weighted harmonic mean of price change, where the weights are the expenditure shares in the <u>current</u> period (period 1).

This chapter discusses two superlative index number formulae: the Fisher and Törnqvist indices. They are also both symmetric indices, in that they give equal weight to expenditure shares in the current and base periods:

- A **Fisher** index is formed by multiplying the Laspeyres and Paasche indices together, then taking the square root of the result. It is a geometric average of a base-weighted index (the Laspeyres) and a current-weighted index (the Paasche).
- A **Törnqvist** index is a weighted geometric average of price relatives, where the weights are the arithmetic average of expenditure shares in the base period (period 0) and the current period (period 1).

This chapter also refers to the geometric Laspeyres index:

- A **geometric Laspeyres** index is a weighted geometric average of price relatives, where the weights are the expenditure shares in the <u>base</u> period (period 0).

The mathematical formulae for all these index numbers can be found at Annex C of this report.

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Unlike the demand systems approach, the superlative approach is possible in practice. Diewert (1976) showed that a class of price indices "closely" approximated a COLI under certain circumstances. This was an important development as it opened the way to approximating a COLI without the need for complex demand systems analysis. Such indices were termed **superlative indices** by Diewert. This development meant that a statistical institute could use the price and weighting information used for traditional price indices to approximate a COLI.

There is a question over which superlative index to adopt, as different superlative index formulae have different strengths. The two most common superlative index number formulae, both in the literature and in use by statistical institutes, are the Fisher and Törnqvist indices. These indices are described in Box 7.2, and the formulae can be found in Annex C.

It was initially expected that different superlative indices would in practice produce very similar results (see ILO, 2004, Chapter 17). However, more recent analysis summarised by Hill (2006) has shown that this is not true, although the commonly used superlative indices (including the Fisher and Törnqvist) produce results that do not differ by much.

Both the Fisher and the Törnqvist indices, and indeed all superlative indices, use a combination of base and current period weights. The indices produced by ONS use base-weighted index number formulae.

Weights are available around two years after the prices have been observed, because expenditure data takes much longer to collect than price data. This means that a superlative index can currently be produced only at a significant time lag. The availability of alternative sources of data, such as scanner data, may make weighting information available much more quickly in the future. However, until such data are available to ONS, the lags involved mean that a superlative index will not be timely enough for most users of consumer price statistics.


## 7.5 The assumptions made in a Cost of Living Index

As explained in Section 7.2, the Cost of Living approach (COLI) is a ratio of minimum costs required to attain the same utility under two different price regimes. Therefore, the theoretical COLI requires some quite strong assumptions about the behaviour of consumers. It is assumed that:

- Consumers have information on the prices of all the goods and services they might want to purchase;
- Consumers have set preferences and budgets, meaning that they change their consumption decisions solely in response to changing relative prices and not due to changing tastes or quality.

These assumptions are necessary as in a COLI it is utility, or the standard of living attained, that is being held constant. This theoretically allows the basket of goods and services and expenditure weights, to vary during the year as consumers' purchasing decisions change. If these assumptions were not true, it could be that the change in purchasing decisions is because they were not aware of better prices on offer, or because their tastes had changed, and therefore the index would no longer be comparing like-with-like.

A superlative index, as explained in Section 7.4, can be used to approximate a COLI if further assumptions are made, including:

– Consumers have *homothetic preferences*. This assumes that the preferences of individual households do not change as their incomes change.

Put another way, this means if a household's income increases, they choose to spend that money on the same goods and services, in the same proportions, as they did with their previous income. This is another way of ensuring that the index compares like-with-like and that consumption can be used to approximate utility.

In practice, these assumptions have implications for the use of Cost of Living Indices. Consider the example of state benefits. Uprating benefits in line with a measure that captures substitution behaviour would compensate recipients of these benefits depending on how what they buy and where they buy it varies within the year. This assumes that the recipients have changed their buying habits in order to maintain the same standard of living at the lowest possible price. This is unlikely to be true.

If these benefits were uprated in line with the CPI, the assumption would be that providers want the recipient's benefits to change consistently with how much the cost of a fixed basket of goods and services has changed. This would imply that the recipients have not changed their purchases in response to price changes within years. This is also unlikely to be true, but may be more defensible.

The COLI would lead to a lower value for inflation and would be a very controversial change. The consideration of whether such a move is appropriate is partly a political issue and would need to be discussed in a wider forum.

## 7.6 Use of Cost of Living Indices in other countries

The USA has gone furthest in using the Cost of Living framework in consumer price statistics. Two influential reviews of the US CPI have taken place since 1960: the Stigler Commission, which was convened in 1961 to examine the measurement of inflation in the US, and the Boskin Commission in 1996. Both reports advocated moving to a COLI target for the US CPI. Following the Boskin report, the US Bureau of Labor Statistics (BLS) adopted the Cost of Living conceptual framework. Starting in July 2002, the BLS produced an experimental, retrospective, superlative index using a chained Törnqvist formula.

However, although the BLS has produced this chained Törnqvist index for over a decade, it is not actually used for any official purpose. The Boskin Commission report noted the significant implications of switching to a Cost of Living measure for US federal finances. This topic has been revisited a number of times. For example, a recent report presented to the Congressional Budget Office (King, 2013) examined what would happen if the US Törnqvist index were to be used for social security and tax allowances; the financial implications would be very significant. A note from the Congressional Budget Office (CBO, 2014) showed that using the chained Törnqvist index for mandatory programmes and the tax code would yield a saving of $216bn between 2014 and 2023.

Most other countries have not followed the US in making a Cost of Living Index the target of their inflation measure. Some of this reluctance is because of the difficulty in obtaining timely current weights, as described in Section 7.4. The necessary assumptions about consumer behaviour described in Section 7.5 may also be a factor.

Perhaps with these issues in mind, Eurostat explicitly states that the HICP, and therefore by extension the UK CPI and CPIH measures, are "pure price indices" and not Cost of Living Indices (see Eurostat, 2014). Nevertheless, some other countries have produced retrospective superlative indices; including Australia (see Bishop, 2013) and New Zealand (see Statistics New Zealand, 2011). In both cases, these have been produced for the purpose of estimating the impact of consumers substituting between different areas of spending. As with the US, we are not aware of these superlative versions being used in an official capacity.

## 7.7 Calculating a superlative index for the UK

ONS has calculated an approximate superlative index for the UK using the Törnqvist formula for the years 2007 to 2009 (see ONS, 2014). In Box 7.1, three types of substitution behaviour were set out. As discussed in Section 7.4, to be able to calculate a superlative index which (subject to certain assumptions) reflects this substitution behaviour, weights are needed for both the base and current periods.

Lower level substitution (within items) refers to substitution between different, but similar products. In the ONS's consumer price statistics, this occurs at the elementary aggregate level; for example, between different brands of bottled lager. However, at this level, no weighting data are available, so a superlative index cannot be calculated. Chapter 10 discusses in detail how some unweighted index number formulae have been described as representing substitution behaviour. However, the empirical evidence for this is not strong. The superlative index calculated by ONS retains the unweighted averages used in the CPI.

Substitution between outlets would also in part be reflected at the elementary aggregate level, if weights were available and an appropriate index number formula was used. This reflects the fact that price quotes for similar products come from different stores. The other dimension to outlet substitution is between types of outlet. Substitution between independent and chain stores would, in principle, be reflected by the superlative index calculated by ONS. However, the shop-type weights have been fixed since 2006 and so in practice, such substitution is not accounted for. This means that substitution between different items in the basket is the only element of substitution reflected by the index produced by ONS.

In a monthly superlative index, the base period weights would refer to the price base period (January in the year) while the current period weights would refer to the current month. In practice ONS does not have monthly weights, only annual weights. Therefore, the index calculated combines the weights closest to the price base period with the following year.

## 7.8 Empirical results

One of the approximate superlative indices calculated by ONS for this review is shown in **Figure 7.1**. The graphs show the expected result; based on locally-collected price data, a measure of inflation that reflects consumer substitution between different goods and services (the Törnqvist index here) shows a lower rate of increase than the current measure (using the Lowe index).

**Figure 7.1: Comparison of CPI (Lowe) and superlative (Törnqvist) indices, 2007-2009**
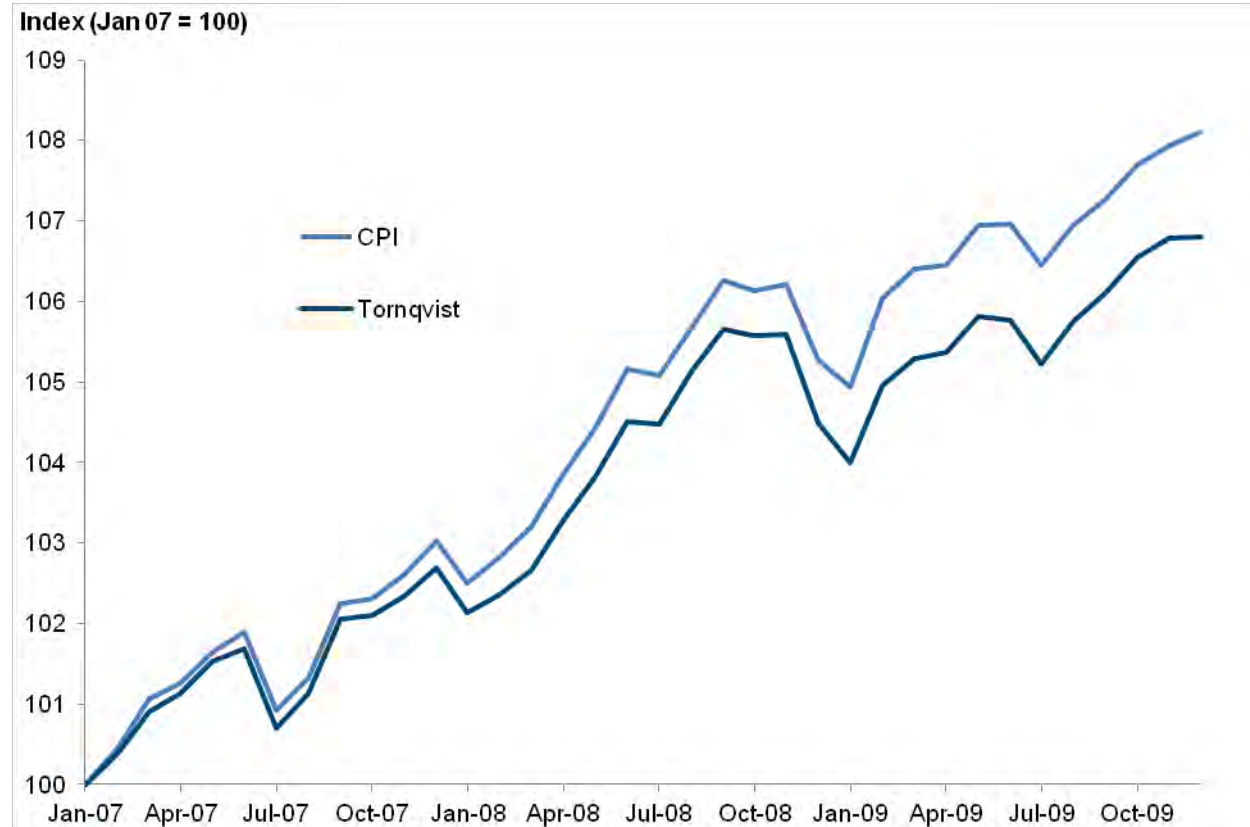


Source: ONS (2014). Based on locally collected price data only

**Figure 7.2** shows the difference in the inflation rate (annual percentage change) reported by the two indices. Over this period, the difference varies between around 0.3 to 0.6 percentage points per year, during a period when the locally collected CPI measure showed an average of 2.6 per cent annual growth.

**Figure 7.2: Difference between CPI (Lowe) and Törnqvist annual growth rates, 2008-2009**
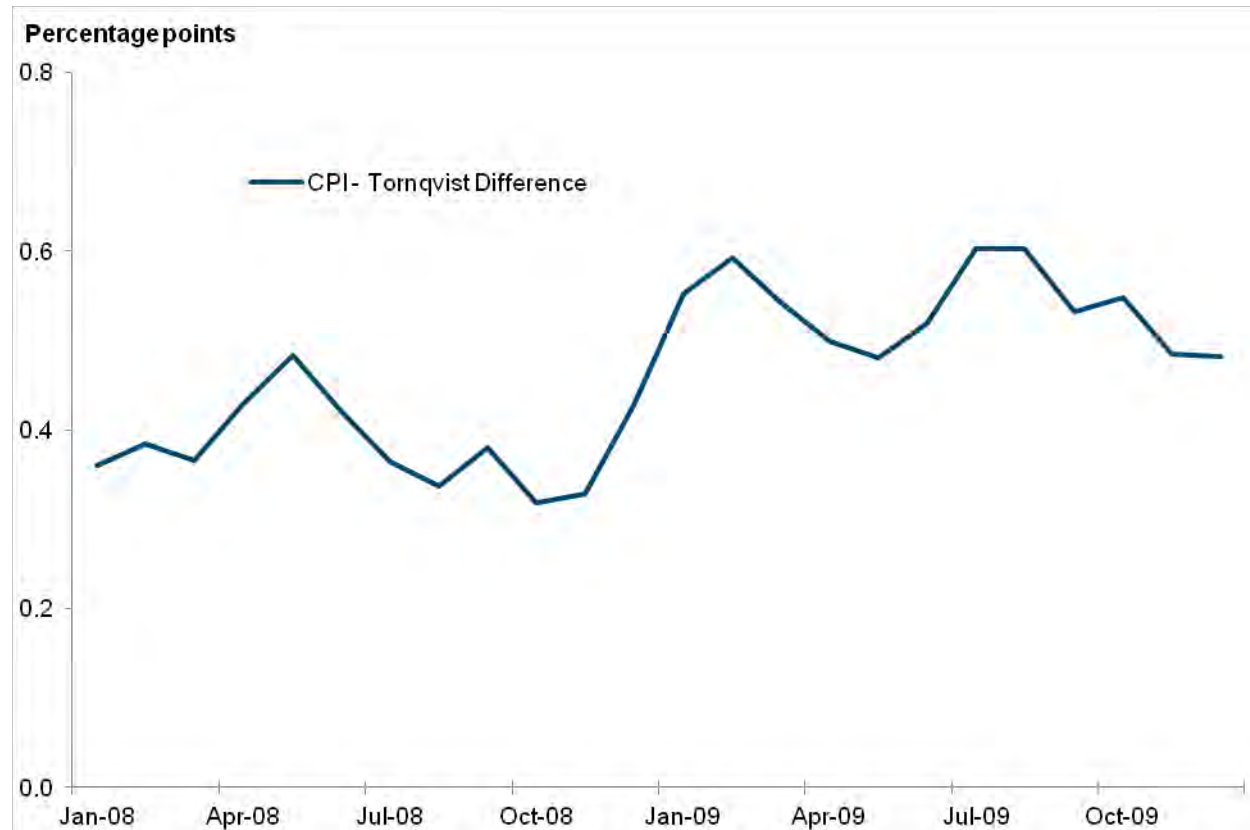


Source: ONS (2014). Based on locally collected price data only

ONS (2014) found that the difference between its superlative index and the CPI was larger than that found by other countries that have produced superlative indices. This arises because ONS has applied the superlative index number formula down to the item level. The approximate COLI measures produced by other countries have typically applied the superlative index formula only at the higher stages of aggregation. This limits the extent to which changes in spending patterns are captured by the indices produced by other countries.

## 7.9 Symmetric price indices and the COLI

The preceding sections have discussed the use of certain index number formulae – the superlative indices – on the grounds that they better capture the substitution behaviour of consumers. However, there is a school of thought that advocates such index number formulae for a different reason – because they are **symmetric**. A symmetric index is simply one that gives equal weight to the current and base period baskets of goods and services. All superlative indices are symmetric.

The ILO CPI Manual (2004, Chapter 15, pp 266-8) argues for symmetric indices by starting from the Laspeyres and Paasche indices. One can calculate the price changes of the basket of goods and services bought in the base period (a Laspeyres) or the current period basket (a Paasche). Both, the Manual argues, are equally valid, but the two give different results.

The Manual goes on to assert that the most defensible approach is to take some equally-weighted average of the two baskets, giving rise to the symmetric indices. For example, one could take a geometric average of the Paasche and Laspeyres indices to obtain a symmetric index. This is, in fact, the Fisher index. The Törnqvist index can similarly be derived as a combination of base and current period index numbers.

Advocates of the symmetric approach argue that such indices have a wide range of advantages over the Lowe indices calculated by most countries. These include the substitution arguments set out earlier in this chapter. Such indices also perform better than the base-weighted indices currently in use against tests (See ILO 2004, Chapter 16) that set out desirable properties for weighted price indices.  They also have support from the stochastic approach (Diewert, 2013).

Symmetric indices are answering a different question to the base weighted indices used by ONS and other statistical institutes. The general question is "how much more would it cost to buy an average of the current and base period baskets now than in the base period?"

The main practical problem with a superlative index still applies to symmetric indices. A symmetric index needs current period weights. These are currently only available at a considerable lag, though if scanner data become more widely available this may change.

A current area of research is whether base-weighted indices, such as the geometric Laspeyres (see Box 7.2), can approximate symmetric indices. ONS (2014) considers this question in the context of the data between 2007 and 2009 used to calculate the superlative index discussed in Section 7.7. The findings are inconclusive. The geometric variants calculated by ONS were quite close to the Törnqvist across all locally collected items. However, they found substantial differences in the measured price change in different areas of expenditure.

Symmetric indices will also tend to give lower results than base-weighted indices such as the CPI and CPIH, for the reasons discussed earlier around substitution behaviour. Adopting a symmetric index (or a base-weighted approximation of one) would be, at least in part, a political judgement.

## 7.10 Conclusions

One of the terms of reference of the review was to consider the Cost of Goods and Cost of Living concepts. The UK's current consumer price statistics already depart substantially from a pure cost of goods approach, in that the basket of goods and services and weights change annually to keep them relevant, and include procedures that account for differences in quality. These features are also part of the Cost of Living concept.

The main remaining difference between current consumer price statistics and a Cost of Living Index is the choice of formula used. In terms of the Cost of Living framework, a formula such as the Törnqvist would capture the impact of consumers substituting between items to maximise their standard of living. There is also broader theoretical support for using such formulae.

Whatever the justification, such an index could currently be produced only at a considerable time lag; this would prevent it being used for operational purposes. The current lack of weighting data at the level of individual products means that a superlative index can only approximate substitution behaviour at the item level and above. Without significant new data sources (such as Scanner data), and a restructuring of consumer price statistics, the best the COLI approach can provide is a lagged estimate of the impact of substituting between items on inflation. The absence of monthly weights means the index is only an approximation of a true superlative index.

That said, there is clear value in publishing a COLI. The ONS should extend current research and should produce a full estimate of CPIH using a superlative index number formula. The difference between this and the main CPIH could be interpreted by users in a number of ways. One of these would be an estimate (subject to suitable economic assumptions) of the impact of consumers substituting between different items on the inflation they experience. Alternatively, it could be seen as showing the impact of an index number formula which uses a symmetric index, considered by some to be superior to base-weighted indices. ONS should continue to develop this measure over time, through its own research and by keeping abreast of international developments.

**ONS should continue its research on producing an experimental superlative index for the UK and should aim to publish such an index annually in arrears once that work is complete and has been fully quality assured.**

# 8. Alternative sources of data for consumer price statistics

## 8.1 Introduction

As discussed elsewhere in this report, ONS obtains the majority of its price data from a field force of price collectors visiting shops around the UK. While this has been augmented by the use of hand-held computers, the approach is essentially the same as that taken in the 1950s. It is perhaps not unreasonable to ask, in the modern information age, whether it is possible to improve upon this.

The single most significant source of data used to weight consumer price statistics remains the Living Costs and Food Survey (LCF), a pen-and-paper diary of household spending. Information from the LCF is a key input into the National Accounts, which is used as the source of weights in the CPI. Even so, the weighting information ONS is able to get from the LCF cannot provide the very detailed information needed to weight price quotes for similar products from different shops. Often, ONS has to fall back on not weighting the data at all. Again, one might wonder if it is possible to do better.

There are alternative sources of price and expenditure data which have the potential to greatly improve the quality of consumer price statistics. But before these sources can be used operationally, there are some significant challenges for ONS to overcome. These are challenges being faced by other national statistical institutes as well, and there is the potential to learn from their experiences.

The three alternative sources are:

- **Shop scanner data**: transaction data collected by retailers at the point of sale.
- **Web scraping**: prices collected from web sites by automatic and semi-automatic tools.
- **Consumer panel data**: transaction and demographic data collected by shoppers using mobile scanners.

The following sections describe these three sources in detail. We then discuss the recent progress ONS has made in looking at alternative data sources, and consider some of the major challenges ONS faces in making more use of these data sources.

## 8.2 Shop scanner data

Most large shops are equipped with a barcode scanning system. When a customer wants to purchase a product from a store, the cashier (or, increasingly, the customer themselves) scans the barcode of the product. As well as generating the information needed to charge the customer the

right amount, the system also keeps a record of what products are sold, at what price, and in what quantities.

Across all transactions, this generates a large and very rich database of price and quantity information. Scanner systems are not the only way in which such databases are created; for example, individual rail ticket sales are compiled into a central database in much the same way. Data from loyalty schemes (such as those operated by some of the major supermarkets) could also be considered as scanner data, and might additionally contain information on the purchaser.

Scanner data can potentially address many of the difficult issues with consumer price statistics. The quantity information that is collected can be used to weight the price data, even at the very detailed levels where weights are currently unavailable. Scanner data can be used to calculate the average price paid per item (sometimes called the **unit price**), which takes into account discounts offered to customers.

Perhaps most intriguingly, the detailed price and quantity information means one can construct indices that reflect how consumers adapt their purchasing habits when prices change, for example, the extent to which they stock up on products on sale. As the weight and price data are available at the same time, this would make it possible to produce superlative indices (see Chapter 7), such as the Törnqvist index, in a timely manner. Such indices can approximate consumers substituting between similar products.

However, shop scanner data are not without challenges. One of these is obtaining the data in the first place; in the UK, retailers have been reluctant to provide their data. Other major challenges include making judgments about what exact products are comparable, dealing with product turnover, and exploiting the weighting information correctly.

Despite these challenges, many countries already make some use of shop scanner data in their consumer price statistics. These include the Netherlands, Sweden, Norway, and Switzerland in Europe, as well as Australia and New Zealand. In this sense, the UK is behind the frontier in making use of these kinds of data.

## 8.3 Web scraping

Web scraping is the process of using automated and semi-automated tools to collect price information from web sites. These tools are first configured to work with a particular web site. Prices and item descriptions for individual products at specified intervals are then lifted from the web site. This can be done at intervals specified by the user.

This is the technique used by price comparison sites. It is also the method used by the Billion Prices Project and PriceStats (see **Box 8.1**) to produce estimates of inflation for various countries around the world.

**Box 8.1: The Billion Prices Project and PriceStats**

The Billion Prices Project is an academic research project set up by the Massachusetts Institute of Technology (MIT). The price indices it produces are based on prices scraped from the websites of online retailers, in combination with official weighting information. In 2011, PriceStats was launched to produce these statistics on a commercial basis. PriceStats produces inflation measures for many countries around the world, including the UK.

PriceStats collects daily prices from thousands of online retailers around the world using web scraping technology, favouring those with large market shares that sell offline as well as online. The data are processed into a consistent format and then quality assured.

As the data are based solely on prices available on the internet, the measures produced by PriceStats are not a full picture of consumer inflation. There are also limits to the coverage; in particular, many services are outside the scope of the indices as they are not available online.

Web scraping is an alternative way of collecting price information for individual products. Current price data collection is resource-intensive. Local data collection is carried out by a field force of price collectors at around 140 locations around the UK, while central data collection consists of ONS visiting web sites and finding the price of a particular product of interest. Automating these tasks makes it possible to capture prices for a much broader range of products, potentially at significantly lower cost.

The main limitation of data scraped from the internet is that only prices are collected; ONS would still need information from other sources to weight its consumer price statistics. It would also be wrong to think of the process as fully automated. Web scrapers need to be adapted to individual web sites. If companies change their website, it can cause the scraper to fail, which can lead to prices not being collected until the scraper is adapted to the new web site. Scrapers need to be supported with tools that identify changes in products to determine whether the old and new products are sufficiently similar that they can be compared directly.

The Netherlands has experimented with the use of web scrapers for several types of products, but have not yet introduced scraped data into their own CPI. We are not aware of any countries currently using web scraped data in the production of their consumer price statistics.

## 8.4 Consumer panel data

Consumer panel data is a form of data collection set up by market research companies. Members of the public volunteer to provide data on their shopping using a barcode scanner so that the market research company knows precisely what products they have purchased. Records are also kept for items without barcodes. The volunteer may also provide a digital image of their receipts.

Consumer panel data collected by market researchers is usually limited in scope. For example, the ShopandScan programme run by Kantar Worldpanel focuses on groceries and, to a lesser extent, clothing.

As with shop scanner data, both the price paid and the quantity purchased are captured. This means that consumer panel data can be used to produce detailed weights or to calculate unit prices for products. Consumer panel data also involves information about the consumer being collected. Such information could be used to produce indices that reflected not just the different spending priorities of different groups, but also the different choices they make about which stores they visit and the quality of the items they buy.

However, it is much more difficult to track the price of an individual product through time using consumer panel data. This is because one is dependent on what members of the panel choose to buy. One would have to use broader item groupings to make comparisons over time. This tends to mean that consumer panel data are used for research (as already is the case in the ONS), rather than producing consumer price statistics.

Consumer panel surveys are not based on statistical random sampling. Panellists volunteer, meaning that they are composed of people who are willing to spend time completing a relatively burdensome survey. Because of this, the panel may not cover all types of buyers in all areas. One way of dealing with this would be for ONS to commission its own panel survey.

## 8.5 The three alternative sources compared

**Figure 8.1** summarises the properties of the three main alternative data sources. Figure 8.1 shows that the three sources have the potential to complement one another. Consumer panel surveys can collect a lot of very useful data, but are limited by the size and the coverage of the panel. They are unlikely to be suitable for generating consumer price statistics, but may be useful in understanding consumer behaviour better, or for providing weighting information.

Shop scanner data are a source of information on both prices paid and quantities purchased. Scanner data generally do not include information on the purchase (loyalty card databases may be an exception), and are limited to shops that have such scanner systems. With several other national statistical institutes already using shop scanner data, there is the opportunity for ONS to learn from their experience.

Web scraping can complement other methods of data collection. By automating much of the process of collecting data from web sites, prices for a much larger set of products, and a wider range of outlets, can be collected. This has the potential to improve upon ONS's current central price collection methods.

**Figure 8.1: Summary of uses of alternative data sources**

| Characteristic | Shop scanner | Web scraping | Consumer panel |
|---|---|---|---|
| Nature of data | Prices and quantities from specific stores | Price quotes for specific items | Some prices and quantities from specific consumers |
| Price data | Yes | Yes | Yes (but small sample) |
| Quantity data | Yes | No | Yes |
| Characteristics of the customer | No (Possibly for loyalty cards) | No | Yes |
| Access | Negotiation, legal obligation (or possibly purchase) | Collected by ONS (subject to permission) | Purchase (or possibly ONS collects) |
| Shop coverage | Shops with scanners that agree to provide data | Prices on websites (subject to permission) | Usually a subset (and limited to panel) |
| Temporal coverage | All transactions (Limited by shops) | As often as wanted (subject to permission) | All transactions (Limited to panel) |
| Likely uses | Source of price data Source of (current) weights Unit prices (incl. discounts) Can reflect substitution | Source of price data | Source of weights Research data set |

## 8.6 The current ONS position on alternative data sources

ONS is just beginning to explore the use of alternative data sources.

ONS has obtained a small amount of scanner data on sales of toothpaste and shampoo. This is being used to explore the issues with using these data to produce consumer price statistics. This work is summarised in ONS (2014), and has included looking at the difference between unweighted and weighted averages to combine prices and the impact of discounting on price movements.

In January 2014 ONS began a 12 month research project on web scraping. The project has led to data being scraped from three supermarket websites over a period of a few months. ONS has commissioned analysis of the scraped data to look at a range of questions, such as the impact of basing price indices on multiple products and/or multiple days from a single store. ONS plans to continue developing its use of scraped data in 2015, with a focus on further feasibility testing and alternative methods of obtaining scraped data. For example, ONS has recently purchased a significant amount of data scraped by mySupermarket, an online price comparison service.

Consumer panel data is the most well-established source of data in the ONS. It is used primarily by the index numbers methodology team to answer specific research questions. There is a long list of research questions ONS analysts would like to investigate using consumer panel data; some prioritisation is needed.

Overall, the ONS is only just taking the first tentative steps in exploiting the additional sources of data that are becoming available. It needs to continue, and probably expand, this programme of work if it is to catch up with, let alone lead, with international best practice.

## 8.7 Three major challenges for alternative data sources

Alternative data sources offer a wide range of possibilities for making consumer price statistics better, from marginal improvements to totally different measures of inflation. But there are some significant challenges to achieving these improvements. This section considers what we believe to be the three most significant challenges to be addressed

### 8.7.1 Access and capability

In order to make a judgement of the costs and benefits of alternative data sources, one must obtain significant samples of the data. Shop scanner and scraped data in particular are different in nature to the data sets ONS works with more traditionally, requiring the building of specific skills and capability.

Access has been a particular problem in developing the use of shop scanner data. In 2012, ONS embarked on a project, funded by Eurostat, to explore the use of scanner data in price statistics. However, ONS was unable to secure significant amounts of data from retailers and the project was stopped in late 2012.

The fundamental problem is one of money and value. While scanner data have real potential to improve price indices, they also have substantial commercial value to the retail sector. There are also significant sensitivities in providing information on shoppers' spending habits to the government. Perhaps because of these issues, and the likely up-front development costs, ONS has yet to make inroads into this area. In other countries, the national statistical institute has been able to use either voluntary agreement or legislation to obtain scanner data from major retailers.

One possibility is that the European Union may legislate to give NSIs, including ONS, the power to require businesses to provide data for consumer price statistics. Clearly, it would be preferable to obtain this data by voluntary agreement. ONS is rightly continuing its efforts to do so, since it recognises the need to establish common models and specifications for working with scanner data.

However, the lack of significant quantities of scanner data is acting as a brake on progress in ONS. On the other hand, ONS does possess a significant database of consumer panel data. ONS is also in the process of building up a database of price information scraped from supermarket websites. Many of the challenges of working with alternative data sources are common to all three sources.

ONS could give greater priority to analysing the data it already has, in order to build skills and capability.

ONS has access to consumer panel data for research purposes but as described, the make-up of the panel of respondents is a limitation, as is the focus on groceries. One possible option would be for ONS to collect its own panel data, for example by introducing barcode scanners into the Living Costs and Food Survey.

## 8.7.2 Continuity

With traditional methods of data collection, continuity is an issue. Sometimes, the item being priced is no longer on sale and the price collector needs to find a replacement. A judgement then needs to be made as to whether the new item is comparable in quality with the old one or not. Chapter 12 of this report discusses the issues that product replacement raises.

Analysis of scanner data uses the barcode (more formally, the 13-digit International Article Number or EAN) to uniquely identify a product. A simple approach to using scanner data is that if the barcode has changed, the product has changed. This happens a lot. ONS (2014) suggested 40 per cent of shampoo and toothpaste EANs changed during the year. This is broadly consistent with a Eurostat estimate that around 30 per cent of EANs change during the year.

In proportionate terms, this is broadly in line with locally collected price data for shampoo and toothpaste. However, in local price collection a missing product is replaced, unless it is thought only to be temporarily unavailable. In the event of a replacement, ONS has to assess whether the products are comparable.

The same issue arises with scanner data, only the quantities involved are much larger. One approach for dealing with this is to calculate a monthly chained index. In a regular price index, the prices in the current period are compared with the base period. In a monthly chained index, the price index prices in the current period are compared with the previous month's prices, and the price index is formed by multiplying (chaining) the monthly changes together.

The advantage of the chained approach is that each month's change can be calculated using a different set of products. In other words, price change between January and February is calculated using the products available in both January and February. Then price change between February and March is calculated using the set of products available in both February and March, which may not be the same as the January / February set. It was for this reason that experts initially advised users of scanner data to employ monthly chained indices. However, this led to difficulties with chain drift (see Section 8.7.3).

Barcode changes can signify fairly trivial changes to products, such as the packaging of the product. However, re-launches could be accompanied by a change in price. If the barcode change means the old and new prices are not compared, this price change would be missed. At present, NSIs using scanner data are not able to take this effect into account.

### 8.7.3 Choosing the right price index formula and regulatory constraints

When CBS Netherlands introduced scanner data, it followed the advice in the 2004 ILO CPI Manual and created a monthly chained index. The Netherlands soon discovered that the index suffered from chain drift. This was the tendency for price indices to drift as a result of promotional price cuts and the subsequent return to normal prices. An example of this is shown in **Box 8.2**.

A variety of solutions have been developed to deal with the monthly chain drift problem. One is to use a more complex form of chain-linking, such as the Rolling Year GEKS (RYGEKS) approach. Another is the so-called "Dutch method", which excludes products that account for a small proportion of sales and then uses a Jevons index. This has the advantage of conforming to the requirement in the HICP to use either the Jevons or Dutot index. ONS (2014) investigates applying the Dutch method to its sample of scanner data.

Formula choice, along with the many other methodological issues in working with scanner data, is the subject of ongoing discussions between Eurostat and the NSIs of member states. Fenwick (2014) provides a good summary of the areas where using shop scanner data may not be compatible with the current HICP regulations.

As discussed in Chapter 7, symmetric indices such as the Törnqvist index have many advantages over the fixed-based indices that ONS (and other NSIs) produce as their main measures. The main practical obstacle to producing a timely symmetric index is that current period weights are not available in time to calculate the index.

Scanner data offers a solution to this problem, by providing both price and quantity information in a timely fashion. The symmetric indices calculated in ONS (2014) are at the elementary aggregate level; that is, they replace unweighted averages. In terms of consumer substitution, they approximate lower level substitution behaviour (substitution between similar products), which is not possible, at any lag, using traditional data collection methods.

In Chapter 7, we recommend that ONS start to produce a lagged superlative index annually as an analytical tool for interested users. This is compatible with the increasing use of shop scanner data, which has the potential to support more rapid updating of such an index.

**Box 8.2: The monthly chain drift problem**

The example here is illustrative and has been taken from Diewert (2013). Diewert states that this example was based on observations of detergent sales in the Netherlands. Consider sales of two commodities over four time periods, as shown in **Figure 8.2**:

**Figure 8.2: Illustrative example of the monthly chain drift problem with two products**

|  | Period 1 | Period 2 | Period 3 | Period 4 |
|---|---|---|---|---|
| Product 1 price | 1.00 | 0.50 | 1.00 | 1.00 |
| Product 2 price | 1.00 | 1.00 | 1.00 | 1.00 |
| Product 1 quantity | 10 | 5,000 | 1 | 100 |
| Product 2 quantity | 100 | 100 | 100 | 100 |
| Product 1 expenditure share | 0.091 | 0.962 | 0.010 | 0.091 |
| Product 2 expenditure share | 0.909 | 0.038 | 0.990 | 0.909 |
|  |  |  |  |  |
| Laspeyres index (between periods) |  | 95.5 | 196.2 | 100 |
| Chained Laspeyres index | 100 | 95.5 | 187.2 | 187.2 |
|  |  |  |  |  |
| Törnqvist index (between periods) |  | 69.4 | 140.0 | 100 |
| Chained Törnqvist index | 100 | 69.4 | 97.2 | 97.2 |

The price of item 1 halves between periods 1 and 2, causing a big jump in sales. The product returns to its original price in period 3 and sales drop right off; perhaps consumers who want the product have already stocked up.  The quantity sold returns to the original level in period 4. Through the same time frame, the price of product 2 and quantity sold remains consistent.

Most people would agree that the price index in period 1 should be the same as period 4; after all, the price and quantity sold of both products is the same. With a chained index however, the path of price and quantity changes between periods 1 and 4 has an influence on the price index; the chained index is *path-dependent*.

The chained index calculates overall price change between each pair of periods in sequence and then multiplies them together. So the chained price index in period 4 is obtained by multiplying the price changes in periods 1-2, 2-3 and 3-4 together. Chained indices do not return to their original values in these circumstances; they suffer from *chain drift*.

In the chained Laspeyres index, chain drift arises because the product 1 price fall between periods 1 and 2 has low weight (only 10 of product 1 were bought), while the increase to period 3 has high weight (5,000 products). In the chained Törnqvist index, chain drift is negative. This is because the average expenditure share (which is what matters in the Törnqvist) is larger in periods 1 and 2 when the price is falling, than when the price recovers between periods 2 and 3. While the drift is much smaller than with the Laspeyres index, it can accumulate over time.

## 8.8 Conclusions

Consumer panel data are a useful research tool. They could potentially be used for providing detailed weighting information in areas ONS currently lacks. However, they are unlikely to replace current data collection practices in a significant way.

Web scraping has the potential to automate large parts of ONS's price data collection, at least in cases where the prices can be obtained from websites. This can be used greatly to widen the number of price quotes ONS uses to construct consumer price indices. The tools to collect data in this way exist and ONS is now experimenting with them.

Shop scanner data has the most potential of the three sources, but also poses the most significant challenges in its use. ONS is now at the stage that countries like the Netherlands were at a decade ago. This is not as much of a disadvantage as it sounds; a great deal of methodological work has been done by those countries, which ONS can now learn from.

ONS should continue to develop its expertise with all three alternatives. They are to some extent complementary, and skills and experience developed with one source can be applied to the others.

The first step is to obtain sufficient quantities of alternative sources of data to be able to assess the feasibility of using such data in consumer price statistics. ONS already has consumer panel data, and is rapidly accumulating web scraped data.

Ideally, retailers would provide scanner data to ONS voluntarily, and ONS should continue to pursue this route. It is to be hoped that retailers will co-operate with ONS in providing scanner data; such data will improve the measurement of inflation for the public good. However, ONS should also consider its options in legislation if it is not able to gain the cooperation of retailers.

As it acquires more data, ONS should increase the resource dedicated to investigating the use of alternative data sources, especially shop scanner data. The area remains one where the research is evolving rapidly, and it will be important for ONS to keep abreast of developments. ONS should set out a more detailed work programme for developing alternative data sources and report regularly on the progress made.

Alternative data sources are a long way from having the breadth of coverage of current data collection methods. For example, even if all the shop scanner data in the UK were collected, many businesses would not be covered, and many items, particularly services, would not be included. There will continue to be an important role for local price collection in consumer price statistics for the foreseeable future.

**ONS should give priority to developing the use of point of sale scanner data and web scraping techniques. ONS should set out a detailed plan for working towards greater use of these techniques in its consumer price statistics over the coming years.**

# 9. The measurement of housing costs in consumer price statistics

## 9.1 Introduction

Owner occupiers' housing (OOH) costs are the costs specific to households that own the house (or other property) they live in. This includes both households that own the property outright and those with a mortgage.  Measuring the change in OOH costs is widely regarded as one of the most challenging elements of constructing an index of consumer prices.

The challenge in deciding how to measure owner occupiers' housing costs comes in two parts. The first of these is deciding what costs should be included. This is important because not everyone agrees on what owner occupiers' housing costs are.

The second challenge is deciding how to measure these costs. There are several distinct approaches, each underpinned by different definitions, assumptions and data requirements. As such, the different approaches have different advantages and disadvantages. What works for some countries does not necessarily work for the UK.

This chapter starts by defining which owner occupiers' housing costs a consumer price index should be seeking to capture. We then set out the main methods that exist for capturing owner occupiers housing costs, and their relevance in the UK. The experience of the ONS with its preferred method, rental equivalence, is then explored in more detail. We conclude by considering council tax, a housing cost not unique to owner occupiers but that is currently excluded from both CPI and CPIH.

## 9.2 What are owner occupiers' housing costs in a consumer price index?

Households purchase property to provide themselves with shelter and security of tenure. In this sense, the purchase of a house is like any other consumer good or service; something that households purchase and consume to satisfy their needs. However, housing is unlike almost any other major good or service in that it is in part an investment. If properly maintained by the owner, a property will often hold or appreciate in value. A household purchasing a house is buying an asset.

This dual nature – part consumption good, part asset – lies behind much of the difficulty in estimating owner occupiers' housing costs. Most statisticians agree that the consumption element is in scope of a consumer price index, while the asset element is not. This is an important factor in the methods designed to measure owner occupiers' housing costs.

Which owner occupiers' housing costs should be included depends on the methodological framework adopted for measuring OOH. These approaches are discussed in the following section.

## 9.3 The four main approaches to estimating owner occupiers' housing costs

Consumer price indices can measure the costs of consumption at three main points; at the point that goods and services are *acquired*, when *payments* for these goods and services are made, and when they are *used*.

For some goods and services the three are close to each other. For longer-lasting goods such as furniture, household appliances and cars (called *durable goods*), the price to acquire the good can be different to the amount it would cost to use such an item over the same period of time; for example, one might hire the item. However, most statisticians agree that such items can be treated in the same way as non-durable goods and services.

Property is the main exception to this rule. The rate at which a property declines in value, or depreciates, is much slower than most other durable goods. Property can retain or even increase its value over time if properly maintained. The acquisition, payments and use approaches to owner occupiers housing costs require different data and lead to different estimates these costs. Other goods that appreciate over time, such as antiques, are usually not included in consumer price statistics.

The ILO CPI Manual (ILO, 2004, Chapter 10) sets out four main ways in which owner occupiers' housing costs can be measured. These are:

– The **net acquisitions** approach, which aims to measure spending on net purchases of the consumer element of housing, and accompanying costs;
– The **payments** (or outlays) approach, which aims to measure the money spent by households on owner occupation;
– The **user cost** approach, a use-based approach that aims to measure the cost of acquiring housing services for a period of time
– The **rental equivalence** approach, a use-based approach that measures the cost of housing services indirectly by asking how much it would cost to rent a property for a period of time.

## 9.4 The net acquisitions approach

Measuring cost at the point a house is acquired gives rise to the **net acquisitions** approach. This treats a house as a purchase of a good that is part asset, part consumable. The "net" part refers to the fact that only properties that are bought from outside the household sector are included, with sales to other sectors netted off. This is because sales between households are transfers and leave the household sector no better or worse off.

The distinction between asset and consumable is represented by considering the building itself (and spending on the property, such as maintenance) as the good being consumed, and the land it stands on as the asset. As the asset element is excluded from a consumer price index, this ideally requires separate information about land and house building prices.

In total, the net acquisitions approach therefore includes:

- Net purchases of dwellings by the household sector (excluding land prices)
- Self-built housing
- Alterations and additions
- Transaction costs (such as taxes and legal fees)
- Running costs (such as repairs and maintenance, insurance)

ONS (2011) considered the options available to ONS for obtaining such net prices, and concluded that none of the available options were suitable. This meant that the net acquisitions measure considered for CPIH was on a "gross price, net weight" basis.

The net acquisitions approach was considered by ONS and the Consumer Prices Advisory Committee (CPAC) for use in the UK. It was ultimately rejected because of the data constraints; the price of new dwellings included both the building and the land. There are other shortcomings in the UK's ability to produce a net acquisitions measure. For example, all new built housing is assumed to be for owner occupation, when in reality some of it will enter into the rental sector.

For both practical and principled reasons the net acquisitions approach is unlikely to be the optimal way of measuring OOH in the UK. Despite these shortcomings, Eurostat is requiring EU member states to develop estimates of owner occupiers' housing costs using the net acquisitions approach. This is discussed further in Section 9.9.

## 9.5 The payments approach

The second approach is the **payments** approach. It is defined by looking at what households pay out as owner occupiers (excluding, as explained above, capital payments). This includes:

- Mortgage interest payments (MIPS)
- Transaction costs
- Running costs (such as repairs and maintenance and insurance)

Mortgage interest payments are usually regarded as within the scope of the payments approach. This in itself makes the payments approach unsuitable for many purposes, such as inflation rate targeting and, arguably, the uprating of benefits.

Transaction costs include estate agency fees and conveyancing. Stamp duty is also arguably a transaction cost, although it is excluded from the RPI, which is sometimes said to follow a payments approach.

Running costs include spending on repairs and maintenance, house insurance and ground rent. Accounting for major repairs – those that go beyond restoring a house to its initial state - poses another problem for the payments approach. These are a significant but irregular part of the costs of owning a home. They are difficult to obtain prices for on a consistent basis, and one needs to disentangle upkeep from alterations which improve the property (and are hence are a form of investment).

One way of dealing with major repairs is to include a component for the depreciation of the property. This is the approach taken in the RPI and RPIJ, following the deliberations of the RPI Advisory Committee in 1994 (CSO, 1994). The approach was characterised as estimating the amount of money households should put aside for necessary major repairs and updating in order to maintain the value of the property. Including depreciation means that the RPI and RPIJ do not strictly follow a payments approach; in some ways, they are closer to a user cost approach (see Section 9.6).

Despite this, the RPI and RPIJ are sometimes described as following the payments approach. **Figure 9.1** shows how owner occupiers' housing costs have evolved over time in the RPI:

**Figure 9.1: Main components of owner occupiers' housing costs in the RPI, 1995-2013**
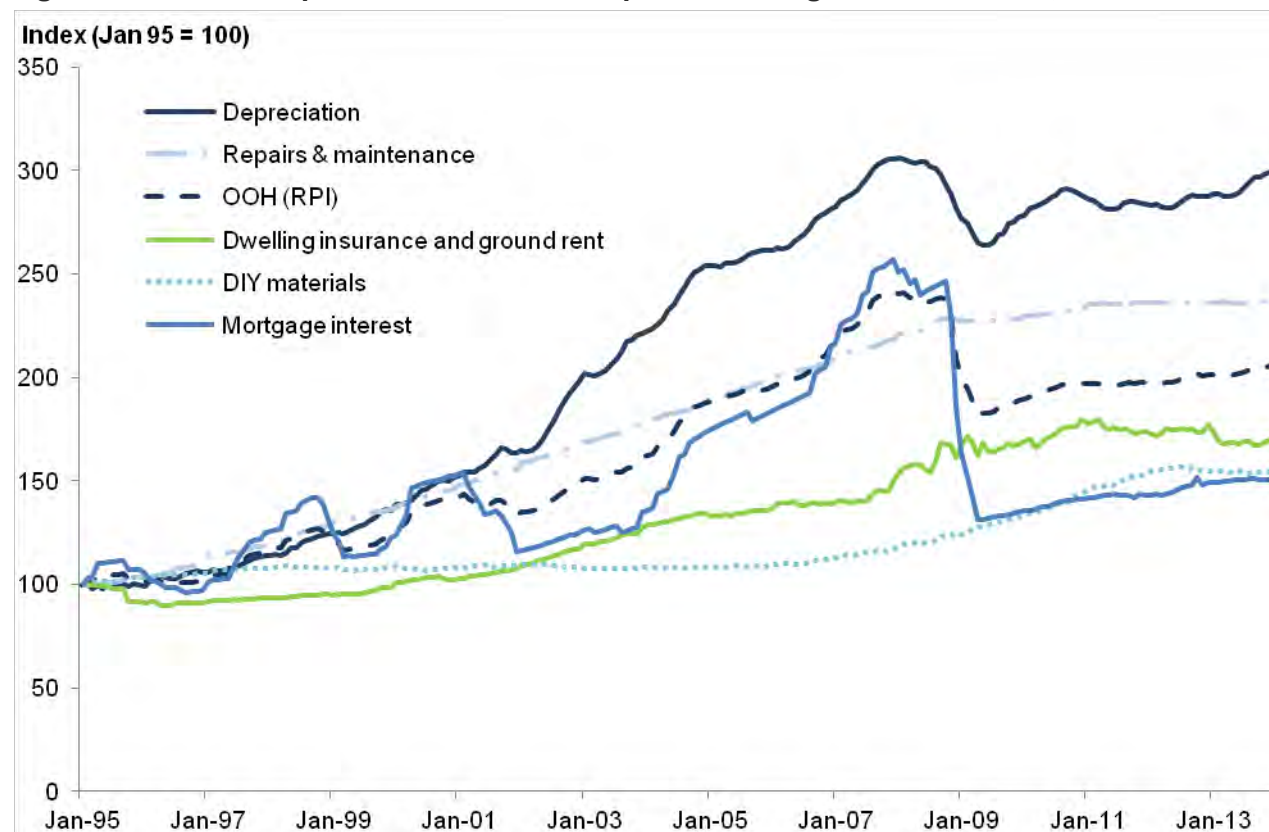


Source: Consumer Price Inflation, ONS. OOH (RPI) was calculated specifically and combines the categories shown.

**Figure 9.1** shows that mortgage interest payments rose quickly at times but fell dramatically from late 2008. Mortgage interest payments are based on the debt per household multiplied by the average interest rate. The average debt per household is based on modelled mortgages over a 23 year period. House prices over the last 23 years therefore feed into the calculation of the debt per household. This means that the MIPS component responds slowly to changing house prices.

Prior to 2010, the interest rate was based on the Standard Variable Rates charged by lenders, meaning that changes to interest rates directly impacted on the MIPS price index. From 2010 onwards, ONS has used the Average Effective Rate across a number of lenders, as compiled by the Bank of England. This takes into account a wider range of mortgage products, including fixed rate mortgages, meaning that it responds less quickly to changes in interest rate. Even so, the MIPS component is more sensitive to changes in interest rates than to changes in house prices.

Figure 9.1 also shows that the depreciation component of housing costs in the RPI has increased more quickly than any other since 1995. This is in large part because the price index for depreciation is based on house prices. In principle, one would want to use the price of the building but not the land; land does not depreciate. This was noted by the 1994 RPI Advisory Committee, but in the absence of a measure of house prices excluding land, they judged the compromise acceptable.

Since this time, depreciation has grown to become the largest component (in terms of weight) of owner occupiers' housing costs, as shown by **Figure 9.2**. House prices have also grown more than any of the individual costs of being an owner occupier, such as repairs and maintenance. This inability to separate building and land prices is as serious a shortcoming for the depreciation component as it is for the net acquisitions measure of housing costs.

**Figure 9.2: Weights of main owner occupiers' housing costs in the RPI in selected years**

|                                 | 1995 | 2000 | 2005 | 2010 | 2014 |
|---------------------------------|------|------|------|------|------|
| Depreciation                    | 30   | 36   | 49   | 55   | 58   |
| Repairs and maintenance         | 10   | 10   | 12   | 12   | 10   |
| Dwelling insurance & ground rent| 9    | 7    | 7    | 7    | 6    |
| DIY materials                   | 13   | 11   | 14   | 8    | 6    |
| Mortgage interest               | 42   | 40   | 50   | 34   | 30   |

Source: Consumer Price Inflation, ONS.

So while superficially attractive the payments approach involves a number of practical challenges. As discussed in Chapter 5, the inclusion of interest rates can also be problematic for a population wide measure given that households with savings benefit from interest rate rises. It may however

be appropriate for use in looking at the experience of particular groups of households, as discussed in detail in Chapter 6

## 9.6 The user cost approach

The **user cost** approach is a use-based approach; that is, it aims to measure the cost of using housing. It treats housing as a capital good that provides services that the owner occupier consumes. The user cost approach measures the costs of owning the house, which are a combination of the actual expenses incurred (for example, repairs and maintenance) and the costs of financing the purchase of the property.

The full user cost model is:

| Full user cost | = | Mortgage interest paid |
|---|---|---|
| | + | Interest forgone on capital used (opportunity cost) |
| | + | Depreciation |
| | + | Running costs (repairs and maintenance, taxes, insurance etc.) |
| | – | Capital gain (difference between price at beginning and end of period) |

Some of these elements are however not directly observable. In practice, countries that have applied the user cost approach adapt this model in some way. For example, Canada excludes opportunity costs and capital gains from its user cost model (Baldwin et al, 2010). As discussed above, the RPI can be thought of as following a user cost model, with opportunity costs and capital gains excluded.

ONS considered a **narrow user cost** approach in 2010 as part of the development work that led to CPIH. The model that ONS developed by ONS in ONS (2010a) was:

| Narrow user cost | = | (Average house price × real rate of interest) |
|---|---|---|
| | + | Depreciation |
| | + | Running costs (repairs and maintenance, taxes, insurance etc.) |

The first term assumes that the sum of mortgage interest and opportunity cost can be represented by the "real rate of interest". This is intended to represent the real return (that is, excluding inflation) of a long-term investment. As reported in ONS (2010a), ONS used a fixed long-term average of bank and building society timed deposit interest rates minus CPI to derive the real rate of interest. In this first model, capital gains were excluded.

The main problem the ONS experienced with the narrow user cost approach was that the resulting price index was very dependent on the way the real rate of interest was calculated. Firstly, one had to agree what the real rate of interest was; ONS found that using index-linked gilts instead of deposit accounts (for example) generated different results. How often the real rate of interest was updated also significantly impacted the behaviour of the series.

At times where the real rate of interest was negative, a house price increase would lead to a fall in owner occupiers' housing costs. The interpretation of this was that the opportunity cost was negative – in other words, it was cheaper to invest in housing than the alternative. However, the fact that rising house prices could cause inflation to fall would have been problematic in gaining public acceptance for the user cost approach.

ONS tested an extension of the model to include capital gains. In this case, the real rate of interest was deflated by the DCLG House Price Index, rather than the CPI. ONS (2010a) showed that this exacerbated the problem of the model without capital gains; at times when house prices were rising quickly, the real rate of interest was negative (housing was generally the best available investment) and owner occupiers' housing costs fell when prices rose.

## 9.7 The rental equivalence approach

The rental equivalence approach is, like the user cost approach, a use-based approach. It treats housing as a capital good that is not itself consumed; instead, it provides a service that the owner occupier consumes. The rental equivalence approach argues that people who own their home can either live in it or rent it out. Therefore, the rent the owner occupier could have received is a measure of how much these services are worth.

The rental equivalence approach measures the forgone value of these services using private rents of comparable properties. The rent charged by landlords covers not just the property but many of the other costs borne by owner occupiers, such as repairs and maintenance and transaction costs. Therefore, under the rental equivalence approach, these are not estimated separately, as to do so would introduce double-counting.

For rental equivalence to work, the rental market needs to be large enough to function, excluding controlled rents. It also requires that private rented properties can represent owner occupied properties. In other words, there need to be enough properties of each type, in each part of the country, to construct a rent price index, weighted for the composition of the owner occupied sector.

Rental equivalence also requires that the houses available for rental are representative (subject to adjustment for property mix) of those in the owner occupied sector. This in turn depends on the source used for the data. These conditions are not satisfied in all countries; for example, some have very small rental markets. The rental equivalence approach is not appropriate in these cases. According to the 2012-13 English Housing Survey there were around 4 million privately rented properties in England alone, just under a fifth of the total housing stock. Properties are available to rent throughout the UK, and all types of property are available on the rental market.

The prices required for rental equivalence are the rents paid by private renters. These prices were already being collected for the RPI and CPI for the private rents component. During the early stages of the development of the rental equivalence method, private rents were collected by ONS's field force. Only a small number of rented properties were priced in each location. ONS also had concerns regarding the overall coverage and quality of the private rents series.

As the work on rental equivalence progressed, ONS worked with the Valuation Office Agency (VOA) and the governments of Wales and Scotland to develop an alternative measure of private rents. This is described in **Box 9.1**.

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**Box 9.1: The Valuation Office Agency data on private rents**

The Valuation Office Agency (VOA) is an executive agency of HM Revenue & Customs. It carries out valuations of properties in England, to provide the Government with the information required to determine taxation and benefits related to property.

VOA rent officers use their awareness of local market conditions to help collect a representative sample of private rents.  They are used to determine LHA rates which affect the benefits paid to housing benefit claimants living in the private rented sector.

The information that rents officers collect on rented properties includes the type of property, number of bedrooms and the rent charged. VOA collected over 480,000 rent prices in 2013. Rents officers distinguish confirmed lettings and advertised rents; only confirmed lettings (which are over 99% of the total) are used when calculating statistics for ONS.

When forming a price index, ONS is aiming to measure the overall change in private rent prices over time. A key question is therefore how long a confirmed rent price remains valid for. This is a balance between the average contract length and the operational processes of VOA. ONS understands the average rental contract length to be 12 months. VOA procedure is to update rental information as close to the renewal or start of new tenancy as possible. In practice, many updates occur between 12 and 15 months. This trade-off has been one of the areas of recent work by ONS and VOA, as discussed later in this chapter.

The legislation governing VOA (the Commissioners of Revenue and Customs Act 2005) does not permit VOA to share microdata with the ONS. Instead, VOA provides aggregated data to ONS, which then uses them to produce price indices of rental housing and hence owner occupiers' housing costs.

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## 9.8 International practice in measuring owner occupiers' housing costs

In 2009, ONS approached other national statistical institutes to find out what approach to owner occupiers' housing costs countries employed, and how this compared with the main purpose of the index. The results were reported in ONS (2012a, p29) and are summarised in **Figure 9.3**. It shows that rental equivalence is the most common approach to estimating owner occupiers' housing costs, with the next most common approach being to exclude them altogether.

**Figure 9.3: Methods for including owner occupiers' housing costs in 29 national CPIs**

|  | Number of countries |
|---|---|
| Rental equivalence | 13 |
| Exclude OOH | 8 |
| Net Acquisitions | 3 |
| User costs | 3 |
| Payments | 1 |
| Mixed | 1 |
| **Total** | **29** |

Source: ONS research (2009)

The choice of method may in part reflect the available data and the nature of the country's housing market. For example, Australia and New Zealand both use the net acquisitions approach to owner occupiers' housing costs; in both countries, sufficiently robust data on the cost of building a property is available. As described by Guðnason and Jónsdóttir (2009), Iceland uses a narrow user cost approach in part because renting is rare, and there is insufficient data to apply a rental equivalence approach.

## 9.9 EU decisions on owner occupiers' housing costs

Since the early stages of the development of the HICP, the net acquisitions approach has been the preferred method for measuring owner occupiers' housing costs. There have been two main drivers behind this. The first is that the HICP aims not to use imputations; both the user cost and rental equivalence approaches make use of imputed transactions (see, for example, Makaronidis & Hayes, 2006, pp2-3).

The second concern was developing a method that all member states could apply. Some EU countries do not have a significant private rented sector, and for these countries the rental equivalence approach would not be appropriate.

The majority of EU member states are in the same position as the UK, in that they cannot construct a net price measure of housing. As one of the principal goals of the HICP is comparability between EU member states, Eurostat has stipulated that all member states should construct "gross price, net weight" measures of housing, even if the country has the data to construct a net price measure (Eurostat, 2013, p22).

Eurostat has required EU member states to provide estimates of owner occupiers' housing costs, on the net acquisitions basis since September 2014. The UK is complying with this regulation, as discussed in more detail in ONS (2014a). At present, owner occupiers' housing costs remain outside the scope of the HICP; Eurostat has committed to producing a report on the operation of the net acquisitions method by 2018.

## 9.10 ONS's decision on owner occupiers' housing costs in CPIH

The user costs and payments approaches to owner occupiers' housing costs were considered by ONS and the Consumer Prices Advisory Committee (CPAC) but dismissed at a relatively early stage (ONS, 2010b). The payments approach was rejected because it was felt by ONS and CPAC to be at odds with the then stated purpose of CPIH: that it was a macro-economic indicator of inflation. As discussed in Section 9.6, the user cost approach was dropped because of the dependency of the measure on the (somewhat arbitrary) real rate of interest and the consequences of a negative rate.

Towards the end of 2012, ONS completed its research work and the choice between the rental equivalence and net acquisitions methods was put before CPAC. Following the advice of CPAC, the decision made by the National Statistician was to use the rental equivalence approach.

There were several reasons for this decision, but the main reason was the fact that the data sources for net acquisitions did not allow the separation of the price of the land and the house. This meant that the prices produced by the net acquisitions method reflected rising asset prices rather than the cost of consuming housing. The rental equivalence method avoids this by measuring the value of the services provided by the asset.

A public consultation followed, and in September 2012 the Board of the UK Statistics Authority accepted the National Statistician's recommendation to produce a measure of owner occupiers' housing costs using the rental equivalence approach.

CPIH was published for the first time in March 2013. CPIH currently follows the same concepts and definitions as the CPI, except that it also includes owner occupiers' housing costs following the rental equivalence approach. At the same time, the private rents components in all the ONS's consumer price statistics moved from using locally collected private rents to the VOA data.

Owner occupiers' housing costs remain outside the scope of the HICP, and hence the UK CPI. As such, CPIH is not governed by EU legislation, an important point that is explored in more detail in Chapter 4 of this report.

## 9.11 Experience with the rental equivalence method

**Figure 9.4** graphs the CPI and CPIH, along with the OOH component of CPIH, as published in late 2014. Low measured inflation in private rents has led to the owner occupiers housing costs component of CPIH growing more slowly than the CPI over time. Therefore CPIH has generally shown slightly lower inflation than the CPI.

**Figure 9.4: CPI, CPIH and OOH component of CPIH, 2005-2013**
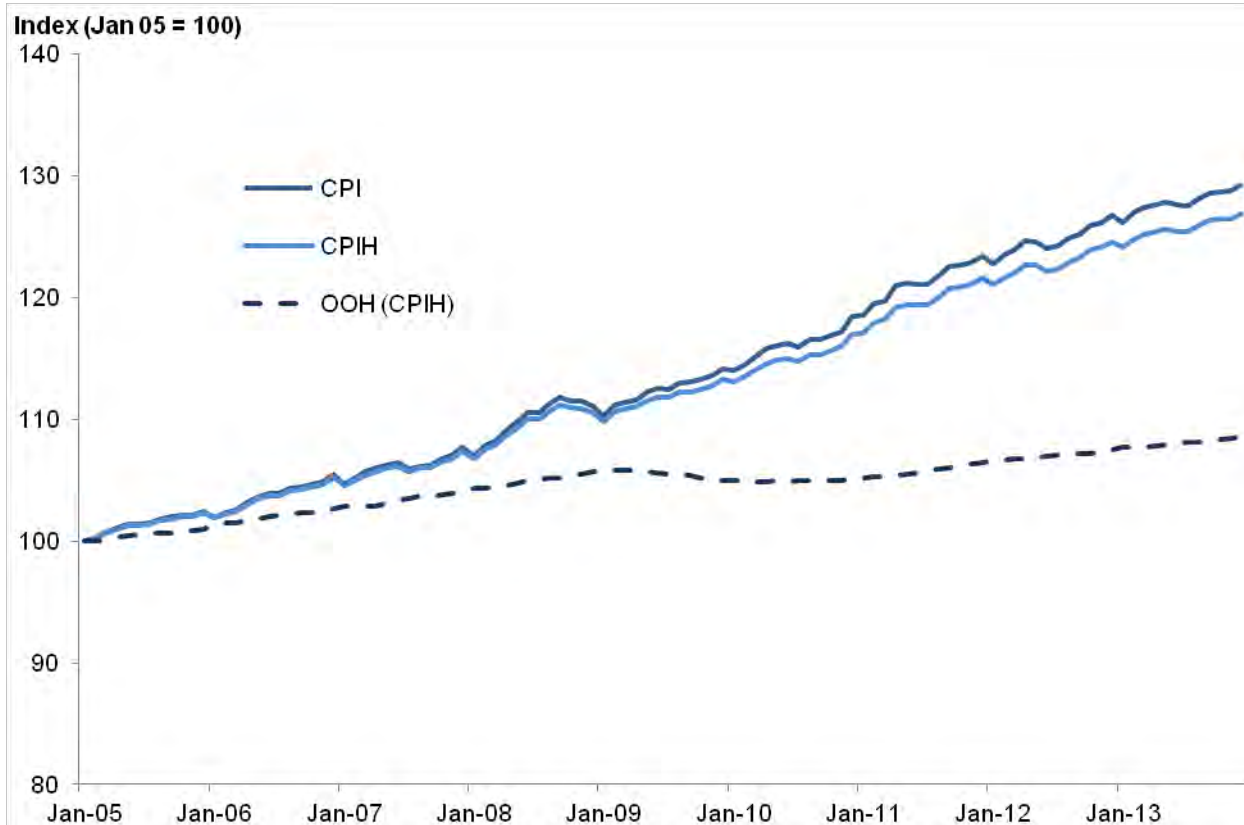


Source: ONS. Based on CPIH as published in 2014

The suggestion that private rents were growing significantly less quickly than other prices was, to say the least, surprising. In 2014, this prompted a (belated) investigation by ONS and VOA into the processing and analysis of the private rents data that underpin owner occupiers' housing costs.

## 9.12 Investigation of VOA data and the suspension of National Statistics status of CPIH

The recent work by ONS and VOA has identified several shortcomings in the methods and processing used to produce the owner occupiers' housing costs price index for CPIH. This led to the National Statistics status of CPIH being discontinued (Dilnot, 2014).

ONS (2014b) discussed four main areas where improvements were being investigated:

– Improvements to the process for determining comparable replacements, leading to more viable matches in future.

– Bringing the process for replacing properties for which there is no comparable replacement into line with that used for other goods and services in consumer price statistics.

– Reducing the sample of properties used at the start of the year, to increase the pool of properties from which comparable replacements can be selected.

– Reassessing the length of time for which a rent price can be considered valid before a replacement property is found.

In September 2014, the National Statistician reported that the impact of addressing these shortcomings on CPIH would be to increase it by 0.2 percentage points in some cases, but more often 0.1 percentage points (Pullinger, 2014).

The revised figures for the OOH component have not yet been published. It is however possible to estimate the size of the likely changes using historic data. Using 2013 data for example, to increase CPIH by 0.1 percentage points would require an increase of approximately 0.8 percentage points in the OOH index.

ONS is working towards implementing changes to the OOH component in March 2015, with an article explaining the changes due ahead of this. Usually, when ONS revises its methods, changes are only made to the data going forwards, in line with the policy of no revisions. However, ONS plans to revise the OOH component throughout the time series from 2005, rather than introduce the change from 2015 onwards (Pullinger, 2014). The final impact on CPIH will depend on the way the changes are implemented.

However, given the likely size of the increase in the OOH component, it is likely that there will still be a sizeable difference between the growth in private rents contributing to OOH in CPIH, and other sources of information on private rents. This is explored in more detail in the following sections.

## 9.13 Private rent growth and quality change

The issue with private rents growth can be illustrated with two charts. The first, in **Figure 9.5**, compares different sources of private rents data that are available since 2005.

**Figure 9.5: Comparison of private rents data sources, 2005–2013**
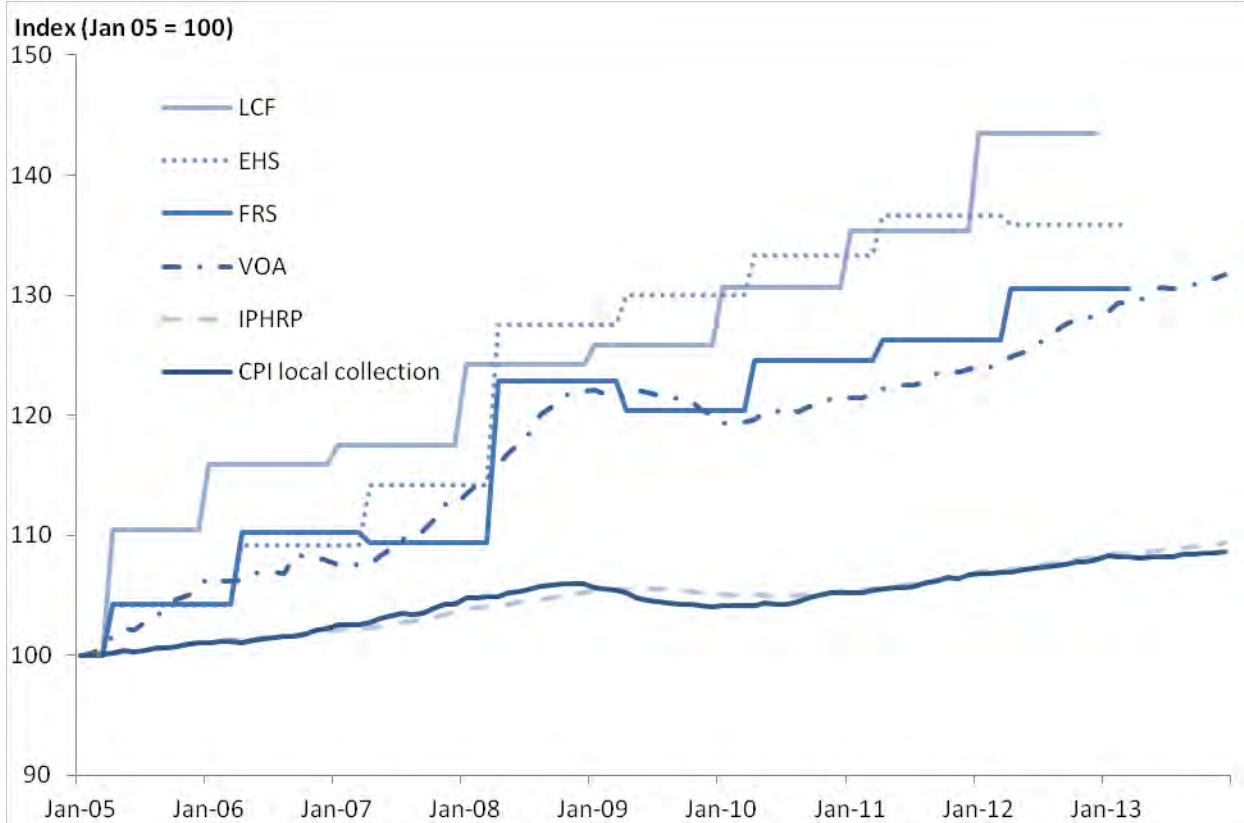


Source: ONS, VOA, DCLG and DWP. IPHRP is shown prior to revisions planned for 2015

In **Figure 9.5**, the Index of Private Housing Rental Prices (IPHRP) is a private rents price index published by ONS, formed from the VOA data. As discussed earlier, the IPHRP shows (prior to planned revisions) much less growth than other sources of rents information: the Family Resources Survey (FRS), the English Housing Survey (EHS) and the Living Costs and Food Survey (LCF).

In fact, the VOA data showed a very similar trend to the data on private rents collected locally by ONS's contracted field force, even though the raw VOA data shows a very similar trend to average rents in other datasets. However, the series resulting from VOA data and local price collections have something else in common. They are both price indices, in that they seek to make pure price comparisons and strip out the impact of quality change in rents. The three surveys, in contrast, take an average of rent prices, with no attempt to control for differences in the quality of properties between years. This meant that ONS initially explained the difference between the new data from VOA and its own survey sources as showing the improvement of the quality of housing stock. The topic of quality change in consumer price statistics is discussed in detail in Chapter 12.

This is highlighted in **Figure 9.6**. It shows the average rent prices recorded by VOA each month (weighted for the owner occupied sector in this case), as well as the average rent in the samples drawn from VOA's data set to inform the OOH component.

**Figure 9.6: VOA average rents weighted for owner occupied sector, England, 2005-2013**
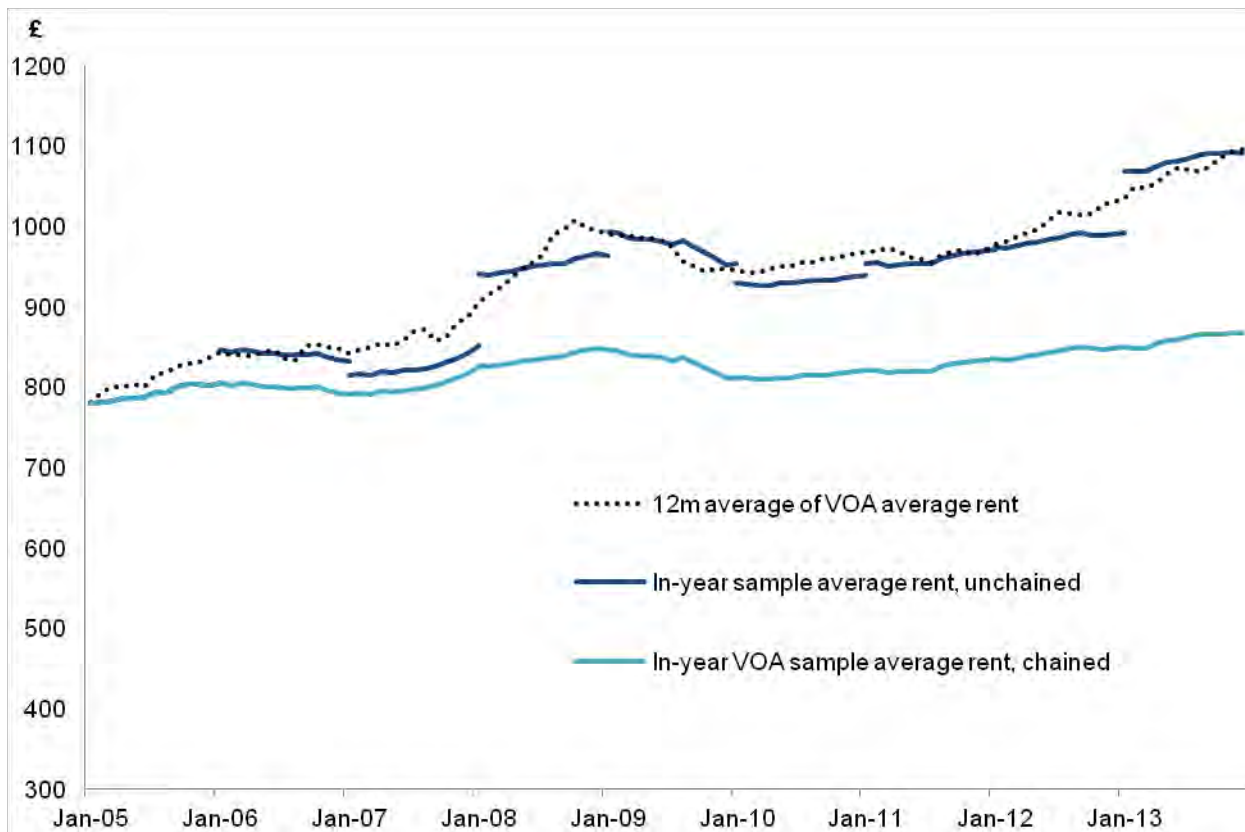


Source: ONS. The series presented here are weighted according to OOH shares of housing by region and type.

The graph shows the impact of the changing sample of VOA data on average rents. The dotted line ('12m average of VOA average rent') shows the average rent of all properties collected by VOA, weighted for the owner occupied sector, and smoothed over a year. Each January, a sample of these properties are drawn from the VOA data set and followed for the year. This gives rise to the broken lines ('In-year sample average rent, unchained'), with the breaks showing the impact of the change in the sample each year. In some cases (for example, between 2007 and 2008) there are significant differences in the old and new samples. Chain-linking removes these differences and gives rise to the third line ('In-year VOA sample average rent, chained').

In total the average rent of the properties VOA collects rents from used to inform the OOH component (using OOH weights) has risen from around £840 a month in 2005 to around £1,100 a month in 2013, an increase of 31 per cent. The chained index increases by 9 per cent between 2005 and 2013.

The difference between the unchained and chained indices arises because of changes in the sample of properties being used to inform the OOH component. The difference is particularly marked between the 2007 and 2008 samples, where the average rent increases by nearly £90. This would be a year-on-year increase of around 10 per cent.

The differences in the sample average rents between years could arise in part because of sampling variation in the properties that VOA are collecting rents for. It could also be that there have been changes in VOA's data collection procedures.

A third possible reason is that improvements in the quality of the private rented stock could be driving the increase in rents. As discussed in Chapter 12, price indices aim to compare at constant quality, in order to measure pure price changes. If the quality of properties is improving, then this could increase the average rent, but any effect would properly be excluded from a rent price index, or the OOH component of CPIH.

The evidence for quality change is presented in Annex A. In summary, the recent expansion in the size of the private rented sector means there is considerable scope for an overall change in the quality level of rented properties. There is some evidence of quality improvement, in particular that the private rented stock is newer and in better repair than it was a few years ago. However, the evidence is far from conclusive, and ONS is continuing its investigations.

The final possibility is of course that like-for-like rent prices did indeed rise by significantly more than is measured by the private rent index, and that some of this increase is being removed by the processing of the private rents data in some way. This emphasises the importance of continuing to investigate and explain the private rents data; ONS's planned article in January 2015 will be an important part of this.

## 9.14 Recent developments in approaches to measuring owner occupiers' housing costs

The rental equivalence methodology is trying to get at what it would cost to rent a similar property. ONS, like other national statistical institutes using the rental equivalence approach, uses the *stock* of rents to answer this question. That is, rentals currently in progress, where the observation is recent enough to be considered current, count towards the rental equivalence price.

There is another way to formulate the question that rental equivalence seeks to answer. That is to take the cost of housing as the rent the owner could charge, should they decide to rent it out now. The difference between the two is that the current methodology gets at an *average* rent for all those properties currently being rented whilst the alternative measures the *marginal* rent – that which this property could attain if rented now. The results may be different if, as seems to be the case, properties originally rented a while ago command lower rents than similar properties more recently rented.

This argument is made by, for example, Shimizu et al (2013) and Ozimek (2013). As this is a relatively new development, ONS understandably did not consider using the price of new lets when developing its rental equivalence measure.

Diewert and Nakamura (2013) goes further and proposes an opportunity cost approach. This considers what the best alternative use of the money tied up in the house is. One option is that the money could have been invested in an alternative financial investment. This is called the financial

opportunity cost and is measured by the user cost approach discussed in Section 9.6. The other option is that the owner could have rented their property out. In this case, the opportunity cost is the forgone rent, measured by the marginal rent described above. The opportunity cost for a household in any year would then be the higher of the two.

ONS's use of the stock of private rents is in line with current best practice, as discussed in the ILO CPI Manual and as practiced by other national statistical institutes. However, these new ideas will need to be considered and examined as part of the ongoing work of ONS.

## 9.15 The treatment of council tax

Council tax is a major cost related to housing faced by households. It is, of course, not particular to owner occupiers: renters pay council tax too. However, the treatment of council tax in consumer price statistics is not entirely straightforward.

Taxes are included in consumer price statistics if they are part of the price of consuming a good or service; for example, VAT or alcohol duty. Taxes that pay for a specific service are also included; in this way, Vehicle Excise Duty is included as a service (use of roads in the UK) is being purchased. Direct taxes, such as income tax, are not included, as these are not spending on consumption.

Council tax sits between these cases. It is much like a direct tax in that it is a contribution to a local authority's budget, which then provides a range of services. The person paying the tax may not use, or even be able to access, all the services; a single person of working age is unlikely to have access to schools, for example. In the National Accounts treatment of income and expenditure, council tax is deducted from income as a direct tax.

On the other hand, one cannot live in a property, whether owned or rented, without paying council tax. Paying council tax is a requirement for living in a property, just as paying VAT is a requirement for purchasing many goods. What the money is then spent on (by Government) is not relevant. Council tax payments are paid for from household budgets in the same way as other goods and services. Households certainly perceive council tax as a bill they have to pay, rather than as a deduction from their income.

Council tax is included in the RPI and RPIJ, where it makes up 4.2 per cent of the index. The CPI does not include council tax. As reported in ONS (2012b), Eurostat previously argued council tax should be included in the UK's HICP, but changed its stance and now opposes its inclusion in the CPI. The same paper, presented to the July 2012 Consumer Prices Advisory Committee (CPAC), proposed including council tax in CPIH. However, council tax currently remains outside the scope of CPIH.

As outlined above, there are arguments for and against including council tax in an inflation measure. The current definition of CPIH has the advantage of coherence with the National Accounts. Users who want to look past changes in price brought about by government (as

opposed to price pressures from within the economy) might prefer council tax to remain outside the scope of CPIH.

However, council tax is experienced as a cost by households, and is paid out of household budgets. Its exclusion from CPIH risks undermining public confidence in the measure. There is a clear justification for considering council tax as an indirect tax on consuming housing, and so belonging by definition in a consumer price index.

**Figure 9.7** shows what the impact of including council tax and Northern Ireland rates in CPIH would have been, if carried out throughout the CPIH time series. The impact is relatively small, ranging between +0.1 and -0.15 percentage points on CPIH. This is in part because council tax rises have been quite close to CPIH; council tax was rising at around 4 per cent between 2006 and 2008, but was substantially below CPIH from 2011 onwards.

**Figure 9.7: CPIH including and excluding council tax, 2006-2013**
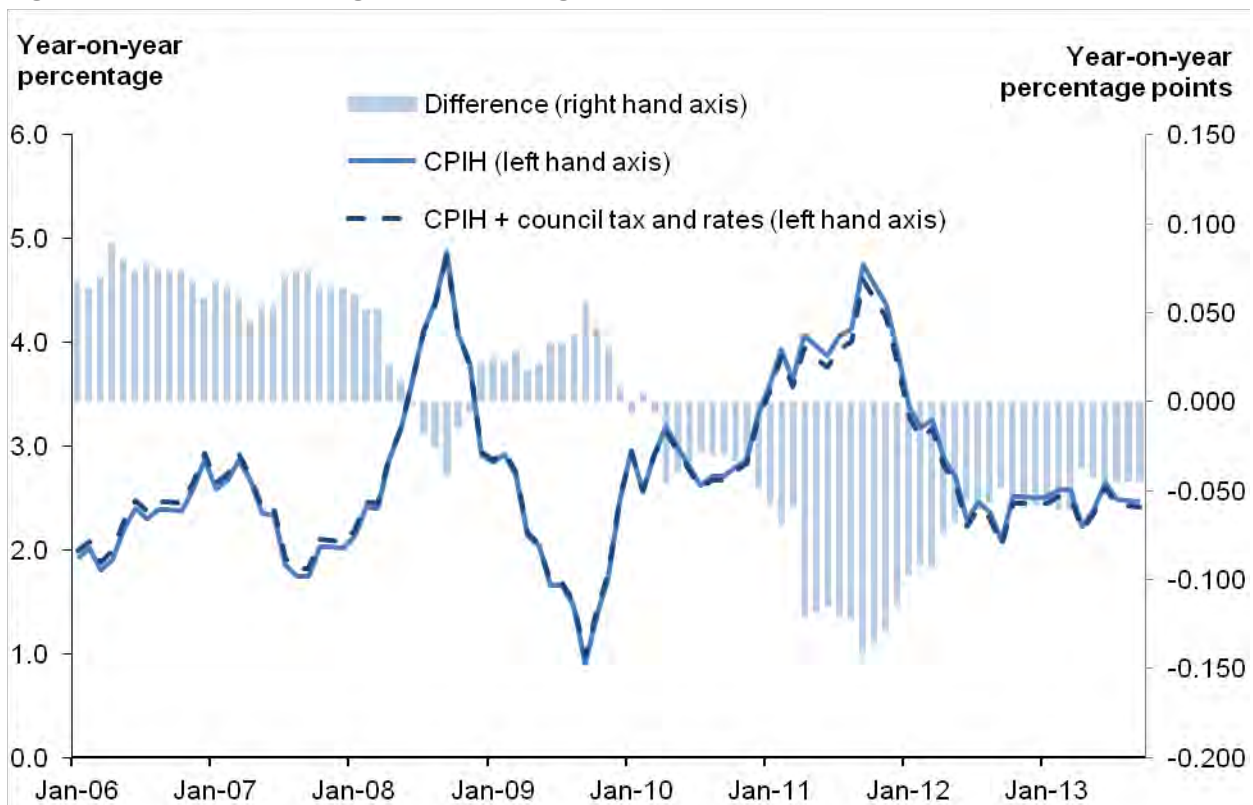


Source: ONS calculations for the Johnson Review. Based on analysis of CPIH as published in 2014

## 9.16 Conclusions

Rental equivalence is an internationally-recognised method for measuring owner occupiers' housing costs. The assumptions underpinning rental equivalence seem reasonable in the context of the UK, and ONS has access to a large, detailed data source on private rents to underpin the

measure. There are significant issues with accurately measuring price for major elements of the other approaches. **ONS should continue to produce CPIH using "rental equivalence" as the method for calculating owner occupiers housing costs.**

There have however been serious problems getting a correct measure of how rent levels change over time – a crucial input into calculating rental equivalence. These problems led to the suspension of the National Statistics status of CPIH. Since then ONS has done a great deal of work identifying and addressing shortcomings in the process used to measure the growth in private rents and hence produce the OOH index. This will improve measurement substantially.

However, there remains a puzzle in that the rental index still grows considerably less quickly than most measures of actual rent levels. This is not an uncommon feature of price indices in the context of quality change. But there is more to be done to explain this difference between the private rent index as measured in CPIH and other sources. At the time of writing, this difference has not been fully explained. **ONS should produce a full explanation of the difference between the rise in the owner occupiers' housing costs component and the larger rise in private rents measured by the VOA and other sources.**

The measurement of owner occupiers' housing costs continues to develop. Some experts are starting to suggest that the rental equivalence method should only use prices from properties let in the current month, as this is what the current rental market is. Others advocate an opportunity cost approach which combines the user cost and rental equivalence approaches. ONS will need to consider developments in the methods and data available for measuring housing costs as part of its ongoing work, to ensure that its measurement of owner occupiers' housing costs remains in line with best practice.

Finally, we have considered the arguments for and against the inclusion of council tax. In our view, council tax can be considered an indirect tax on living in a house, and is perceived by most people as a payment made by households, rather than a deduction from income. We believe CPIH will command more confidence amongst the general public if council tax were to be included. **The UK Statistics Authority should consult on including council tax in CPIH.**

# 10. The use of unweighted averages in consumer price statistics

## 10.1 Introduction

Price indices are formed by weighting and aggregating prices. At the lowest level, this means combining price quotes collected from a range of shops for products that meet a common specification. These are then used to calculate an average price change. An example would be combining prices for an 800g sliced white loaf of bread from different shops in a region.

Ideally, these averages would be weighted according to the shares of spending that each product priced accounted for. In practice, statistical agencies often do not have this information for individual products and must use an unweighted average instead.

This chapter begins by introducing the three unweighted averages that are used in the UK's consumer price statistics. It describes the debate over the use of these averages in the UK. We then discuss the various approaches that have been used to justify different unweighted averages, before drawing our conclusions.

## 10.2 Types of unweighted averages

There are many ways of combining price quotes without weights to produce an unweighted price index. Three are used by ONS. These indices are not new; even the most recent here is over 100 years old. The indices are named for economists associated with their use.

The first index is the arithmetic average of price relatives. The price relatives (current period price divided by base period price) of all the products in the elementary aggregate are added up and divided by the number of products. This is commonly known as the **Carli** index.

The second index is the ratio of the arithmetic averages of prices. The current period prices (not price relatives) of all the products are added up and divided by the number of products to get an average current period price. The process is repeated with base period prices to get an average base period price. The average current period price is divided by the average base period price to give the index. This is commonly known as the **Dutot** index.

The third index in use is the geometric average of price relatives. The price relatives (current period price divided by base period price) of all the products are multiplied together. The $n$th root of the result is taken, where $n$ is the number of products. If there were two products, a square root would be taken. Three products would mean a cube root, and so on. This index is known as the

**Jevons** index. The Jevons is also the ratio of the geometric mean price in the current and base periods.

**Box 10.1** gives an example of the three types of elementary average calculated from an example set of data. The index number formulae can be found in Annex C.

**Box 10.1: The three unweighted averages used by ONS**

**Figure 10.1** sets out some example data for six products, from which the three unweighted averages used by ONS are calculated.

**Figure 10.1: Illustrative price data for six products**

|  | Base period price | Current period price | Price relative |
|---|---|---|---|
| Product 1 | 2.50 | 5.00 | 2.00 |
| Product 2 | 3.00 | 3.00 | 1.00 |
| Product 3 | 2.50 | 2.00 | 0.80 |
| Product 4 | 4.00 | 4.20 | 1.05 |
| Product 5 | 3.50 | 4.20 | 1.20 |
| Product 6 | 4.00 | 3.40 | 0.85 |

**Carli:** Arithmetic average of price relatives:

= (2 + 1 + 0.8 + 1.05 + 1.2 + 0.85) / 6                **= 1.15**

**Dutot:** Ratio of arithmetic average prices in the current and base period:

Current period average price = (5.00 + 3.00 + 2.00 + 4.20 + 4.20 + 3.40) / 6 = 3.6333...

Base period average price     = (2.50 + 3.00 + 2.50 + 4.00 + 3.50 + 4.00) / 6 = 3.25

Ratio of average prices        = 3.6333... / 3.25       = 1.1179...      **= 1.12**

**Jevons**: Geometric average of price relatives

= $(2 × 1 × 0.8 × 1.05 × 1.2 × 0.85)^{1/6}$ = 1.0939... **= 1.09**

Equivalently, the ratio of the geometric mean prices in the current and base periods:

Current period geometric mean price = $(5.00 × 3.00 × 2.00 × 4.20 × 4.20 × 3.40)^{1/6}$ = 3.4875...

Base period geometric mean price = $(2.50 × 3.00 × 2.50 × 4.00 × 3.50 × 4.00)^{1/6}$ = 3.1881...

Ratio of average prices        = 3.4875... / 3.1881    = 1.0939...       **= 1.09**

When price relatives are close to each other, the three unweighted averages give similar results. Typically, the Dutot and Jevons give relatively similar results to each other (see ILO, 2004, Ch20, pp362-3). It is a mathematical result that the Carli index will always give results equal to or higher than the Jevons; the greater the variation in price relatives, the bigger the difference tends to be.

## 10.3 The use of unweighted averages in the four main measures of inflation

**Figure 10.2** gives an indication of the level of usage of each unweighted average in the four main measures of inflation.

**Figure 10.2: Formulae used in current headline indices, 2012, per cent of index total weight**

|                          | CPI | CPIH | RPI | RPIJ |
|--------------------------|-----|------|-----|------|
| **Carli**                | 0   | 0    | 27  | 0    |
| **Dutot**                | 5   | 4    | 29  | 29   |
| **Jevons**               | 63  | 55   | 0   | 27   |
| **Other / weighted formula** | 33 | 41 | 43 | 43   |

Source: Consumer Price Inflation, ONS and Johnson Review calculations

The CPI uses Jevons in almost every case where no weights are available; the main exception where Dutot is used is for petrol and diesel prices[9]. CPIH incorporates imputed rentals, which use a mix of the Jevons average to combine price quotes within individual strata, and weighted arithmetic averages to combine the strata.

The RPI and RPIJ use the Dutot for items where there is relatively little variation in price between products, such as food, alcohol, tobacco and personal goods. For items where there is more variation within the item description, such as for household appliances or furniture, the Carli (for the RPI) or the Jevons (for RPIJ) is used. This is because the Dutot can produce odd results when products at very different price levels are combined, as discussed further in Section 10.9.2. RPIJ was created to use the Jevons as a direct result of concerns regarding the Carli, which are detailed in the course of this chapter.

In around 30 to 40 per cent of cases, ONS has some information with which to weight prices. For some items, such as gas and electricity bills, car purchases, and mobile phone charges, these weights are available at the lowest stage of aggregation. In these cases, one can use a weighted index number formula. In other cases, ONS has some weighting information but at the very lowest level an unweighted average is needed; holidays are one example of this.

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[9] Petrol and diesel prices are collected as weekly average prices, which are then combined into a monthly average using the Dutot formula.

## 10.4 A brief history of the issues with the Carli index

It was in the 1970s that price statisticians first started to have concerns regarding the Carli index. These concerns centred on how the Carli index behaves across a chain-link.

Consider three periods in succession. Prices change between the first and second period (for example, a sale) but then revert to their original price in the third month, a phenomenon known as *price bouncing*. If one calculated the price index for change from the first to the second period, and again from the second to the third period, one would expect the index for the first and third periods to be the same. This is true of the Dutot and Jevons indices, but not of the Carli.

This matters if the Carli index is used in a chain-linked price index (which consumer price indices generally are between years). In fact, the Carli index always gives an equal or higher value under these circumstances, leading statisticians to describe it as "upwardly biased". An illustration of this effect can be found in Section 10.9.1.

This problem was significant enough for Statistics Canada to replace the Carli index in 1978 (ONS, 2012), initially with the Dutot index. When the Harmonised Index of Consumer Prices was developed in the 1990s, the use of Carli was effectively banned under the regulations, with Dutot or Jevons to be used instead. Empirically, the Jevons and Dutot tend to be more consistent with one another than with the Carli. It was at this point that the UK first began publishing indices using different unweighted averages: the RPI with the Carli and Dutot, and the HICP (later to become the CPI in the UK) with the Jevons and Dutot.

## 10.5 Elementary aggregates and lower level substitution

Around the same time as the introduction of the HICP, in the United States the Boskin Commission was publishing its report on the US CPI. Boskin et al (1996) argued that unweighted arithmetic averages were biased upwards because they did not take account of the response of consumers to changes in price. Boskin further argued that geometric averages better reflected substitution towards products whose prices were increasing less quickly.

Suppose we are choosing a variety of apple to buy. We bought Royal Galas in the base period. In the second period, we notice that Royal Galas have become more expensive, but Red Delicious (which we like just as much) have become cheaper. We switch to Red Delicious, and we are just as happy. Substitution behaviour is discussed in more detail in Chapter 7 of this report.

Boskin argued the Jevons index modelled this substitution behaviour better than the Carli. As discussed in Section 10.10, there are serious issues in using substitution behaviour as a rationale to choosing between unweighted averages. Even so, Boskin's recommendations were influential. The US switched to using Jevons in 1999. Over the next few years, many other countries followed suit, giving consumer substitution behaviour as one reason for making the change. Many of these countries were using the Dutot index before this point; the Dutot tends to be numerically closer to the Jevons than the Carli is, reducing the impact of making the change.

The UK published its response to the Boskin report in 1997, saying it would investigate arguments for the use of the different unweighted averages. However, while ONS examined the issue in detail, the findings were not acted on. At the time, the ONS's main focus was on developing the measure known today as the CPI so that it met legislative requirements.

## 10.6 The formula effect in the UK

From the late 1990s onwards, ONS published two different measures of inflation: the RPI and CPI. Amongst other differences in scope and coverage, the two use different unweighted index formulae. The difference between the RPI and CPI resulting from the different formulae is referred to as the "formula effect".

It is possible to estimate the formula effect separately from the other differences between the RPI and CPI, as shown in **Figure 10.3**. Indeed, ONS has published these estimates for many years. The formula effect (other things being equal) makes the RPI larger than the CPI. This is because, as a mathematical result, the Carli index will always be equal to or higher than the Jevons index.

**Figure 10.3: The formula effect, 1997-2013 (RPI compared with CPI annual growth rates)**
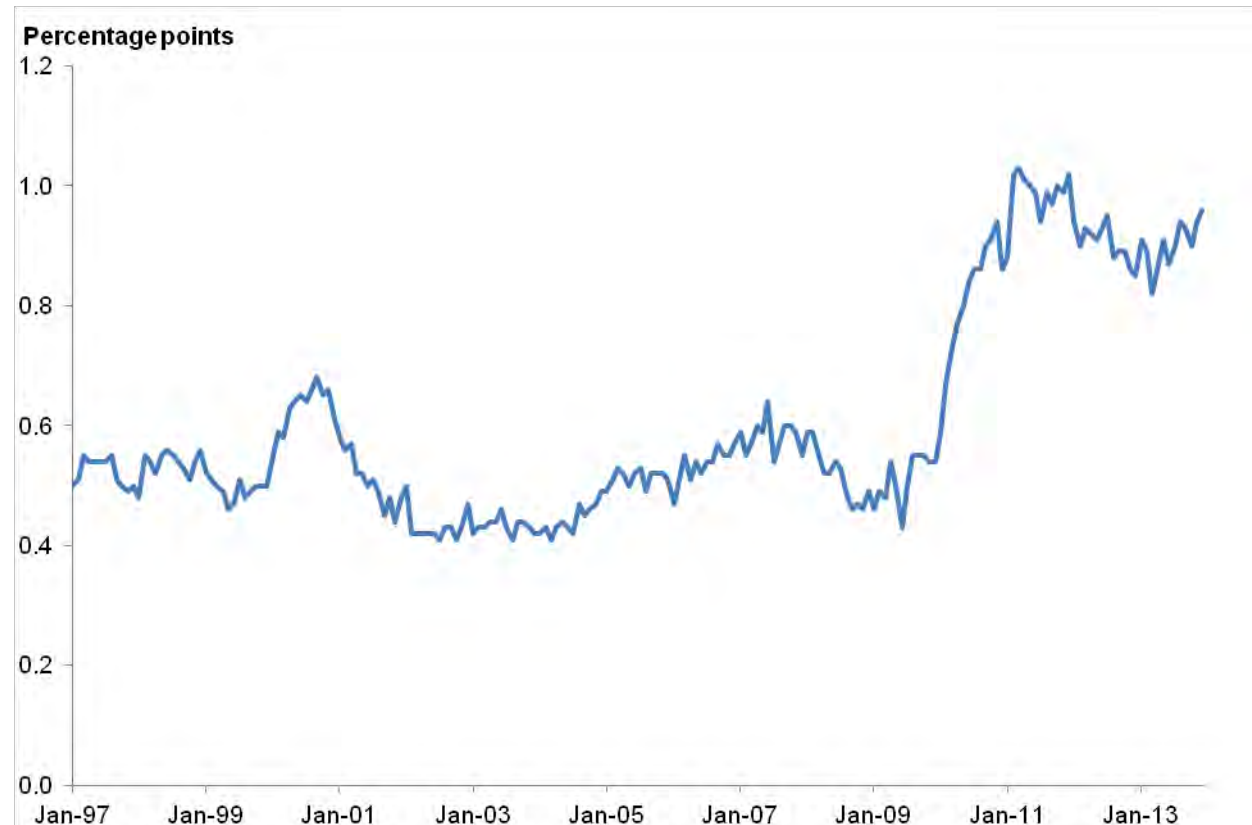


Source: Consumer Price Inflation, ONS (reconciliation of the RPI and CPI)

The formula effect was fairly consistent over time between up to 2010, varying between 0.4 and 0.6 percentage points in size. But then the formula effect increased from 0.6 to 0.9 percentage points during 2010, and has remained at broadly this level since.

When the increase in the formula effect became apparent in 2010, ONS investigated the causes. ONS had made some changes to the collection of clothing prices, intended to improve the estimates of clothing inflation in the CPI. It appeared that these changes caused both the RPI and CPI to increase, but the increase in the RPI was larger. This led to ONS taking a broader look at the Carli, Dutot and Jevons index formulae.

## 10.7 Consultation and the National Statistician's decision on the RPI

In late 2012, ONS and the Consumer Prices Advisory Committee (CPAC) reached the conclusion that the use of the Carli index at the elementary aggregate stage was not methodological best practice, and should be reconsidered. This view was based on the inferior properties of the Carli index (see Section 10.9.1), the resulting upward bias of the Carli compared to other unweighted indices, and the fact that no other major national statistical institute was using the Carli (ONS, 2012a).

In October 2012, the National Statistician consulted users on what should be done about the RPI, in light of the shortcomings of the Carli index (ONS, 2012b). As described in Section 3.8 of this report, the National Statistician's recommendation was to retain the Carli index in the RPI. The RPIJ measure was also introduced, which replaces the Carli index with the Jevons index.

## 10.8 Different approaches to choosing an unweighted average

The problem of which unweighted average formula is most suitable is one that index number experts have been wrestling with for a long time. A number of different approaches have been developed to answer this question:

- The **test** (or **axiomatic**) approach, where indices are compared against a set of desirable properties.
- The **economic** approach, which considers which index most closely approximates consumer behaviour in response to changing prices.
- The **stochastic** approach, which looks at the distribution of price relatives to determine an appropriate index to aggregate them.
- The **sampling** approach, which considers how closely unweighted indices approximate weighted indices.

In addition, there are other statistical considerations and arguments which were relevant to the National Statistician's decision, and which also inform the view formed by this Review:

- Issues with the **numerical performance** of the indices
- Comparisons with practice in **other national statistical institutes.**
- The possibility of **tightening item descriptions** in order to reduce price dispersion.
- How easy the unweighted averages are for users to **understand.**

The following sections consider each of these approaches and the available evidence in turn.

## 10.9 The test approach

The test approach sets out a set of desirable properties for index number formulae to have. Experts differ on the relative importance of the tests, and an index failing a test does not necessarily mean that index is unsuitable. Even so, the tests tell us something useful about the performance of the three unweighted indices in practice.

The number of tests and the way they are set out depends on the author. The tests as we have considered them, are given in Annex D; they are based on the tests set out in the ILO CPI Manual (ILO, 2004, Ch20, pp363-4).

### 10.9.1 The Carli index under the test approach

The Carli index fails three of the tests: the "price bouncing" test, the time reversal test and the circularity test. Statisticians differ on the importance of the price bouncing and circularity tests, but most regard the failure of the Carli to pass the time reversal test as a significant shortcoming (Diewert (2013)).

The time reversal test looks at what happens if one calculates the price change between two periods in both directions. The desirable property is that one should be the inverse to the other. Put another way, if one calculates the change from the first to the second period, and the change from the second to the first period, and multiply the two together, the result should be 1.

Not only does the Carli index fail this test, but it fails in one direction – the value is always greater than 1. It is this property of the Carli index that gives rise to the phenomenon of "chain drift". As described earlier, this property of the Carli was enough for some countries to abandon using it.

Consumer price indices are chained every time the basket is updated. In most countries, this occurs every two or three years, but in the UK chain-linking is annual. In most other situations, this is an advantage of UK consumer price statistics as they can more closely reflect what consumers are buying. But in the context of the chain drift problem, more frequent chain linking leads to greater scope for chain drift. This is illustrated in **Figure 10.4**:

**Figure 10.4: Illustrative example of chain drift in the Carli index**

| | Prices | | | Price relatives | | | |
|---|---|---|---|---|---|---|---|
| | Period 0 | Period 1 | Period 2 | Period 1 / Period 0 | Period 2 / Period 1 | Period 2 / Period 0 | |
| Product 1 | 100 | 150 | 200 | 1.50 | 1.33 | 2.00 | |
| Product 2 | 200 | 100 | 200 | 0.50 | 2.00 | 1.00 | |

| | | | | Price indices | | | |
|---|---|---|---|---|---|---|---|
| | | | | Period 0 to Period 1 | Period 1 to Period 2 | Period 0 to Period 2 Direct | Period 0 to Period 2 Chained |
| **Carli** | | | | **1.00** | **1.67** | **1.50** | **1.67** |
| Dutot | | | | 0.83 | 1.60 | 1.33 | 1.33 |
| Jevons | | | | 0.87 | 1.63 | 1.41 | 1.41 |

The direct index in **Figure 10.4** is calculated from the changes from period 0 to period 2; the chain-linked measure is calculated by multiplying the period 0 to 1 change by the period 1 to 2 change. The two approaches should give the same result but for the Carli index, they do not. This would not be an issue for an index that is not chain-linked. However, consumer price indices in the UK are chain-linked, so that different years (where different products, items and outlets are collected) can be combined into a single, continuous, time series.

In practice, price indices are linked at higher levels of aggregation (see Chapter 2 for details). It is the interaction between the higher level formula (a weighted arithmetic average called a Lowe index) and the unweighted average that causes chain drift. This interaction effect between the Lowe and the unweighted average means that indices using Jevons and Dutot at the elementary aggregate level will also exhibit some chain drift.

The likely impact of chain drift has been analysed in ONS (2014). This analysis is based on locally-collected UK price data (as used in the CPI) for 2009 and 2010. An artificial chain-link has been introduced in the middle of the year, so the impact of chain drift can be examined at the class level without changes to the weights and items in the basket having an effect.

This is illustrated in **Figure 10.5**, taken from that paper. Each point in the chart represents one class of the CPI in either 2009 or 2010. The y-axis indicates the index level in that year; the x-axis the amount of chain drift (the difference between the direct and indirect index). The results suggest that chain drift is substantially higher when a Carli index is used at the elementary aggregate level, compared with both the Jevons and Dutot indices.

**Figure 10.5: Chain drift in class level indices using different unweighted averages, 2009 and 2010**
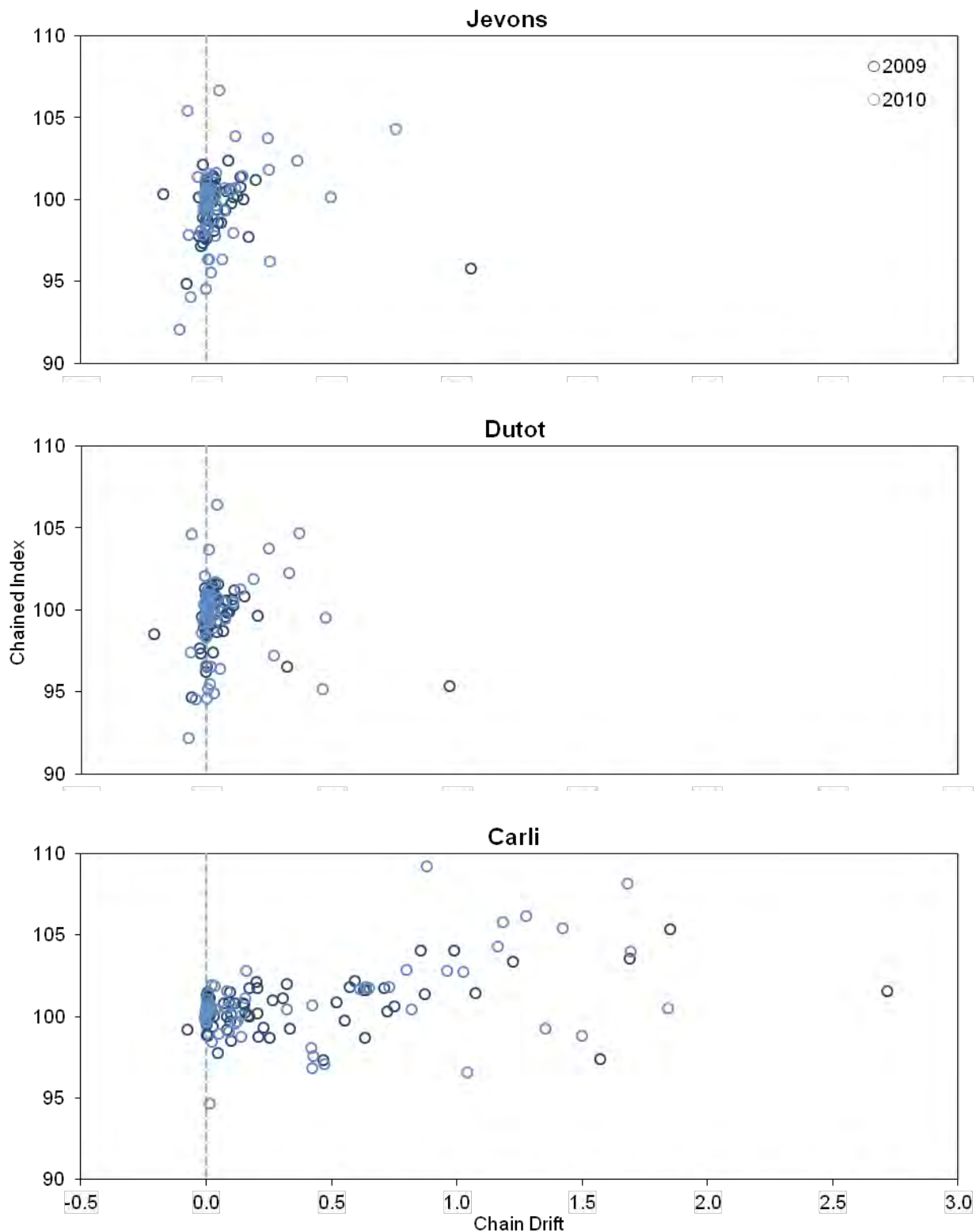


Source: ONS (2014). Each point represents on class index in either 2009 or 2010, Based on locally collected CPI data.

### 10.9.2 The Dutot index under the test approach

The Dutot index fails one of the tests, the "commensurability" test. This is seen as a serious issue for the Dutot index. In real terms, the impact is that Dutot indices are dominated by the price movements of products with high prices. An illustrative example of this in action is shown in **Figure 10.6**.

**Figure 10.6: Illustration of the impact of price level on the Dutot index**

| | Example 1 | | | | Example 2 | | |
|---|---|---|---|---|---|---|---|
| | **Period 0 price** | **Period 1 price** | **Price relative** | | **Period 0 price** | **Period 1 price** | **Price relative** |
| Product 1 | 100 | 150 | 1.50 | | 1000 | 1500 | 1.50 |
| Product 2 | 80 | 100 | 1.25 | | 80 | 100 | 1.25 |
| Product 3 | 200 | 210 | 1.05 | | 200 | 210 | 1.05 |
| Product 4 | 100 | 90 | 0.90 | | 100 | 90 | 0.90 |
| | | | | | | | |
| Carli | | | 1.18 | | | | 1.18 |
| **Dutot** | | | **1.15** | | | | **1.38** |
| Jevons | | | 1.15 | | | | 1.15 |

The price changes of the four items are the same in both examples in Figure 10.6. The only difference is the price of item 1 is higher in the second example. The Carli and the Jevons indices give the same results. The Dutot index however is much more affected by the price change of item 1 and as a result the Dutot shows a bigger increase in this example.

The advice given to statistical agencies is not to use Dutot in cases where different products in an elementary aggregate have significantly different prices (ILO, 2004, Ch20, p364). This is the reason why the RPI and RPIJ only use the Dutot for items where the prices of products are relatively similar.

### 10.9.3 The Jevons index under the test approach

In contrast to the Carli and the Dutot indices, the Jevons index passes all 12 of the tests set out in the ILO CPI Manual. However, it should be noted that the Jevons behaves somewhat erratically under some numeric conditions (see Section 10.13).

### 10.9.4 Summary of the test approach

We give some weight to the results that follow from the axiomatic approach in reaching our view on unweighted averages. In particular, the Carli index fails the time reversal test, which leads to a considerable increase in the chain drift of the aggregate measure and is likely to be contributing to the formula effect. The Dutot index fails the commensurability test, which restricts its usefulness to cases where items are relatively homogeneous.

## 10.10 The economic approach

The economic approach relies on the idea of consumers buying the combination of goods and services that gives them most satisfaction (utility).  It asks how much more it costs consumers to get the same utility in the current period as they did in the base period. As summarised in ONS (2012b, pp14-15), different EA formulae have been interpreted as implying different levels of substitution. The Carli and Dutot have been interpreted as being consistent with no substitution, within a simple model of consumer behaviour. The Jevons was interpreted as being consistent with the quantity of a product purchased varying in inverse proportion to the change in that product's price.

As described in Diewert (2012), the economic approach has been used to argue that the unweighted average should be selected based on which assumption of substitution behaviour is better. If consumers tend not to substitute, then either the Carli or Dutot index should be preferred. If consumers substitute away from goods that increase in price (relative to others), the Jevons index is more suitable.

It is this argument that lay behind Boskin's statement that the US CPI suffered from "lower level substitution bias", as it did not reflect consumer substitution towards products that increase in price less. ONS's research also indicated that the substitution argument was the rationale behind some countries' decision to choose the Jevons over the Dutot.

Implicit in this argument is the idea that the target index should be a Cost of Living Index, one that reflects substitution behaviour (see Chapter 7 for more details). That is not currently the explicit target of any measure currently being produced by ONS, with the CPI (as defined by Eurostat) being a measure of "pure price change".

The ILO CPI Manual (ILO, 2004, Chapter 20, pp364-366) is often cited in support of applying the economic approach to the choice of unweighted average. The author of this chapter of the manual, Prof. Erwin Diewert, has since said that this was not appropriate and went as far as describing the inclusion of this material in the ILO CPI Manual as "a mistake" (Diewert, 2012, p87). In Diewert's view, the economic approach is only appropriate when one has weights for the data. By definition, this is not the case when choosing an elementary aggregate formula.

The ONS had previously placed some weight on the substitution argument when considering its use of unweighted averages in the RPI. However, in the face of Diewert's report and their own

analysis, ONS changed its mind in late 2012 and stated that it would not be considering the economic arguments when choosing an unweighted average (ONS, 2012b, p15).

This change of emphasis has been unfortunate. Much effort had been put into explaining the arguments around substitution, so the fact that these arguments became redundant in late 2012 has caused confusion.

In summary, the argument that the Jevons index is preferable because it allows for substitution is *not* key to the choice of Jevons over Carli. We place no weight on the economic approach to choosing between unweighted averages. When no weights are available, the choice of aggregation method cannot be determined by views about the appropriateness of allowing for substitution.

## 10.11 The stochastic approach

It is possible to argue that the distribution of price relatives should determine the appropriate unweighted index (see, for example, ONS, 2012c). A normal distribution of price relatives would be evidence in favour of the Carli index, while a log-normal distribution would be evidence in favour of the Jevons index. This approach is known as the *stochastic approach*.

ONS tested this approach in ONS (2012c), using both ONS's production data and the same detailed price and expenditure data on alcohol purchases as was used to test the economic approach. The analysis suggested that neither distribution fitted the data well, providing no strong evidence for the Carli or Jevons indices.

## 10.12 The sampling approach and the question of the target

Related to the stochastic approach, the sampling approach considers what it is that the unweighted index is attempting to approximate, and then tests how well it estimates it. This is known as the *sampling approach*.

The target of the unweighted index has never been stated, for either the RPI or the CPI. When weights are available, ONS uses the Laspeyres-type Lowe index. This has led some to argue that the target of the unweighted index is the Laspeyres index. The Carli index is a theoretically unbiased estimate of the Laspeyres index, if sampling with probabilities proportional to expenditure shares (Balk, 2008) Therefore it is argued that the Carli should be used as the unweighted average.

In practice, ONS sampling procedure is some way from this. The probability of a particular store being selected is based on shop size, which is likely to have some relationship to expenditure shares. However, the choice of product within each store (see Section 2.4.1) is based on what is available and a judgement of what is typically bought in the area, rather than any sort of random sampling. In practice therefore, how good an estimate it is will depend on how close the actual (unobserved) weights are to being equal to each other.

ONS tested the sampling approach in ONS (2012c), using consumer panel data on alcohol purchases. ONS found that, if the unweighted average is indeed attempting to estimate a Laspeyres, there is some evidence that a Carli is a better estimator of it than a Jevons, although unsurprisingly no unweighted average performs well as an estimate of a weighted average. The results are further limited by the set of items considered and the data source. For example, the results based on consumer panel alcohol data would not necessarily be the same for panel data on other items, or for the data collected by ONS for its consumer price statistics.

At most, the sampling approach provides weak evidence in favour of the Carli, and assumes that it is accepted that the goal of the unweighted average is to approximate a Laspeyres index.

## 10.13 Numerical behaviour of unweighted averages

When prices and price relatives are fairly similar to each other, the three main unweighted averages give similar values. As discussed in Section 10.9.2, when the prices of products in a given time period are very different, the Dutot can give quite different price changes to the other indices. This is related to the way the Dutot fails one of the standard tests of index numbers.

Both the Jevons and the Carli fail to return a result when the base price of an item is zero. In practice, at the level at which unweighted averages are used, this situation does not arise; individual products that have no base price do not appear in a price index.

A Jevons index can be highly influenced by very big increases or decreases in price of individual items. An example of the impact in a large fall in price in one item is shown in **Figure 10.7**:

**Figure 10.7: Illustration of the impact of large price falls on the Jevons index**

| | Example 1 | | | | Example 2 | | |
|---|---|---|---|---|---|---|---|
| | **Period 0 price** | **Period 1 price** | **Price relative** | | **Period 0 price** | **Period 1 price** | **Price relative** |
| Product 1 | 100 | 150 | 1.50 | | 100 | 150 | 1.50 |
| Product 2 | 80 | 100 | 1.25 | | 80 | 100 | 1.25 |
| Product 3 | 200 | 210 | 1.05 | | 200 | 210 | 1.05 |
| Product 4 | 100 | 90 | 0.90 | | 100 | 25 | 0.25 |
| | | | | | | | |
| Carli | | | 1.18 | | | | 1.01 |
| Dutot | | | 1.15 | | | | 1.01 |
| **Jevons** | | | **1.15** | | | | **0.84** |

In Figure 10.7, the difference between the two examples is that product 4 is now showing a much larger price fall between the two periods. This affects the Jevons much more than the other two indices. However, product 4 had to fall in price quite a long way to create this large a difference; a price relative of 0.25 means the price has fallen by a factor of four between periods 0 and 1. Such large falls are rare. Calculations carried out by ONS indicate that in 2013, the average number of price relatives per item of 0.25 or less (as product 4 in Figure 10.7) was 0.03 per cent.

## 10.14 International comparisons

As part of its work on the formula effect, ONS investigated the use of unweighted averages in other national statistics institutes, as presented in ONS (2012d). ONS asked which unweighted average countries used, whether this had changed, and why this was. In 2011, of the more than 30 countries examined by ONS, none of them were still using the Carli index[10].

The current position partly reflects the harmonisation brought about by the HICP amongst European Union member states. However, EU law does not prevent countries producing separate consumer price indices for their own purposes and indeed many member states do. However, only one other country, Slovenia, takes advantage of this flexibility to use a different formula in their national CPI.

As described earlier in this chapter, several countries, including Australia, Canada, Denmark and Italy, had previously used the Carli but moved to an alternative, usually the Jevons. In some cases,

[10] Israel, which was not covered by ONS (2012d), appears to use the Carli index.

this was due to concerns about the behaviour of the Carli index when chain-linked. In some other cases, the reason the country provided for the change was that the Jevons better reflected substitution behaviour.

As discussed in Section 10.10, we do not accept the economic argument for choosing between unweighted averages. However, this does not amount to an argument that the Carli is more appropriate than Jevons or Dutot. The fact that the Carli index is not generally used by other countries in their consumer price statistics is in our view evidence against the suitability of the Carli in the UK's consumer price statistics.

## 10.15 The impact of tighter item descriptions

One suggestion made during the consultation on the RPI in 2012 was that specifying items more precisely might go some way to addressing the issues around unweighted averages. If the prices of products were more similar to each other, the objection to using the Dutot formula (that it is overly influenced by more expensive products) would be less of an issue. In addition, if the price relatives were more similar to each other, the Carli and Jevons indices would be more similar to each other, and the formula effect would be smaller.

There are three main arguments against a general tightening in definitions. The first is that it is impossible to achieve in practice for many items. An example is wine: one can define a bottle of wine quite specifically and still encounter wide variations between products meeting the specification.

The second argument is that very tightly defined item specifications can make it much harder to find appropriate items to collect prices for, and harder to replace those items if and when they are withdrawn from sale. This leads to the index being based on fewer price quotes, specifically those products that are available throughout the year. This risks not being very representative of price trends of the item.

The third argument is that a price index calculated from very tightly defined items may, in any case, not be very representative of consumer price inflation. For example, one could specify a vacuum cleaner in such a way that only one cleaner on the market conforms to the specification. The prices collected for such an item would likely be similar. But unless most consumers were buying that particular vacuum cleaner, the resulting index would not be a particularly good reflection of the costs faced by consumers.

Even if it were possible to specify items in such a way that one could be assured that the resulting prices are reasonably homogenous, it is not clear to us that the Dutot would be preferable to the Jevons. It would deal with the main objection to using Dutot; it would not in itself provide an argument for not using Jevons. Similarly, even if it were possible to reduce the formula effect through tighter specification of items, the Carli index would still not be in line with international best practice.

## 10.16 Ease of understanding of unweighted averages

Some users have argued that the Jevons index is less suitable as an unweighted average because it is difficult to explain to the general public. The Jevons is certainly the least intuitive of the three; explaining "taking the $n$th root" in plain English is not straight forward. But in the context of the overall complexity involved in the construction of price indices, this feels like a minor issue relative to the big statistical issues of whether the methods used are unbiased and robust.

## 10.17 Conclusions

As stated at the beginning of the chapter, unweighted averages are less than ideal. They are used because of an absence of information to weight individual price quotes. An unweighted average that approximates the behaviour of a weighted average would be ideal, but ONS's analysis suggests that none of the unweighted averages are particularly effective at approximating weighted averages.

New data sources are helping to develop understanding of unweighted averages. They also raise the possibility of replacing them with weighted averages. In particular, shop scanner data (see Chapter 8) includes information on quantities purchased, which may diminish the need for unweighted averages, or remove it altogether.

However, some unweighted averages are clearly less appropriate than others. The ONS was slow to address known problems with the Carli index, only taking action when the increase in the formula effect was such that it could no longer be ignored. The evidence has not changed substantially since ONS and CPAC determined in late 2012 that the Carli index did not meet best international practice. Indeed, the one new piece of evidence supports the view that chain drift is a serious problem for the Carli index.

The Carli fails a number of the axiomatic tests in such a way that leads to it being upwardly biased when chain-linked. It is not in general use by other national statistical institutes. The Carli should not be used in any index aiming to achieve a good estimate of changes in consumer prices.

The Carli index is not suitable for use; it is less clear which of the Dutot or the Jevons is better. There are circumstances in which the Dutot index is not suitable; that is, when the items being priced are substantially different. However, the Jevons also behaves differently to the other averages when there are substantial price falls or increases. **ONS should review and publish its criteria for choosing how to combine price quotes at the lowest stage of aggregation.**

# 11. Specific design issues in consumer price statistics

## 11.1 Introduction

The construction of consumer price statistics is complex. One needs to determine what prices to collect, where prices are to be collected from, how often to collect them, and how to combine them to form an overall measure of price change. A description of the current process of collecting consumer price statistics can be found in Chapter 2 of this report.

This chapter focuses on three specific areas in the current design of consumer price statistics:

- Issues around the sources of higher-level weighting information, and the differences these introduce between the RPI and CPI;
- The treatment of different shop types in consumer price statistics;
- Determining where and when prices are collected.

Each of these three areas is explored in turn. This chapter also looks briefly at a small number of groups of items which we believe should be prioritised by ONS for further work.

## 11.2 Higher-level weights in the UK's consumer price statistics

In this report, the term "higher level weights" refers to weighting at the class level and above in the CPI and CPIH, and weighting at the section level and above in the RPI and RPIJ. Weights at the higher level for each index come from a single primary source: the household expenditure data in the National Accounts for the CPI and CPIH, and the Living Costs and Food Survey (LCF) for the RPI and RPIJ.

## 11.3 The household sector accounts

The National Accounts draw upon data from a wide variety of sources, where each source has been scrutinised in turn and found to be fit for purpose. In many cases, this is the Living Costs and Food Survey. However, if ONS finds that the Retail Sales Inquiry (for example) provides a more reliable picture of clothing expenditure, then the National Accounts allows these data to be used instead. **Figure 11.1** shows the different data sources used for each COICOP (Classification of Individual Consumption by Purpose) Division of expenditure. The weights are shares of expenditure, in parts per thousand. A weight of 95 means that division represents 9.5 per cent of total expenditure:

**Figure 11.1: CPIH household expenditure sources by COICOP Division**

| COICOP Division | 2013 weight | 2014 weight | Sources used |
|---|---|---|---|
| 1. Food and Non-Alcoholic Beverages | 95 | 95 | Living Costs and Food Survey |
| 2. Alcoholic Beverages and Tobacco | 38 | 38 | HMRC administrative data |
| 3. Clothing and Footwear | 60 | 60 | Retail Sales Inquiry |
| 4. Housing, Water, Electricity, Gas and Other Fuels | 244 | 265 | Living Costs and Food Survey<br>Local Authorities' administrative data,<br>Utility companies' administrative data |
| 5. Furniture, Household Equipment and Maintenance | 52 | 49 | Retail Sales Inquiry<br>Living Costs and Food Survey |
| 6. Health | 23 | 19 | Living Costs and Food Survey |
| 7. Transport | 128 | 130 | International Passenger Survey<br>Industry associations<br>Department for Transport<br>Department for Energy & Climate Change |
| 8. Communication | 26 | 26 | Large communication companies<br>Sector regulators<br>Living Costs and Food Survey |
| 9. Recreation and Culture | 123 | 121 | Retail Sales Inquiry<br>Living Costs and Food Survey |
| 10. Education | 18 | 19 | Living Costs and Food Survey<br>Department for Education |
| 11. Restaurants and Hotels | 103 | 102 | Living Costs and Food Survey<br>Armed Forces accommodation data<br>HMRC and market research survey for alcohol |
| 12. Miscellaneous Goods and Services | 90 | 76 | Bank of England<br>Financial Inquiries Surveys<br>Living Costs and Food Survey<br>Association of British Insurers |
| **All Divisions** | **1000** | **1000** | |

Source: Consumer Price Inflation, ONS

The primary data sources require some adjustment in order to match the National Accounts concept of household sector spending in the UK. For example, spending abroad by UK households is removed from the Living Costs and Food Survey totals. Surveys such as the Retail Sales Inquiry that collect data from businesses need to exclude spending by other sectors (for example, sales to other businesses).

The relative strengths of the different sources of data are taken account of when the National Accounts is balanced. To reach the final expenditure estimates, different sources of data – for example, on production, imports and exports – are reconciled and balanced to produce a coherent picture of the UK economy. This process is known as supply-use balancing.

The National Accounts is prepared using carefully constructed concepts, definitions and systems. This has advantages; for example, in helping to think coherently about the true cost to households of certain goods and services (such as insurance).

## 11.4 Issues with the use of the household sector accounts

The goal of the National Accounts is to produce the best possible picture of the UK economy. Revisions are an accepted part of this process; when better methods or data become available, the National Accounts can be changed. As a matter of policy, consumer price statistics are not revised. Revisions would be difficult for stakeholders such as holders of index-linked gilts and pensioners to accept. But this means that changes to consumer price statistics are only introduced going forward; the historic time series does not change.

To illustrate what this can mean in practice, we consider some examples drawn from the housing sector of the CPIH. The expenditure weights for this Division are shown in **Figure 11.2**.

**Figure 11.2: CPIH weights in the housing sector, 2010-2014 (all items = 1000)**

|  | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|
| 04.1 Actual rentals for housing | 48 | 51 | 57 | 55 | 59 |
| 04.2 Owner occupiers housing costs | 106 | 107 | 116 | 122 | 156 |
| 04.3 Regular maintenance and repair of the dwelling | 16 | 17 | 12 | 14 | 2 |
| 04.4 Water supply and misc. services for the dwelling | 9 | 10 | 10 | 10 | 10 |
| 04.5.1 Electricity | 17 | 16 | 18 | 17 | 18 |
| 04.5.2 Gas | 22 | 20 | 28 | 23 | 17 |
| 04.5.3 Liquid fuels | 1 | 2 | 2 | 2 | 2 |
| 04.5.4 Solid fuels | 1 | 1 | 1 | 1 | 1 |

Source: Consumer Price Inflation, ONS

The weight given to gas in CPIH fluctuates over the five years. This volatility is mainly caused by different levels of gas use by households. Each year reflects expenditure from two years earlier, price-updated to allow for changes in price. For example, the 2012 gas weight reflects gas spending by households in 2010, updated for price changes between 2010 and the end of 2011. In 2010, the weight is high because gas consumption that year was high; there were particularly cold spells of weather at the beginning and end of the year.

It seems clear that weather conditions particular to 2010 should not unduly affect the 2012 gas weight. There is a strong case for taking a rolling average of three years, as is done for other volatile items (such as insurance premiums).  This should be possible while remaining within HICP regulations. Article 3 of Eurostat regulation 1114/2010 states that weights from consumption patterns from two years previously should be used, "except in exceptional and duly motivated circumstances". Avoiding spurious movements in weights due to weather conditions would appear to be within the scope of this.

Weather conditions are not the main reason for the change in the gas weight between 2013 and 2014. Instead, information provided by the Department of Energy and Climate Change caused ONS to reassess the way it reconciled gas expenditure against other parts of the accounts. In the National Accounts, this led to the historic estimates of household gas spending being revised downwards. Consumer price statistics are not revised as a matter of policy, so the weight is changed going forward and not historically.

Fortunately, the impact of the difference in weights is not huge. Calculations carried out by ONS suggest that, had the corrected 2013 weights been used for CPIH, the CPIH 12-month inflation rate would have been around 0.03 per cent lower than the published figures.

The weight for owner occupiers' housing costs increased quite substantially between 2013 and 2014, and the regular maintenance and repair weight fell. Again, this is a result of a change to the National Accounts, but in this case it is a change in definitions that drives the changes in the weights.

In the 2012 National Accounts (published in 2013), the 2010 European System of Accounting was implemented. This clarified that repairs that would normally be carried out by landlords are considered part of owner occupiers housing costs.

As with the gas weight example, because of the "no revisions" policy, the weights in the CPI and CPIH could only be changed from 2014 onwards. In CPIH, this led to an increase in the weight for owner occupiers' housing (OOH) costs, and a reduction in the weight for regular repairs and maintenance. In the CPI, where OOH costs are excluded, the weight for regular repairs and maintenance fell, with the impact distributed proportionally over the rest of the basket. One consequence of this is that the 15 items that collectively represent "Regular Maintenance and Repair of the Dwelling" now contribute very little towards the CPI and CPIH.

The National Accounts provides the best available information for weighting a consumer price statistic. Part of the appeal is the continuous improvement of the sources and methods. This does however cause discontinuities in the CPI and CPIH when changes are made, due to the policy of not revising the CPI and CPIH.

It is important that statisticians in the National Accounts and Prices work areas within ONS proactively discuss upcoming changes to the National Accounts. This would enable Prices Division to have some input, and to make appropriate plans for changes being introduced. Prices Division would then be able to prepare their analysis on the likely impact of these changes, and make this analysis available to users when the new weights were introduced.

As an example, further changes are planned to the imputed rental part of the National Accounts, intended to bring the Accounts into line with the rental equivalence method used in CPIH. This will likely cause the weight for owner occupiers' housing costs in CPIH to change again. National Accounts and Prices Division have already begun to engage around the forthcoming changes, which should help ensure they are handled as smoothly as possible.

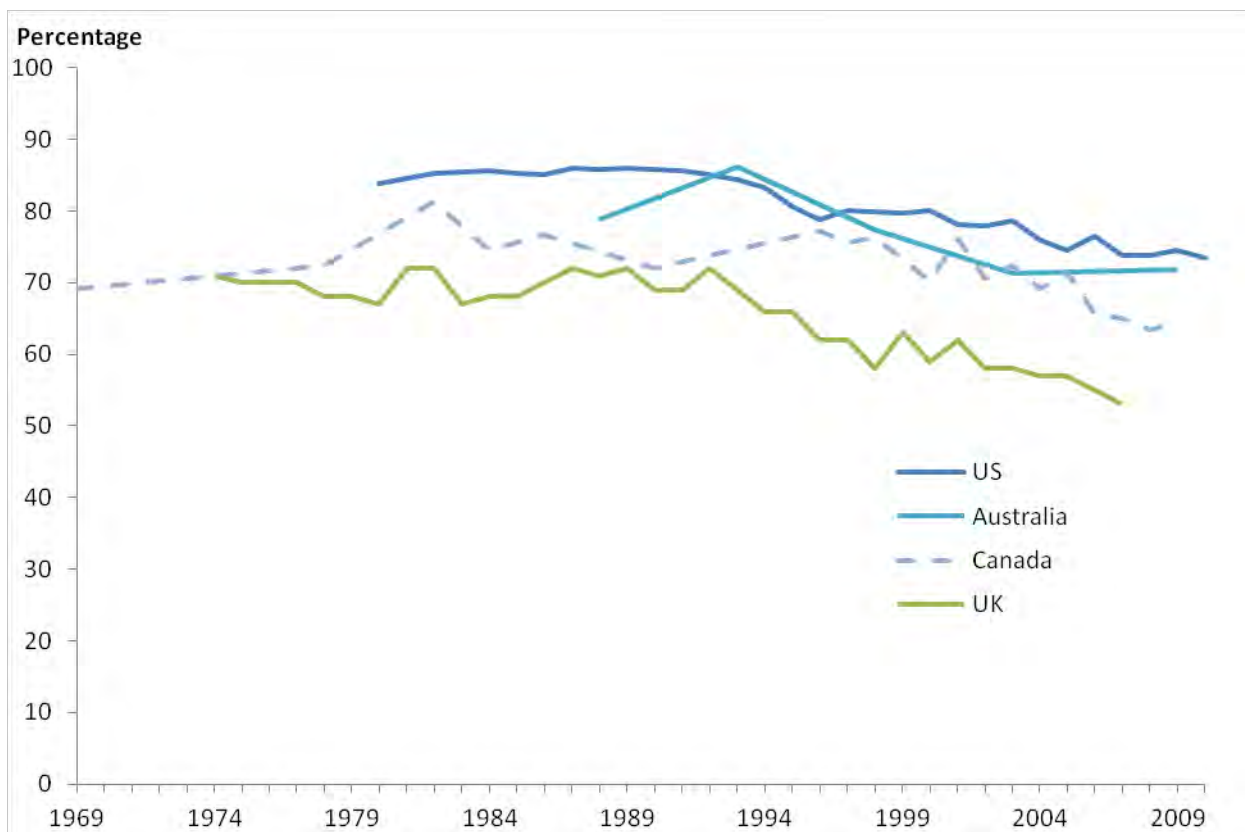## 11.5 The use of the Living Costs and Food Survey in upper level weighting

As described above, the Living Costs and Food Survey (LCF) informs a substantial proportion of household consumption expenditure in the National Accounts, and hence the weights in the CPI and CPIH. In the RPI and RPIJ, almost all of the weights are derived from the Living Costs and Food Survey. Additionally, many lower level weights are derived from the LCF. Any measure of inflation by subgroups, such as those discussed in Chapter 6 of this report, would rely on the LCF.

The UK has run a household spending survey annually since 1957. In 2001, the Family Expenditure Survey (FES) was merged with another survey to form the Expenditure and Food Survey (EFS). More recently, the EFS became part of the Integrated Household Survey (IHS) and the current name, the Living Costs and Food Survey, was adopted.

The LCF is a continuous household spending survey. Participation in the LCF is voluntary; in 2013, only 48 per cent of households approached provided a valid response. Each person aged 16 and over in the household is asked to keep a diary of their spending for two weeks, with children aged between 7 and 15 given a simplified diary. The survey uses an interview to collect information about regular spending (such as rent and mortgage payments), and big but infrequent purchases (such as cars).

The survey costs around £3.7m a year at present. This is less expensive than the Labour Force Survey, but the cost per achieved response is the highest of any social survey run by ONS. The sample in 2013 is roughly the same size as it was in 2000. However, the number of valid responses has fallen from around 6,500 in 1999-00 to 5,000 in 2013 (ONS, 2000, p164 & ONS, 2014a). Other ONS household surveys have also experienced a long-term decline in response rates. For example, the Wave 1 Labour Force Survey response rate fell from around 75 per cent in 2001 to under 60 per cent in 2014 (ONS, 2014b).

Declining response rates are also a problem in other countries' household spending surveys. Barrett et al (2013) show falls in response rates since 2000 in household surveys run by Australia, Canada and the United States. However, the response rate in the United Kingdom is lower than the other three countries, as shown in **Figure 11.3**.

**Figure 11.3: Household expenditure survey response rates in four countries, 1969 - 2010**



Source: Barrett et al (2013)

## 11.5.1 Sampling variability in the Living Costs and Food Survey

A reduction in the effective sample size, all other things being equal, will increase the uncertainty around the spending estimates the LCF produces. This in turn will increase the uncertainty around the weights used in the RPI and CPI that are based on LCF data. This is likely to be more of a problem for items purchased infrequently, and that represent a small share of overall household spending.

There is a natural limit to how far sampling variability in the LCF can be reduced. The survey would have to expand dramatically to reduce sampling variability to satisfactory levels on all areas of spending. The alternative strategy is to seek other, more precise sources of data and use these instead, the approach taken in the National Accounts.

## 11.5.2 Non-response error in the Living Costs and Food Survey

Bias may arise because the households that do respond to the survey are not representative of all households. The LCF corrects for non-response using a model based on household characteristics. The combined impact of weighting, first for non-response and then to make LCF representative of the UK population, is small. In 2012, weighted household spending was 0.4

percentage points lower than the unweighted figure. The non-response correction is in the process of being reviewed.

Other studies have pointed towards significant under-reporting in LCF expenditure. Barrett et al (2013) showed the coverage of the LCF (the proportion of household sector accounts spending captured by LCF) has been falling over time. Their findings are shown in **Figure 11.4**.

The authors find falling coverage in the household expenditure survey over time in both the UK and US. In Australia, coverage had been lower but has improved recently. The Canadian survey actually over-reports slightly, compared with their National Accounts. The authors suggest that the fall in coverage may be because of falling response rates, particularly in wealthy households. The 2013 UK coverage rate, using the same methodology, is around 71 per cent.

**Figure 11.4: Household expenditure survey coverage rates in four countries, 1969 – 2010**
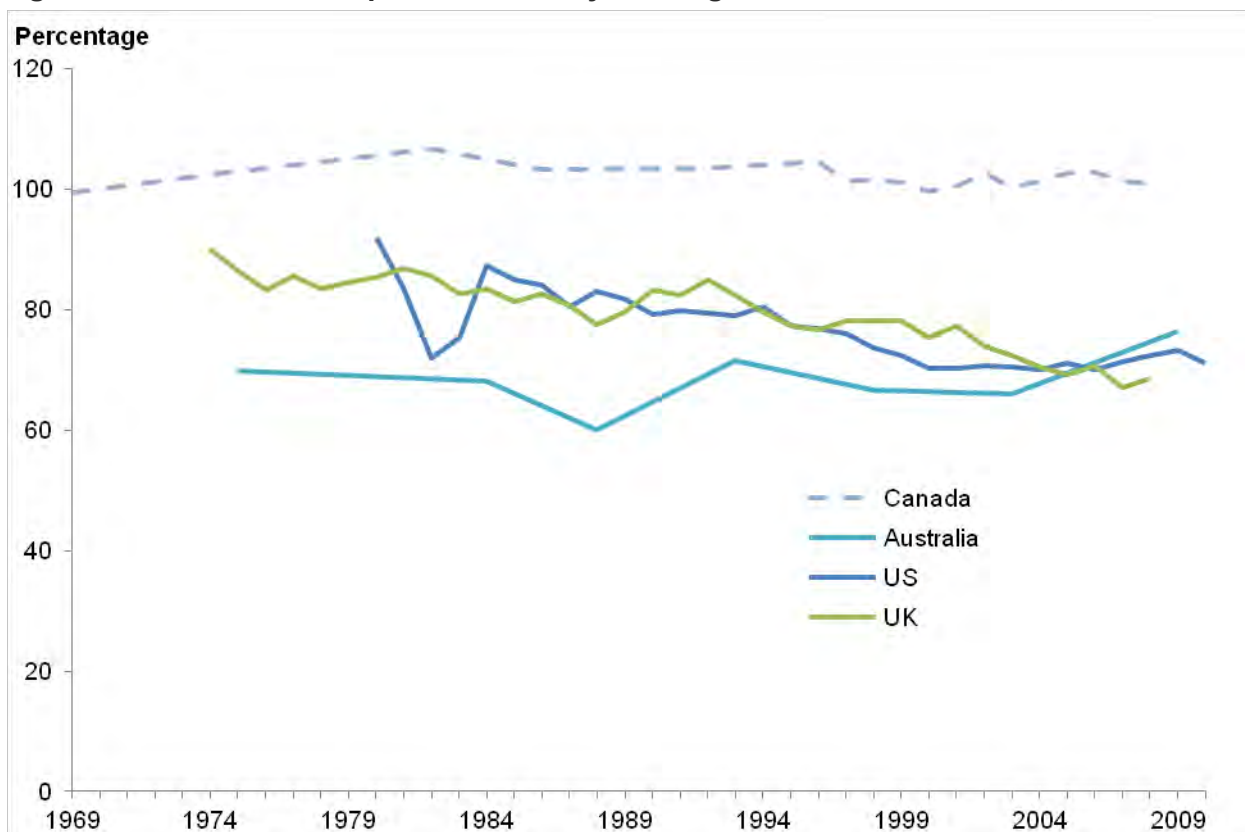


Source: Barrett et al (2013)

In the United States, concern regarding under-reporting in their Consumer Expenditure Survey has led to the US Bureau of Labour Statistics setting up the Gemini Redesign Project (BLS, 2012 & 2014). This is a major programme intended to lead to a feasibility test in 2018, and implementation at some point in the future. The project aims to reduce the measurement error in the survey, improve data quality and increase the flexibility of the survey tool, all without increasing the current operating budget of the survey. The Gemini Project vision document states that the primary use of their Consumer Expenditure Survey is to weight their consumer price indices. Many of the

challenges they face - busy respondents, privacy concerns, non-English speaking households - are challenges for the UK too.

ONS (2014c, pp78-79) gives an indication of the size of this effect at the class level. In a substantial majority of classes, expenditure as measured by the National Accounts is higher than that measured by the LCF. Some of the cases where the National Accounts appears to under-report are due to differences in definition (for example, the insurance weight is net of claims in the National Accounts, but not LCF).

A final, instructive example to consider is internet subscriptions, as shown in **Figure 11.5**. Spending on internet subscriptions, as measured by the LCF, was substantially lower than that measured by Ofcom until the end of 2010, but the two sources move into close alignment from 2011. This coincides with a change in the LCF questionnaire to better capture this form of household spending. This demonstrates that issues of under-reporting can go unaddressed for several years, but that it is possible to improve the LCF in these cases.

**Figure 11.5: LCF and Ofcom spending on internet subscriptions, 1997-2011**
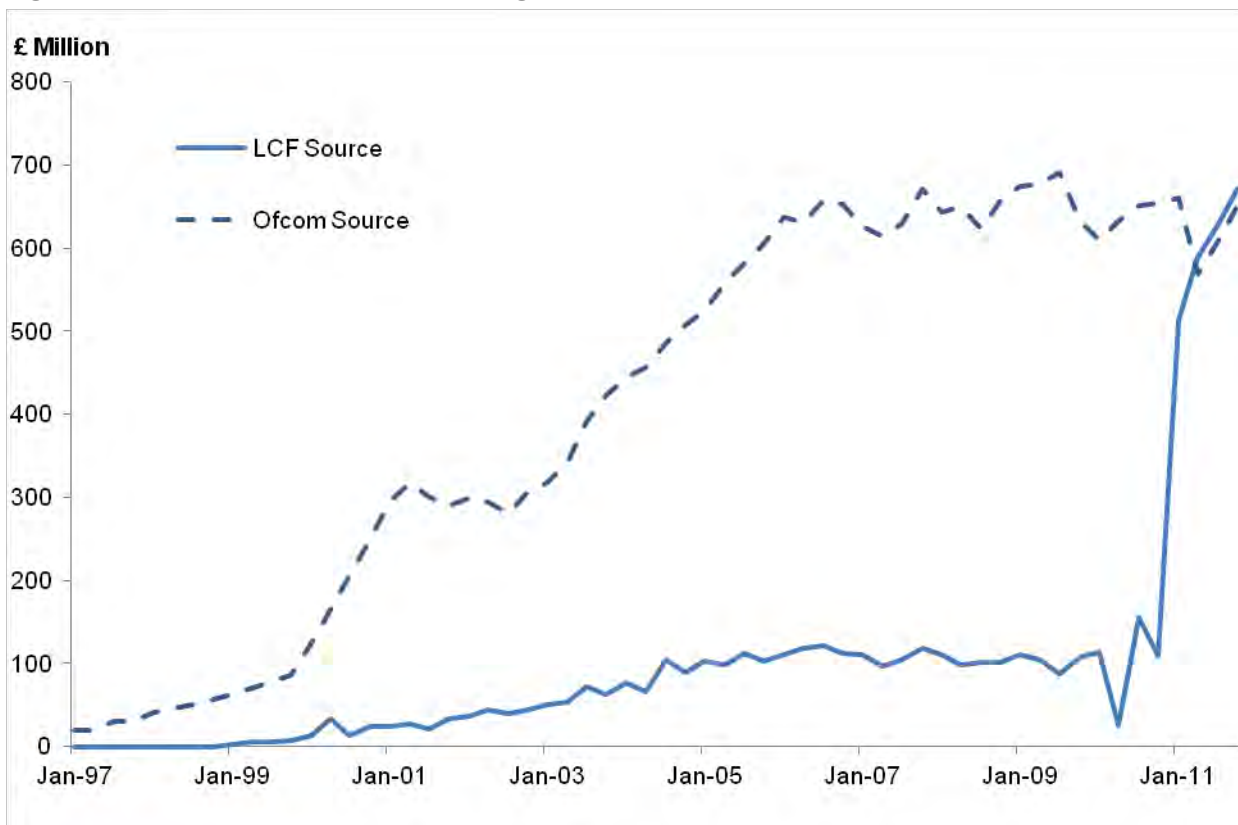


Source: National Accounts, ONS. Expenditure totals are quarterly.

In summary, the Living Costs and Food Survey is the most important single source of weighting information in the ONS's consumer price statistics. As discussed in this section, and in common with similar surveys, its response rate has declined, and the proportion of household expenditure covered by it has also fallen, with possible consequences for the accuracy of the resulting weights.

A review of the LCF is necessary to ensure that it continues to provide high quality, reliable data for weighting the consumer price statistics produced by ONS. This should include incorporating LCF into the ONS's electronic data collection programme.

## 11.6 Compiling and comparing RPI and CPIH weights

The weights used in ONS's consumer price statistics are sometimes interpreted as giving information on the changing trends in the spending of households over time. A user making such an interpretation would, however, have some cause for confusion. First, the RPI and CPIH (or CPI) have quite different weights, and sometimes move in different directions. An example of this is what has happened to the weights for gas and electricity over the last few years, as shown in **Figure 11.6**.

**Figure 11.6: Comparison of RPI and CPIH weights for gas and electricity, 2005–2014**

|  | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| CPIH Electricity | 12 | 14 | 17 | 16 | 18 | 17 | 16 | 18 | 17 | 18 |
| RPI Electricity | 15 | 15 | 18 | 16 | 23 | 18 | 20 | 21 | 20 | 22 |
| CPIH Gas | 11 | 13 | 16 | 13 | 22 | 22 | 20 | 28 | 23 | 17 |
| RPI Gas | 13 | 14 | 18 | 13 | 23 | 17 | 18 | 21 | 19 | 21 |

Source: Consumer Price Inflation, ONS

The RPI electricity weight shows an overall increase (with some fluctuations) over the period, while in CPIH the weight is broadly flat after 2009. The RPI weight for gas also generally increases over time but with some volatility, particularly between 2007 and 2010. The CPIH gas weight sees a step change between 2008 and 2009, a particularly high weight in 2012 and a fall in 2014. The issues around the CPIH gas weight were discussed in Section 11.4: the CPIH weights reflect weather conditions two years ago, and information from DECC led to National Accounts estimates on gas expenditure being lowered in time for the 2014 weight.

ONS discusses these issues in an annual article it publishes on the weights used in its consumer price statistics, the latest of which is ONS (2014d). However, the focus of this article, and previous ones, is very much on explaining the changes in the RPI and CPI weights in isolation. The differences in movements between the two measures are not explored.

Users should be aware that the published weights for the CPI and CPIH reflect the best available understanding of what households spend their money on in the UK at the time they were produced. However, because of the policy of not revising consumer price statistics, changes between years can reflect changes in sources and definitions, as well as changes in spending. The CPI and CPIH

weights should not be used to analyse trends in consumer spending in the UK over time, and this should be made clear to users.

## 11.7 The treatment of different shop types in consumer price statistics

The treatment of different types of shop in ONS's consumer price statistics is quite complex. A small number of items in the basket specifically relate to purchases made over the internet. For example, there is a "CD bought over the internet" item, distinct from purchases from physical stores, and uses weighting information from the LCF. However, for the great majority of items, where the item is purchased is not part of the description, and different shops and other outlets are combined.

Some items in the basket are stratified between independent and multiple stores. Retailers with ten or more shops are considered multiples, those with nine or fewer independents. The shop-type weights are created using data from the forerunner of ONS's Annual Business Survey (ABS). The weights have not been updated since 2006.

Within each stratum, prices for similar products from individual outlets are combined, in most cases using unweighted averages. Very large chains with regional or national pricing policies are visited once per region or country, and the prices collected are replicated (using shop replication factors) to compensate for the shops not visited.

This outline raises two main issues. First, the shop type weights are now seriously out of date, and should be revisited. The second issue is that the stratification is potentially no longer appropriate. In the past, a distinction was drawn between independent and chain stores because for some items, they were felt to experience different price movements. This may no longer be the appropriate distinction to make.

ONS investigated the impact of a more detailed stratification of clothing prices by outlet type in ONS (2012). The six outlet types were: supermarkets, high street stores, department stores, discount retailers, independent retailers and mail order companies. Data from the Retail Sales Inquiry was used to weight each of the outlet types separately. The results are shown in **Figure 11.7.**

**Figure 11.7: Impact of increased stratification on clothing CPI, 2006-2011**
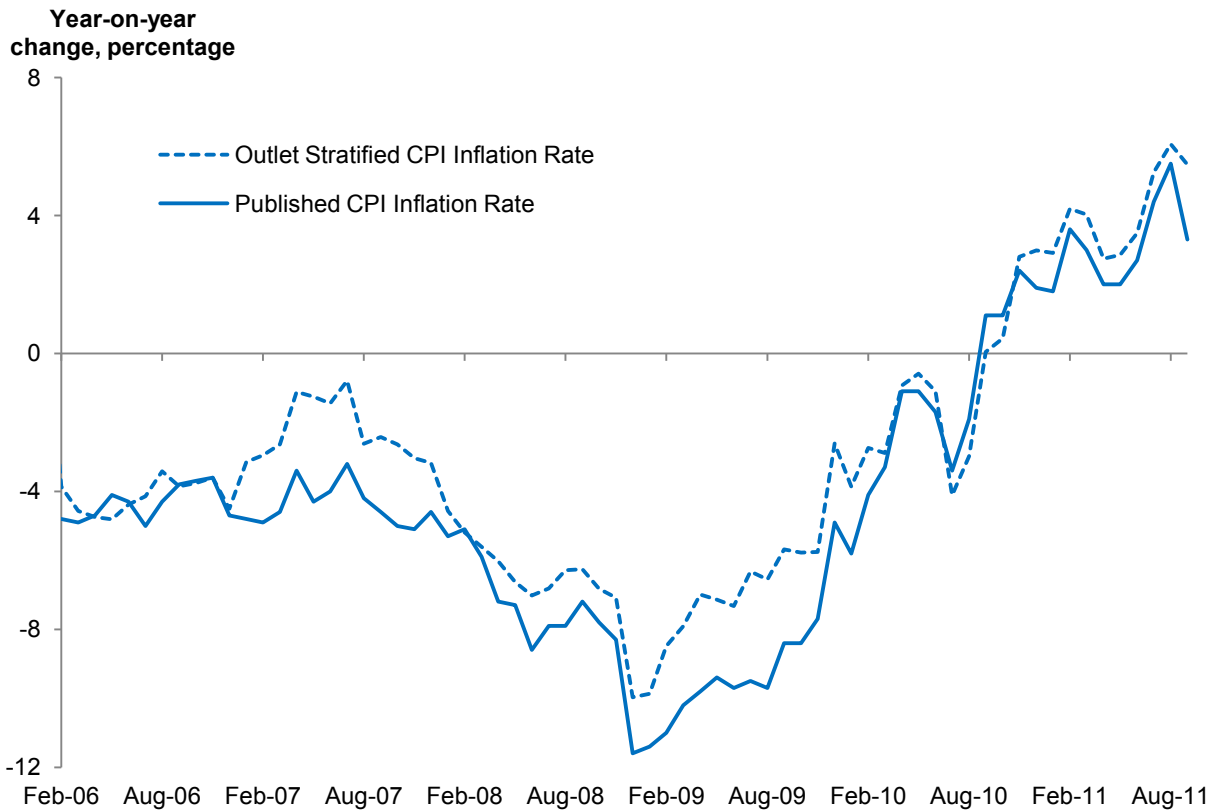


Source: ONS (2012)

The clothing CPI variant with six shop types produces an inflation rate that is on average 1.2 percentage points higher than the published CPI over the period January 2006 to September 2011. The gap is lower after the changes made to the collection of clothing items in 2010, averaging 0.6 percentage points from this point forward.

The fact that shop-type weights have not changed since 2006 is a cause for concern. ONS should look at ways in which it can update shop-type weights in the future. This should be considered more broadly; as will be discussed in the following sections, a different structure could have other advantages.

One possibility would be to consider using data from the Retail Sales Inquiry (used to produce the Retail Sales Index, or RSI) to weight by type of shop. There are areas of common interest between the Inquiry and consumer price statistics, where it should be possible for the teams to work together to improve both the RSI and consumer price statistics. For example, the Retail Sales Inquiry team would ideally have separate indices for internet sales. Separately stratifying internet sales in consumer price statistics could potentially improve these statistics and the RSI.

## 11.8 The impact of changing outlets on consumer price statistics

For many goods and services, the internet accounts for an increasing amount of purchases. In many cases, purchasing over the internet is cheaper than buying in physical stores. In other words, people are able to purchase the same product for less money than was previously possible. However, and perhaps counter-intuitively, this does not show up in a consumer price index as a fall in inflation.

Consider an extreme example. Suppose CDs can be purchased one year for £10 on the high street, and £8 over the internet. Everyone buys their CDs from the high street. The following year, the prices remain the same, but everyone purchases their CDs from the internet. The average price paid by consumers has fallen from £10 to £8. However, the price of a CD from both the high street and the internet has remained the same. Under such circumstances, all ONS's consumer price indices would show no change.

The rationale for this is that ONS's consumer price statistics are fixed basket indices. Between years, if a particular shop type starts to account for a greater share of total sales, then price changes at that shop type will in principle (if weights are available) start to have more weight in the index. However, the resulting change in the average price does not have an impact.

One interpretation of this is that goods and services purchased from different outlets should be considered different, even if the products themselves are the same. There may be differences in outlet convenience, terms and conditions, customer service, or the range of products available. But purchasing a CD (or other item) over the internet may not only be cheaper, but easier and more convenient than buying it from the high street. And still the fall in price is not accounted for in consumer price statistics.

One could make the comparison with technological change. When a manufacturing process becomes more efficient, a product becomes cheaper to make. If this fall in price is passed onto the consumer, one would expect this to show up in a price index, and it does. When a new distribution channel becomes available (such as the internet), the impact is not captured, for the reasons given above. Nor is the internet the first such innovation; the shift from small, local, shops to large supermarkets with distribution centres also reduced costs; this too is not captured by traditional consumer price statistics.

The Cost of Living conceptual framework (see Chapter 7) accounts for consumers moving to outlets where prices are increasing less rapidly, where it is termed outlet substitution. The Cost of Living framework also provides a way of reflecting such shifts, through the use of an appropriate (superlative) index number formula.

But a measure reflecting substitution behaviour would not capture the full impact of new outlets, because substitution is a response to price change, not price level. In the CD example set out earlier, the price of CDs at each outlet is not changing, but the price paid for CDs is. The concept being sought here is therefore closer to the average price paid for the item, across all outlets, rather than the average price change across outlets.

The question that traditional price indices ask – "how much more does it cost to buy a representative basket of consumer goods and services than a year ago" – is compatible with an approach that reflects changes in outlets. To calculate such a measure would require a change in index structure, and information on sales in different types of shop.  It might not be compatible with current EU regulations governing the HICP. However, as argued elsewhere, CPIH is within the UK's control. Including the impact of changes in outlets on the price paid by consumers should be considered by ONS as it reviews the way it stratifies its consumer price statistics by shop type.

## 11.9 Where and when prices are collected

ONS collects prices from around 140 locations around the UK, with a proportion of the locations being changed each year. These locations are areas that typically contain one or more urban areas, so that shops selling the majority of goods and services in the basket can be found. The economic geography of the UK is not static; new shops are being opened all the time, while old ones close. It is, therefore, important to ensure that the locations ONS uses to collect prices remain up to date. ONS is currently in the process of reviewing the locations it uses, an important part of keeping the sampling frame up to date.

As discussed in Chapter 2, ONS aims to collect the majority of prices on one particular day each month, referred to as 'Index Day'. This is a requirement of the RPI. However, the regulations governing the HICP (and hence the CPI) require that prices be collected across at least one working week. Products known to exhibit volatile prices – in particular, motor fuel and fresh food – should be collected on more than one day (Eurostat, 2013, Regulation 701/2006, pp93-94).

Prices for motor fuels are already collected throughout the month for the CPI and CPIH. ONS has been reviewing the collection of fresh food prices in order to comply with the Eurostat regulations. Again, this is important work that we support.

## 11.10 Collecting prices from the internet for consumer price statistics

The impact of internet retailing has grown dramatically in the past few years. Data from ONS's Retail Sales publication shows that between 2008 and 2013, the value of internet sales (in current prices) increased by 142 per cent. By October 2014, 11 per cent of retail spending was on the internet (ONS, 2014e). As discussed in Sections 11.7 and 11.8, there is potential value to the ONS in being able to distinguish between the internet and physical shops in its consumer price statistics. This section starts to consider some of the challenges this would pose for data collection.

The term "internet sales" combines, under one term, a range of different activities. At one end of the spectrum, there are businesses that are wholly based online, with no retail outlets that ONS price collectors can visit. At the other end, there are retailers which predominantly sell through physical shops, but combine this with a website where users can place orders, and may have a variety of options for taking delivery of their goods. This was not even a new issue introduced by

the internet; catalogue and mail order shopping has been around for a long time and has been included in the UK's consumer price statistics.

ONS data collection procedures reflect the internet in many ways. Some items, such as music downloads and e-books, are primarily purchased over the internet. As mentioned in the previous section, a small number of items are specifically related to internet purchases. For example, CDs, DVDs, Blu-Ray discs and computer games have separate items in the basket for online and retail purchase.

However, there are other models. Prices for some large chains are collected directly from their websites, rather than by visiting the stores. In the case of clothing, prices from large internet and mail-order retailers are combined in the same elementary aggregate as price quotes from physical shops, although shop replication factors (see Chapter 2) are used to reflect market shares. Prices for personal computers are collected by ONS central staff from a range of retailers, both internet-only and those with physical shops.

In the Retail Sales Index, any transaction that takes place online is regarded as an internet sale, irrespective of how the product is eventually provided to the consumer. Any attempt to carry this definition into ONS's consumer price statistics would have to consider the implications for the current ways in which data are collected.

In short, internet retailing has a huge impact on consumer price statistics. As described above, there is no clear line between "the internet" and physical shops. In some cases, products available over the internet are not fully reflected in the ONS's consumer price statistics; an example would be the rise in internet clothing retailers in recent years.

When new items are introduced into the basket of goods and services, ONS considers how best to collect prices for these. However, existing items are not always subject to the same level of consideration. ONS should seek to ensure that it chooses appropriately between central and local data collection for all items. Where ONS collects centrally, it should ensure the sources from which it collects prices fully reflect where products are available and purchased from.

## 11.11 Items with specific issues in the basket of goods and services

In the course of this review, we have focused on issues that cut across consumer price statistics. No attempt has been made to look at individual items in the basket, with the exception of housing. In part, this is because ONS already carries out this review activity itself, examining those items that are giving cause for concern. However, in the course of this review, we have become aware of a few items that it would be useful for ONS to review in the near future.

- **Air fares** are amongst the most volatile items in the basket of goods and services; movements in the cost of air fares often have enough impact to show up in the aggregate indices. Improvements in the measurement of air fares would be welcomed by users.

- **Clothing** has already been the subject of a great deal of research work, as a result of the investigation of the increase in the formula effect in 2010. ONS should pull together this work and make it publicly available.

- **Mobile phone charges** are amongst the more complex of ONS's data collections, and are based on the cheapest tariff that meets each of a series of customer profiles, provided by Ofcom. The pay monthly component is based on an average contract length of 22 months; as such, only 1/22th of prices are updated each month. This is in contrast to **bundled telecommunications services** (packages that sell TV, broadband and phone calls), which also commonly feature contract tie-ins but where all prices are updated every month. This discrepancy could usefully be explained or resolved.

- **Package holidays** collectively represent around 6 per cent of CPIH, and are amongst the most time-consuming items in the basket of goods and services to collect. The issue with holidays arises because holidays purchased at different times of year are quite different products; a holiday in Austria in January is quite different to one in July.

  ONS's consumer price statistics deal with this by forming price relatives that compare the current month price for a holiday with the same holiday a year ago, rather than the price base period. The price index is then formed as a weighted average of the price relatives observed so far. This is different to the methods used elsewhere in the index and results in price change for the holiday items lagging the rest of the index. Eurostat have started to look at ONS's method; we agree it should be a priority. This also applies to the **accommodation services proxy**, which covers some holiday accommodation in the UK.

  Package holidays are predominantly collected from brochures. This feels increasingly out of date, given the degree to which holidays are now booked online. ONS could look to collect more prices over the internet. Perhaps web scraping (see Chapter 8) could one day be used to collect these prices.

## 11.12 Conclusions

Consumer price statistics require a complex sample design and weighting framework. The way in which this framework is constructed has plenty of scope to influence the consumer price statistics produced.

The National Accounts provides the appropriate framework for the higher level weights. In particular, the National Accounts seeks to combine various sources in order to make the best possible balanced estimates of expenditure. However, some weights within the Accounts are volatile, or (in the case of expenditure on gas) depend on conditions in the year the weights data were observed that are irrelevant to the current year. **ONS should use more than one year of National Accounts data in cases where the weights are particularly volatile, or reflect particular circumstances in the latest year available (such as the weight for gas spending).**

The Living Costs and Food Survey remains the most widely-used source of household spending data in the National Accounts. It is the source for almost all the RPI weights, and will be an important component of developing weights for particular groups of the population. The survey, like similar surveys run by other countries, is suffering from a falling response rate and covers less of overall UK household spending than it once did. **ONS should review the Living Costs and Food Survey (LCF) in light of the need to have good consumption data at a household level both to inform the National Accounts and to help with the creation of reliable estimates of the inflation experience of different population groups. External experts should be involved. More resource should be devoted to the LCF if ONS deems that necessary for the provision of high quality, reliable data on household spending.**

The annual update of weights relies heavily upon a small number of staff in Prices Division, and would benefit from more extensive engagement between Prices Division and National Accounts; the review of this process that ONS has recently started is welcome.

ONS publishes an annual article on the weights in its main consumer price indices each year; this article provides useful information to users. However, further improvements can be made. **ONS should improve its commentary on the weights tables that accompany the RPI and CPIH, so that it explains why weights differ and/or move in different directions in the RPI and CPIH. ONS should aim to publish the annual article on the updated weights at the time the weights change.**

Some items in the basket are stratified by shop type (independent or multiple). However, the data that were used to update these weights are no longer available, and, in any case, the stratification may no longer reflect differences in price change between outlets; there is no separate stratum for internet retailers, for example. **ONS should review the stratification of consumer price statistics by shop type. The aim should be to introduce an appropriate stratification where weights for the different types of shops are available and can be updated.** During this review, ONS should assess the impact of outlet substitution on price indices and, in the light of that work, should consider whether substitution between different outlets (for example, from shops to the internet) should be reflected in any of its statistics.

ONS is in the process of reviewing both the boundaries for its locations for local data collection and the frequency with which prices for some items are collected. These are both important exercises. To this, we would add that the sources used for central data collection should also be looked at. **ONS should set out a transparent, regular and frequent process for reviewing which individual items in the basket are collected by local price collectors and which are collected from web sites, catalogues and brochures, to ensure this reflects how different items are purchased in practice.**

# 12. Quality change and new items in consumer price statistics

## 12.1 Introduction

If the goods and services consumed by UK households remained constant over time, calculating the rate of inflation would be relatively straightforward. However, this is not the case. The goods and services offered to consumers change; some new goods and services become available, others fall out of favour and their quality may improve or deteriorate.

This issue can be regarded at two levels. Firstly, the items for which prices are being collected must be kept relevant; they have to be goods and services that are representative of what consumers are buying. Secondly, there is the issue of how to deal with a specific product no longer being available. This chapter explores how these changes are handled in the UK's consumer price statistics.

## 12.2 Updating the basket of goods and services

In the UK's consumer price statistics, the prices of a selected basket of goods and services are monitored over time. This basket has to represent the spending patterns of UK households and is informed by current consumer trends. Of course, these spending patterns do not remain static over time. The goods and services that UK households purchase change, so the basket also changes.

The introduction of new goods into the basket is essential to make sure the basket stays up to date. One famous example (mentioned by the Boskin Commission in their 1996 report) is the fact that video cassette recorders (VCRs) remained outside the US CPI for several years in the late 1970s and 1980s, finally entering the basket in 1987. This arose because the US basket of goods was only updated every ten years. Reductions in the price of VCRs did not affect the index, despite the fact that a lot of Americans were buying them and were benefiting from their cheaper price.

For this reason, statistical agencies update their basket of goods and services regularly. In the UK, the basket is updated every year. New items are introduced to the basket, to better represent the purchases being made by UK households. Other items are removed from the basket because they are no longer bought in sufficient amounts for them to be considered representative. In some cases the item remains unchanged but the specification changes, to better reflect what consumers are buying. In the UK, where consumers' expenditure exceeds around £400 million on an item annually it is explicitly represented in the basket, except where those items are judged to be adequately represented by other items in the baskets (ONS, 2014a). The same threshold is used to consider whether an item with declining sales should drop out of the basket.

The quality and specification of some goods and services is changing rapidly over time. Technology goods, such as TVs, are an example of this. When a new TV technology is first introduced the price of that technology will often be high. Only a few people buy the product. A TV with the new feature would not be representative of the TVs most people buy. ONS price collectors would be instructed not to collect prices for it. A current example is 3D TVs, which are widely available in 2014 but specifically excluded from ONS price collection.

## 12.3 Chain-linking with basket updates

UK consumer price statistics are constructed as measures of price change within years – using a specified basket of goods and services. For each item in the basket, price quotes are collected for a range of products meeting a common item description. Each product selected has its price collected each month. The current and base period prices are used to calculate a price index for the item. This continues for each of the goods and services until the following January, when the items in the basket change and the series starts again. This process creates a series showing the growth in average price from January to January each year for each item. Continuous time series are formed by aggregating the item indices up to the class level, and chain-linking on to the existing series.

In January, prices for the items in the old and new basket are collected. Because the items in the basket and their specifications change, the prices will be different. Some of the locations visited will also change. Collecting prices for the old and new baskets creates a link between the two years.

This is illustrated for the case of vacuum cleaners in **Figure 12.1**. Where there is a gap between the two average prices in January there has been a change in the products that are being collected. As the change in price is due to a basket change, rather than an actual price change, the difference between the two baskets is 'linked out'. Figure 12.1 uses chain-linking at the item level to show a simplified example of the effect that chain-linking can have. As explained in Chapter 2, in the production of the CPI and CPIH chain-linking takes place at the more aggregated class level.

The top line in the chart shows what happened to the actual arithmetic mean price of vacuum cleaners collected between 1996 and 2013. The bottom line can be thought of as removing the effect of changes between years to the set of vacuum cleaners for which prices are being collected. This is as a result of linking the years together to remove the gaps. The latter lies well below the former, this reflects a shift towards collecting prices for more expensive vacuum cleaners over time.

There is, for example, a significant divergence in January 2004, where the average price for vacuum cleaners rises from £136.66 in the old basket to £172.39 for the new basket. This increase in price is due to different vacuum cleaners being priced; this could be due to a change in specification of the product, location or outlet. Figure 12.1 also shows there are occasions, such as in January 2013, where there is little or no difference in the average price between the old and new baskets.

**Figure 12.1: The effect of chain-linking, Vacuum Cleaners, 1996-2013**
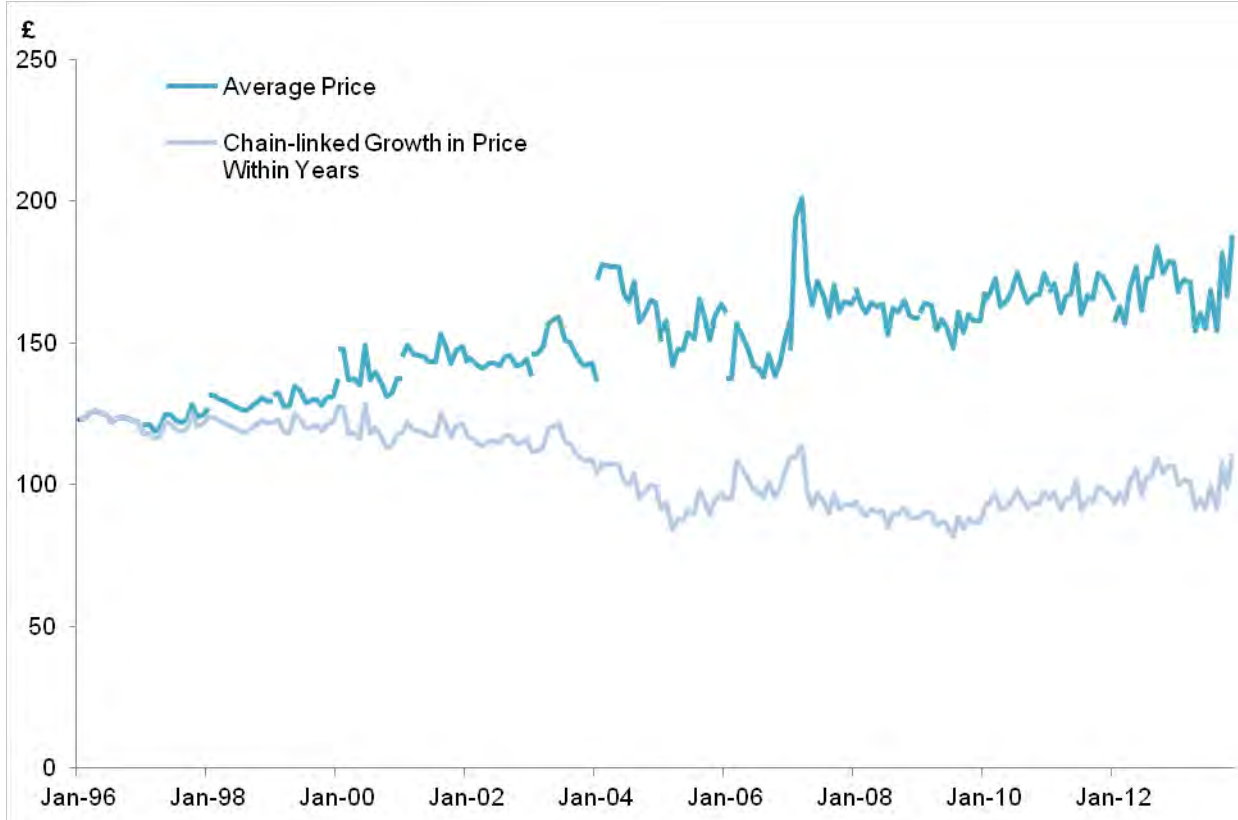


Source: ONS

The process of chain-linking removes any price change caused by the products collected changing, as opposed to the prices of the products themselves changing. In other words, it shows the growth in price of the item as if there had been no change in the selection of products that make up that item. In terms of Figure 12.1, the difference in the two lines shows the increasing prices of the new products entering the basket, which can be seen as the quality of the products improving, over the 17 year period.

In the RPI, the weights and basket change happen in the same month, February. This means that the process of chain-linking happens once a year, at the section level using the aggregated within-year item indices.

Chain-linking is slightly more complicated in the CPI than in the RPI. The structure of the CPI is shown in Figure 2.2. The within year indices for items, such as the Vacuum Cleaners index, are aggregated with other similar items into a class. These aggregated indices are then chain-linked together, rather than item level indices being made into a continuous series. In the CPI the basket is changed in February along with the item weights, but the class weights are changed in January. The explanation for why this occurs is in Box 2.5. This has the effect of creating a double chain-link. The practicalities of double chain-linking an index are outlined in **Box 12.1**.

Even though chain-linking is not referred to as a quality adjustment, in practice this is how much of the change in quality in items collected is accounted for in consumer price statistics. For example,

in a new collection year, bread could be priced from a cheaper shop than in the year before. This reduces the average price of the products being collected, but there has been no change in the price of the products. The impact of this price change does not enter the price index, because of chain-linking.

Another example could be that in the future, 3D TVs might account for enough spending to be deemed representative of what households are buying. ONS could then broaden the description of TVs to include 3D TVs. This change will likely cause the average price for TVs to change, and this change will again be removed by chain-linking.

Chain-linking just aligns the price growth of different selections of products. It does not imply positive or negative quality change. It is therefore an implicit quality adjustment and does not control for any of the features, in terms of specification or location, of an item when there is a change in average price between years.

In practice, this means that goods and services whose quality is improving over time (such as technology goods) may show low or even negative rates of inflation, even though the typical price of an product of that type could be similar to what it was several years ago. It implicitly reflects quality change; the new products are more capable than the old ones.

**Box 12.1 Chain-linking in the CPI**

Chain-linking in CPI is complex. The class (the structure of CPI is set out in Figure 2.2) level weights are updated in January, while the item weights are updated along with the basket in February. This means the index has to be chain-linked twice. This is calculated as follows:

1. Start with the within year class-level index up to December, in the example this is Bread and Cereals for 2011.

2. In January 2012, the class level weights are updated but basket remains the same, therefore the change in price must be measured from the previous month, December, using the new weights.

3. This creates a **link factor**, which makes January 2012 comparable with the whole of 2011 even though there has been a change in the weights. Each subsequent value included in the index must be multiplied by this link factor, as there has been a break in the series.

4. This happens again in February, when the lower level weights and basket change making it not comparable with the January. January is calculated using the old and new weights, like December was before, and then creates a second linking factor.

5. This creates a double chain-link. The index has to be chain-linked in this way to keep it comparable throughout and across years.

**Figure 12.2: Example of double-chain linking in CPI using Bread and Cereals, 2011-2013**

| | 2011 basket and class weights | 2011 basket and 2012 class weights | 2012 basket and class weights | 2012 basket and 2013 class weights | 2013 basket and class weights | Link Factors | Chain-linked series |
|---|---|---|---|---|---|---|---|
| CPI INDEX 01.1.1 : BREAD & CEREALS Jan 2011=100 | | | | | | | |
| Jan-11 | 100.00 | | | | | | 100.00 |
| Feb-11 | 102.82 | | | | | | 102.82 |
| Mar-11 | 100.15 | | | | | | 100.15 |
| ⋮ | ⋮ | | | | | | ⋮ |
| Oct-11 | 104.04 | | | | | | 104.04 |
| Nov-11 | 103.05 | | | | | | 103.05 |
| Dec-11 | 104.12 | 100.00 | | | | **1.0412** | 104.12 |
| Jan-12 | | 99.27 | 100.00 | | | **0.9927** | 103.35 |
| Feb-12 | | | 101.40 | | | | 104.80 |
| Mar-12 | | | 101.55 | | | | 104.95 |
| ⋮ | | | ⋮ | | | | ⋮ |
| Oct-12 | | | 101.99 | | | | 105.41 |
| Nov-12 | | | 103.54 | | | | 107.01 |
| Dec-12 | | | 103.91 | 100.00 | | **1.0391** | 107.39 |
| Jan-13 | | | | 100.14 | 100.00 | **1.0014** | 107.55 |
| Feb-13 | | | | | 100.35 | | 107.93 |
| Mar-13 | | | | | 101.13 | | 108.77 |
| ⋮ | | | | | ⋮ | | ⋮ |
| Nov-13 | | | | | 101.70 | | 109.38 |
| Dec-13 | | | | | 103.12 | | 110.90 |

Source: ONS

## 12.4 Quality adjustment within years

Section 12.3 explained how chain-linking and basket updates deal with quality change and new goods and services over different years. There is a related question when a product has to be replaced within the year.

When a product is no longer available within the collection year, a replacement product must be selected by the price collector. The price collector must then decide whether the new product is directly comparable to (that is of similar quality to) the old product. To do this, ONS provides guidance on what products can be considered comparable to each other, based on the characteristics of the item that consumers value.

As an example, **Figure 12.3** shows the guidance provided by ONS on comparability for televisions for 2014. There are currently three different TVs in the basket, reflecting different screen sizes.

**Figure 12.3: Guidance provided to price collectors for replacement TVs, 2014**

| Specification difference | Flat panel TV 12"-22" | Flat panel TV 23"-32" | Flat panel TV over 32" |
|---|---|---|---|
| **Brand** | Comparable if similar quality | Comparable if similar quality | Comparable if similar quality |
| **Screen type (Plasma / LCD / LED)** | Not comparable | Not comparable | Not comparable |
| **Screen size** | Comparable | Comparable | Not comparable |
| **Inbuilt digital tuner (None / Freeview / Freesat)** | Not comparable | Not comparable | Not comparable |
| **Internet (Smart) TV (Yes / No)** | Not comparable | Not comparable | Not comparable |
| **Integrated DVD player** | Not comparable | Do not select | Do not select |
| **3D Screen** | Do not select | Do not select | Do not select |
| **Definition (Standard vs high definition)** | Not comparable | Not comparable | Not comparable |

Source: ONS

One purpose of the guidelines is to prevent two different TVs being compared to each other as if they were the same. A TV with 37 inch screen in March is likely to cost more than one with a 25 inch screen in February, independent of inflation between the two months. In the case of TVs, assuming comparability of all TVs would likely lead to an upward bias. As TVs improve over time, if these improvements are not taken into account, we overstate the price change that has not come from improving quality.

To interpret Figure 12.3, if a 27 inch screen LCD TV is no longer available, and the replacement product selected by the price collector is a 27 inch screen LED TV, then that would be deemed non-comparable, because the LED screen is a different technology. No explicit judgement is made as to whether the LED TV is better or worse quality than the LCD TV, just that the two are incomparable. If the replacement was a 32 inch screen LCD TV that would be deemed sufficiently comparable.

However it is likely that over time the quality of products such as TVs will tend to increase and therefore the implicit quality adjustment tends to be a positive one. As mentioned in Section 12.3, the quality change procedures used by ONS do not account for the direction of quality change. This means the positive quality adjustment is not universal; there are items where quality has implicitly fallen. This could be where the collectors start to price items in a cheaper shop; the price has not actually gone down but a new lower price has entered the market. An example of a product where average prices have risen less quickly than the price index is baked beans, which is shown in Annex B.

When choosing a product, the price collector has to ensure that the item being priced remains representative. That is, one that is typical of what enough consumers buy. This includes within year replacements and picking products to price at the beginning of the year. They are also instructed not to select new technology. For example, in Figure 12.3 3D TVs are not to be selected. This avoids the steep price falls associated with new technology entering into the index[11]. When a replacement product is needed, the decision as to whether the old and new products are comparable is very important. If products are comparable, any price difference between the two products will contribute to the price index. Price collectors are instructed to avoid picking a non-comparable product if at all possible.

If the new product is deemed not comparable to the one it replaced, then ONS has a range of tools available to allow it to make consistent comparisons over time. The options are summarised in **Figure 12.4**.

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[11]   While not an issue of quality adjustment, the practice of not selecting new goods also means that price indices do not pick up the effect that new goods becoming available may have on improving consumer welfare. A *Cost of Living Index* (as discussed in Chapter 7) might do this. The indices which ONS currently produces do not.

**Figure 12.4: Options for within-year product replacement used in UK consumer price statistics**

| Method | Description | Examples of use |
|---|---|---|
| **Direct comparison** | New product price compared directly to old product price | • Same item of clothing in different colour<br>• Tinned fruit, same sized tin but different fruit |
| **Class mean imputation** | Where a non-comparable replacement is chosen, a base price for the new product is estimated using the price movements of similar products | • TV replaced by another TV with different specification<br>• A T-shirt bought in a supermarket replaced by a T-shirt bought on the high street |
| **Quantity adjustment** | Old product price is pro-rated to make it directly comparable to new product price (e.g. if bigger, the price is increased proportionately) | • Chocolate bar becomes smaller<br>• Toothpaste tube gets bigger |
| **Hedonic regression** | A price for the new product in the base period is modelled. Model aims to value the relevant specifications of the item. Current and base period prices compared.<br><br>Method is resource-intensive so only used where it adds value. | • New tablet computer replaces old model<br>• Also PCs, laptops, smartphones |

Source: ONS

Quantity adjustment and hedonic regression could more precisely be called specification adjustment, in that they both seek to correct for differences in the specification between products. Both seek to explain the difference in the price that is due to quality change, rather than deciding a replacement product is not comparable.

## 12.5 Non-comparability in replacement products

Many goods and services have a life cycle. When the product is first introduced, prices can be relatively high. During the life of the product, the price may fall. This could be because of more efficient production processes, a lack of demand, or competition from similar products. The price may fall further towards the end of the product's life in order to sell existing stocks (although ONS

avoids pricing products that are "reduced to clear"). So for many products, prices tend to fall during the product's life cycle.

The seller may introduce a margin on the price of a new product to offset the discounting expected later in the life of the product. When price collectors find that a product is no longer available, it will often be because the product is coming to the end of its life cycle. The product chosen to replace the unavailable product will tend to be earlier in its life cycle, and therefore likely to be less discounted than the old product. In these cases, the price increase between the original and replacement product is not entirely due to quality change.

Ideally, one wants to include changes in the seller's margin between two products in a price index, but not price change caused by differences in quality. If the old product and its replacement are considered comparable, the difference in price between the products enters into the index. Any change in the seller's margin will be included. If the two products are deemed non-comparable, the difference in price between the products does not enter into the price index. This means, correctly, that two significantly different products are not compared as if they are the same. However, averaged across many products, this risks the rebuilding of the seller's margin being missed.

Advice to price collectors in terms of picking replacement products is obviously crucial here. As already mentioned, ONS asks price collectors to pick comparable replacements if they possibly can. ONS issues guidance, such as that given for TVs in Figure 12.3, to help price collectors determine what is and is not comparable. Concerns about the seller's margin effect were one of the main issues motivating the changes ONS made to its clothing data collection in 2010. Price collectors were asked to allow more variation between the old and replacement product, and still deem them comparable (ONS 2010, p2)

This does place a lot of emphasis on judgements over comparability. For items where products are regularly replaced by non-comparable products during the year, the base price will be re-imputed with each replacement. These imputed base prices are based on the price change experienced by similar products. These imputations from non-comparable replacements can end up being the main driver of overall price change in that item and therefore have reducing relevance to actual experienced inflation (Capleton, 2012). The ILO CPI Manual (2004, Section 8.25) advises statistical agencies to monitor product groups to see if some products are particularly prone to being replaced by non-comparable alternatives to be aware of this problem.

**Figure 12.5: Implicit within- and between-year quality changes in Vacuum Cleaners, 1996-2013**



Source: ONS

**Figure 12.5** is identical to 12.1 but with the addition of a price index series for vacuum cleaners. This index is created using the Dutot formula (explained in Chapter 10). As in Figure 12.1, the difference between the top two lines shows the impact on average price of the quality of vacuum cleaners being collected changing between years.

The price index controls for the effects of non-comparable replacements on average price, where as the middle line, chain-linked growth in price within years, does not. This means that if a product of higher price (and implicitly higher quality) is used as a replacement for another product it is treated as a price rise in the middle line, but is seen as a quality change in the index. The gap between the two lines can therefore be seen as the impact on average price of the quality of vacuum cleaners being collected changing within years.

Figure 12.5 shows a simplified example of the effect that discontinuation and replacement of products has on an index. Before 2004, the index falls compared with the middle line. This means the non-comparable replacement products are on average higher in price and quality than the original products. Between 2004 and 2008 however, the index is increasing at a faster rate than the middle line.

This implies that the replacement products are of a lower price over this period, and are implicitly of lower quality. However, for items with a short product life the choice of which products are comparable is very important. Further analysis in Annex B shows some examples of this.

ONS does carry out some ad-hoc monitoring of the regularity of use of non-comparable markers. This monitoring supported the changes in collection practice for clothing in 2010. It has also supported the use of hedonic price adjustment for items where there is a high rate of within year replacement. However, there has been no systematic review of how frequently different product types are judged non-comparable. We recommend that ONS has a more transparent policy on the use of non-comparable markers and that ONS reviews how frequently the non-comparable marker is used for each item.

Systematically reviewing the use of non-comparable markers and comparing the number of non-comparable replacements between items will enable ONS to determine which items are more prone to the use of non-comparable markers. It should enable ONS to see if price collectors are being consistent across items with similar product life-cycles. If inconsistencies were found, analysis of the type of products being collected and comparison of the item index alongside average price should show of what effect non-comparable markers are having on the reported inflation of the item. An initial analysis of non-comparable replacements at the class level in 2013 is available in Annex B.

## 12.6 Hedonic adjustment

As briefly discussed earlier, hedonic adjustment is a procedure used by ONS to deal with product replacement for a small number of technology goods, such as PCs, laptops and smartphones. This is because these products are rapidly replaced by superior versions of the same product, sometimes more than once in the same year. It consists of developing a model for valuing products based on their specification. It is essentially a way of putting a price on individual improvements between an old product and the one selected to replace it. This is widely seen as the most comprehensive way to price non-comparable replacement products. Hedonic adjustment is currently only used in 0.73 per cent of the index[12].

Instead of using hedonic adjustment, non-comparable replacement technology goods could be adjusted using methods used elsewhere in the basket. This would involve imputing price movements of non-comparable replacements using similar products. However, the rate at which technology products are replaced within the year tends to be very high relative to the rest of the basket. This means that the set of similar products that have not had replacements is very small, but would have a lot of impact on the movement of the item price index. This set of similar products is also probably no longer representative of the products being purchased by consumers.

**Figure 12.6** shows all three of these options for laptops, which is hedonically adjusted in the CPI.

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[12] In terms of 2013 expenditure weights (ONS, 2014b, p.4)

**Figure 12.6: Quality adjustments of Laptops in CPI, 2005–2013**
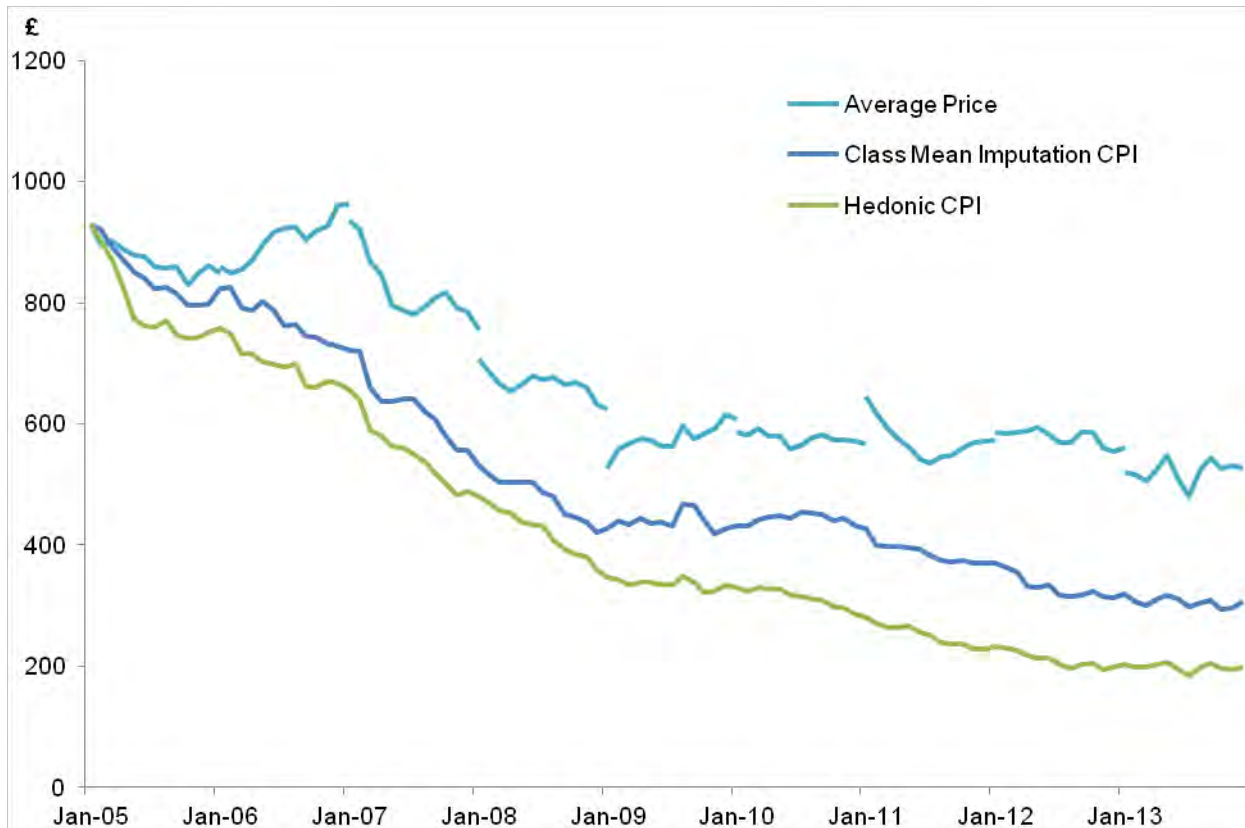


Source: ONS

The Average Price curves have the same methodology as that in Figure 12.1 and 12.5: they show the average price of a laptop in the sample split into years. As with vacuum cleaners before, this series does not control for the change in the mix of laptops being priced, either within or between years.  This shows a considerable fall in price since 2005; Laptops are cheaper than they were, even without taking account of any changes in quality.

The 'Class Mean Imputation CPI' line shows what a price index for laptops would look if it followed the second concept outlined above. Where a laptop in the sample replaced by a non-comparable replacement, the price movements would be imputed using similar products.

The 'Hedonic CPI' line shows the hedonically adjusted series for Laptops used in the CPI. Each part of the specification of the new product is priced using a hedonic regression, accurately measuring what the base price would have been for the product.  Hedonic adjustment is an important resource when products change regularly throughout the year. Laptops are a prime example of this. Laptops have a replacement rate of 2.9 in 2013, this means that each laptop in the sample was on average replaced 2.9 times in 2013 (ONS, 2014b).

## 12.7 Quality change over the long term

Over the long run, treating quality change appropriately poses additional challenges. Consider lighting, an example discussed by Nordhaus (1998). Over the course of hundreds of years, society

has moved from candlelight to gas lamps to electric light bulbs. Each change in technology makes light cheaper. Over the same period, the cost of wax, then gas, and now electricity has been rising.

An inflation measure that puts a price on the means of making light (which is what the CPI does) would show a rise in prices. An inflation measure that puts a price on the cost of light itself would show a decline, because of the technological improvements over the same period. Astin (1998) makes a similar point about changes to the cost of listening to music over a period of 60 years. Indeed, Astin argues that the difficulty in comparing significant shifts in technology is such that consumer price indices are not ideal for making long-run comparisons over time.

This is an important issue but may simply reflect the limits of what a consumer price index can do. But it is something that people who use consumer price indices for very long term contracts, such as pension indexation, should perhaps consider.

## 12.8 Conclusions

It is essential to have robust procedures for dealing with quality change and new goods in order to have a useful set of consumer price statistics. A consumer price index that only ever prices the same items, in the same shops, would become unrepresentative and biased. The basket of goods and services, and the shops visited, need to change over time. Due to this updating of the basket, ONS indices are chain-linked together to make a continuous series over time.

When individual products are no longer available within the year, a replacement product must be sought. A judgement must be made as to whether the replacement is comparable to the product that is no longer for sale. This involves a degree of subjectivity. ONS controls for this as best it can by providing detailed guidance for its price collectors.

Exactly how this happens has the potential to matter a great deal.  While ONS broadly appears to follow best practice, there is no systematic monitoring either of how frequently different products are judged as non-comparable or of the extent to which the price index for particular goods and services deviates from the change in the average price collected. Nor do we have a good sense of the importance of any bias that may result from rebuilding of sellers' margins in the face of quality change. All these are genuinely important and ought to be monitored and reported on regularly.

**ONS should introduce regular monitoring of the impact of quality adjustment on its consumer price statistics. This includes monitoring how often non-comparable replacements occur for each item in the basket of goods and services, and investigating those items where this is frequent. ONS should particularly seek to understand cases where the relevant price index deviates substantially from the average price collected.**  This should enable ONS to ensure the consistency of their use and understand their effect on price indices.

# 13. The treatment of discounts in consumer price statistics

## 13.1 Introduction

Using special offers, of one form or another, to persuade customers to buy a product is as old as the retail trade. There is a vast range of special offers, from price cuts to "buy one, get one free" offers, from loyalty cards to discounts for students and pensioners. This chapter will refer to all special offers collectively as "discounts".

Many retail businesses put a great deal of thought into using promotions to make their products stand out from the competition. Retailers shift their focus between different products, and different forms of discounting, in order to sell more of their goods and services. The issue for consumer price statistics is that some forms of discounting are easier to capture than others. ONS captures some forms of discounting in its consumer price statistics, but not others.

This chapter starts by considering current ONS practice with respect to discounts. It considers whether a wider range of discounts should be included in ONS's consumer price statistics, and the available evidence on the likely impact.

## 13.2 Current ONS practice on collecting discounts

The underlying principle of ONS's current treatment of discounts is that a discount has to be available to all, at the time of purchase, to be included. The term "available to all" is the key part of this, because it is this element that removes most types of discounting from being within scope of consumer price statistics.

**Figure 13.1** lists some of the discounts that one can find in shops today. This is not intended to be exhaustive, rather to show the range of discounts on offer to consumers and whether they are in scope and currently covered by UK consumer price statistics.

**Figure 13.1: Examples of discounts offered by retailers**

| Group | Description | Examples of what is included |
|---|---|---|
| Single Purchase | Discounts which only require the purchase of a single product | • Clearance/End of Life<br>• Damage Stock<br>• Sales<br>• X% extra free<br>• X extra free<br>• X% free |
| Multiple Purchase | Discounts which require the purchase of multiple products | • Buy X get Y free<br>• Multi-buys<br>• X for Y |
| Other | Other forms of discount or special offer | • Free gifts<br>• Coupons<br>• Loyalty cards<br>• Meal deal<br>• Mix & Match<br>• Codes with no available description |
| Non-promotion | No discount is applied | |

Source: ONS (2014)

ONS's current policy on collecting discounts is based on three main principles. These principles, and how they apply to the discounts described in Figure 13.1, are set out briefly in the following sections.

### 13.2.1 Discounts must be available to all

Within current practice, a discount must be accessible to all purchasers to be considered within the scope of ONS's consumer price statistics. The principle of a discount being "available to all" clearly excludes discounts based on who the purchaser is, such as student discounts. It excludes discounts based on who the purchaser works for, such as staff discounts. It also excludes trade-ins, as these depend on what the individual purchaser already owns.

This principle also makes any negotiation by the purchaser for a better deal out of scope. This is dependent on the purchaser's willingness and ability to negotiate, as well as the retailer's

response. Negotiation and bargaining clearly therefore do not make a discounted price that is available to all.

Perhaps less obviously, a discount having to be available to all excludes loyalty cards and coupons from price collection. Even though most loyalty card schemes are free to join, not everyone does, and people who are members often do not have their card with them when they pay for their items. Similarly, coupons are made available through magazines, online, and through the post. Not everyone is able to access the same discount. It can also difficult for price collectors to find out about and not everyone will decide to use them.

Finally, this principle is currently interpreted as excluding almost all forms of multi-buy discounting. Product specifications are usually for a single item, for example, a tube of toothpaste. The fact that one might be able to buy a second tube of toothpaste for half the price of the first is not reflected in the price collected, because the item specified is a single tube of toothpaste. Some households may choose not to buy the second tube of toothpaste and therefore do not benefit from the discount. In this case, the discount is available to all but not all who have bought the item have taken up the discount.

The only exception to this rule is if the item specification contains multiple items, such as the "three-piece suite" item. In this case, if buying the three individual items of furniture entitles the purchaser to a discount, this is reflected in the price.

### 13.2.2 Discounts must be available at the time of purchase

To be reflected in a price collection, the discount has to be readily available to households.  If a discount is not available at the time of purchase, it will take extra effort to obtain and might not be taken up by some consumers. "Cash-back" schemes are excluded on these grounds.

### 13.2.3 The discounted product must be of comparable quality

There is nothing explicit about item quality in the principle outlining the inclusion of discounts. However, when collecting the prices of a product, each month's price needs to be for the same product or one of comparable quality. This aspect of price collection is discussed further in Chapter 12. Damaged and marked goods (such as ex-display models) and products near their "best before" date are excluded on these grounds.

## 13.3 Which discounts should ideally be included?

The three principles discussed in Section 13.2 are the basis on which discounts are currently included in ONS's consumer price indices. We do not necessarily see why these principles are currently in use. For example, the *average* price of a product will be lower if some, but not all, customers can access it at a discount. One probably would want to take account, for example, of

discounted rail fares for pensioners. The problems are more practical. In general it is not known how many people take up this kind of discount, and therefore not possible to include them in price indices. The ONS should think of these concepts as broad rules of thumb reflecting information constraints, which could therefore change as data availability improves. In fact discounting may well be important enough that effort should be put in specifically to find ways of incorporating a range of discounting that the current "principles" disallow.

For the rest of this chapter we focus specifically on multi-buy discounts. These are available to everyone at the time of purchase, and should be included even given the current set of "principles". But they are not currently included. They are significant enough to be worth collecting information on.

This focus does not imply that other forms of discounting, including discounting for only certain parts of the population, should not also be looked at.

## 13.4 The impact of the changing nature of discounts

Primarily because of the current practice of only including discounts that are available to all, most of the discounts listed at the start of this chapter are not included in the prices collected by ONS. In fact, only price reductions and sales are included. This means that the changing behaviour of retailers poses a problem for inflation measurement. When retailers change the type of discount on offer, it can move into or out of scope of ONS's consumer price statistics.

Consider a retailer that is selling a large pot of yoghurt for £1.50 each. In order to try to sell more of that product, they offer two for £2.50, costing £1.25 each. The price ONS will collect in this example is still £1.50, because one has to buy two yoghurt pots to access the discount, and not everyone will want to.

The retailer then changes its approach, deciding to concentrate on offering low prices rather than multi-buy discounts. It calculates that the average price per pot of yoghurt sold when the multi-buy offer was running was £1.40. The retailer therefore decides to offer the yoghurt for £1.40 a pot, with no multi-buy offer. The price ONS collects is now £1.40 even though, from the retailer's perspective, the average price per pot is the same as when the multi-buy offer was running.

The prevalence of discounts may be changing over time, as well as the discounting types used. Data from Kantar, shown in **Figure 13.2**, shows that the use of discounts in groceries as a proportion of total sales, increased year-on-year between 2007 and 2012. Interestingly, from 2012 onwards, the proportion of sales accounted for by multi-buy and "Y for £X" promotions started to fall, with temporary price reductions accounting for a greater share of total sales.

**Figure 13.2: Discounts on 'fast moving' consumer goods as a percentage of total sales, 2007-2013**
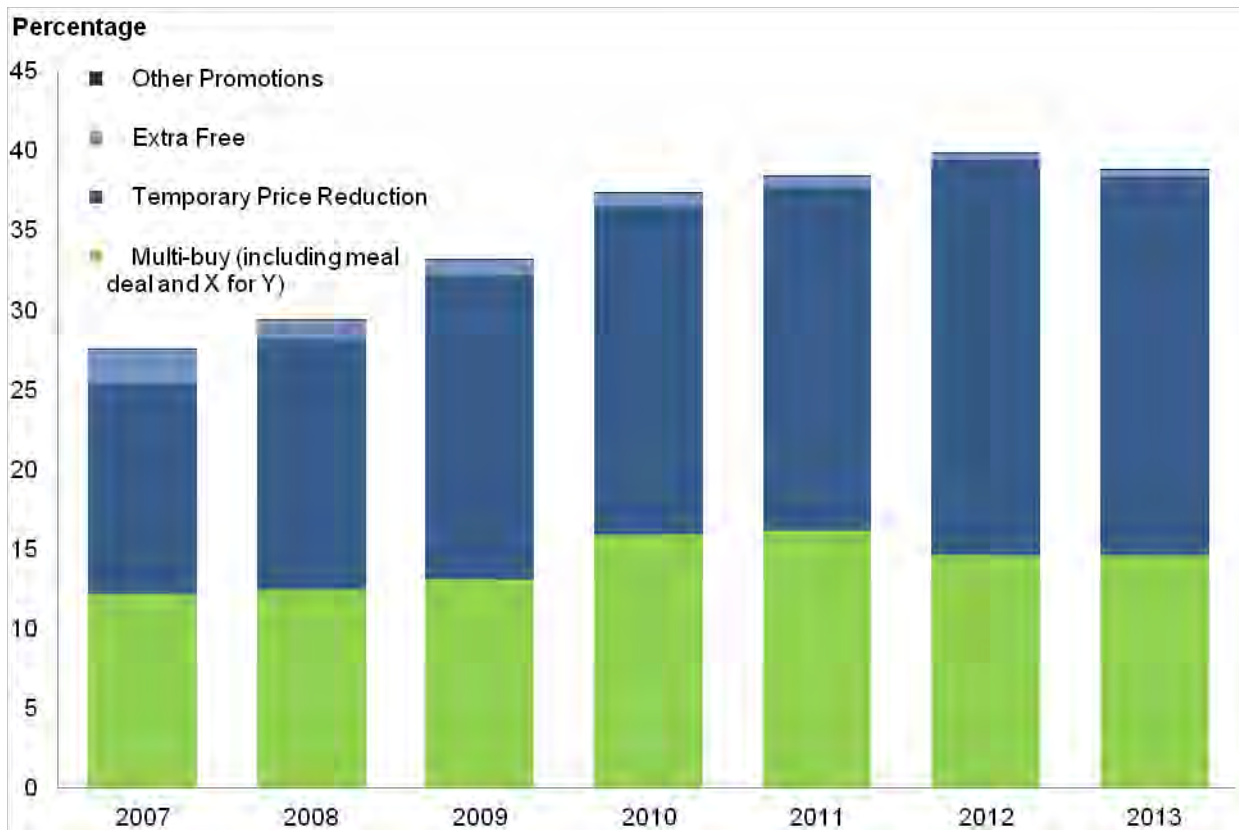


Source: Kantar

If multi-buy discounting is increasing over time, and is not being picked up by price indices, it is likely that these indices are missing out on price reductions being experienced by consumers. Similarly, if retailers switch from price cutting to multi-buy offers, this may have an effect on inflation statistics that is not replicated in the experiences of the individual. Having one form of discounting that influences inflation (the direct price cut), but another (multi-buy) that does not, is an issue that needs to be examined. ONS have carried out some analysis in the area. This work is ongoing, but early analysis is highlighted in Section 13.8.

## 13.5 International practice on multi-buy discounts

On the issue of multi-buy discounts, the ILO CPI Manual states that:

> bonus products provided "free" to the consumer, either by larger pack sizes or offers such as "two packs for the price of one" should be treated as price reductions, although they may be ignored in practice when the offers are temporary and quickly reversed (ILO, 2004 p54).

ONS current practice currently ignores such price reductions.

The European Union Harmonized Index of Consumer Prices (HICP) regulations (with which the CPI needs to comply) on the treatment of price reductions state that the prices used in the HICP should be 'prices paid by households to purchase individual goods and services [...] after deductions for discounts and off peak purchases' (Eurostat 2013, p80). The regulations also state that 'inducements in the form of extras' (Eurostat 2013, p81) should be disregarded if not significant.

Eurostat, the governing body responsible for the HICP, clarifies that the term "inducements in the form of extras" applies to what we have defined in this chapter as multi-buy discounts, and that these should be either disregarded or treated as a change in specification. This implies that, if significant, multi-buy discounts should be taken into account.

So far as it is possible to ascertain, ONS appears to be compliant with EU regulations on the treatment of price reductions and most other European countries follow UK practice in disregarding most types of discounts, including multi-buy discounts.

Some countries, such as the Netherlands and Sweden, are starting to use shop scanner data in their consumer price indices. This type of data can be used to look into discounts. However, the data these countries have cannot be used to see which type of discount is being used. This difficulty is also a factor in the work by ONS summarised in Section 13.8.

Eurostat is in the process of updating the regulations regarding the HICP. We understand that this update will emphasise that a variety of discounts, including multi-buy discounts, should be included if significant. This could be due to the fact that several member states now use shop scanner data, and that the regulations should recognise and support this.

## 13.6 How to price multi-buy discounts?

As discussed in the previous section, countries that have access to shop scanner data automatically capture many kinds of discounts, which may include multi-buy discounts. It is often impossible to see which type of discount is being used. However, the data can be used to provide a *unit price* across all goods. This is the average price paid per unit sold across the period in question, and is calculated by dividing total sales of the product by the total quantity sold.

ONS is currently looking into the use of point-of-sale scanner data in consumer price indices and specifically its use in pricing discounts. This is still at an early analytical stage and is not used in the indices. The main ONS price collection observes prices of individual items. With traditional data collection methods, a major issue is the degree to which discounts are taken up by consumers.

## 13.7 Take-up rates of multi-buy discounts

The multi-buy offer described in Section 13.4 was that pots of yoghurt that cost £1.50 each, but two could be purchased for £2.50. Under current ONS practice, the price would be £1.50; the customer

is assumed to only want one pot. If the customer bought two pots, the price per pot would be £1.25.

The two extremes of assuming no take-up of the offer, pricing at £1.50, and complete take-up of the offer, £1.25, are both unlikely to be representative of the choices made by households. If ONS had data that showed the amount of items sold and total sales, a unit price estimate could be created. This would capture the average price paid by a consumer for a product, even if we do not know what type of discount is being used.

Estimating take-up rates to price multi-buy discounted items would also be difficult. The take-up rate of a multi-buy discount is likely to vary with the type of item being purchased. Customers are more likely to stock up on goods that keep for a long time, such as household cleaning products. They are also more likely to stock up on products that take up little space at home.

The take-up rate of a multi-buy discount is also likely to vary depending on how large a reduction in price can be obtained and how much of the item has to be bought. A deal offering 25% off six bottles of wine represents a substantial saving, but would involve spending a lot of money on wine in one visit. A "buy one, get one free" offer would be taken up by most consumers. And every deal in between would be taken up to different degrees.

"Buy one, get one free" would appear to be the easiest multi-buy discount to price. One could argue that the customer gets twice as much product, and has little incentive not to take the free product, so the price per item is half what it would be without the deal. But even here, the situation is not as simple as it may seem. Such deals are often offered on very perishable items, such as salads. Customers may choose not to take the free item, knowing it will go to waste.

With some multi-buy offers, it is not clear where the discount would accrue. A good example is the "dine in for two for £10" offer popular in some supermarkets. Here, the customer gets to choose several elements from a range of products, for example; a starter course, a main course, a side dish and a bottle of wine. If the starter is £3, the main £4, the side dish £2 and the bottle of wine £6, the total price of the individual elements of the meal is £15. How should the discount be applied to the individual items?

This discussion helps to illustrate the likely difficulties of reflecting multi-buy discounts in consumer price statistics, using current data collection methods. Seeking to incorporate more forms of discounts, including multi-buy discounts, would be a major undertaking.

## 13.8 Analysis on discounts

ONS undertook research into the prevalence of discounts over time and their impact on the consumer price indices calculated when they are included using consumer panel data (ONS, 2014). These data were collated from receipts for a sample of UK households and include information on discounts. However, the method used to record promotional transactions was inconsistent. Identification of all the individual products within a multi-buy type discount could not

be made and this did not allow for a detailed analysis. The data were instead split into two parts; those transactions with discount codes and those without.

ONS sought to answer two questions with this analysis:

1. Are consumers spending proportionally more money on discounts now than in the past?
2. How does the inclusion of discounts affect the range of consumer prices?

To understand whether the take-up of discounts is changing over time, four different grocery products were selected for further examination. These were yoghurts, orange juice, bottled cola and washing up liquid. Comparing the aggregate expenditure on each item with and without promotion implies the impact of the promotion on the consumers' preferences. The analysis shows that expenditure on discounts increased for some goods, as one might expect. However, it decreased in others.  This supports the previous discussion about take-up rates; consumers do not take up every multi-buy discount on offer.

Between 2009 and 2011 the household expenditure patterns on each of the four selected goods changed in different ways. The goods that showed the most different results were orange juice and yoghurt. For orange juice, the proportion of expenditure on promotions dropped greatly. For the yoghurt goods, the opposite is true.  Bottled cola exhibited a constant proportion of expenditure on the discounted goods in comparison to non-discounted. Different goods offering the same discounts seem to be causing different consumption behaviour. Without clear data outlining take-up rates it is difficult to know exactly how to treat multi-buy discounts.

This analysis can be taken further by exploring the effect that the inclusion of multi-buy discounts would have on consumer price indices. **Figure 13.3** shows a group level (see Figure 2.2 for the CPI structure) price index for Alcohol, compared to the same index including all promotions on price. The index including discounts has attempted to replicate CPI methodology and price collection as closely as possible. Again, this makes use of consumer panel data. The promotions category includes some discount types that are already included in ONS's consumer price statistics.

The effect appears to be relatively small at the group level. However, calculating the growth over 12 months shows differences of several percentage points, both at the overall alcohol group level and at the class and item level.

Figures 13.3 and 13.4 show the indices including and excluding discounts. The methodology used in creating them is slightly different from that used in the published CPI. This means that the CPI differs from the 'including discounts' line by more than just discounts.  Further research would be required to try to reconcile these differences. Also the categorisation of transactions into promotions and non-promotions applied here is relatively crude. Given the limitations we do not infer this level of change would also be seen in the CPI. It instead shows us that the uptake of discounting can vary greatly between goods and it is plausible that the inclusion of further discounts than are already included may have a large effect on parts of the CPI. ONS are starting to collect shop scanner and web-scraped data that should allow this analysis to be taken further. Chapter 8 of this report covers alternative data sources in more detail.

**Figure 13.3: Index level when including and excluding all promotions at the 'Alcoholic Beverages' group-level, 2009-2011**
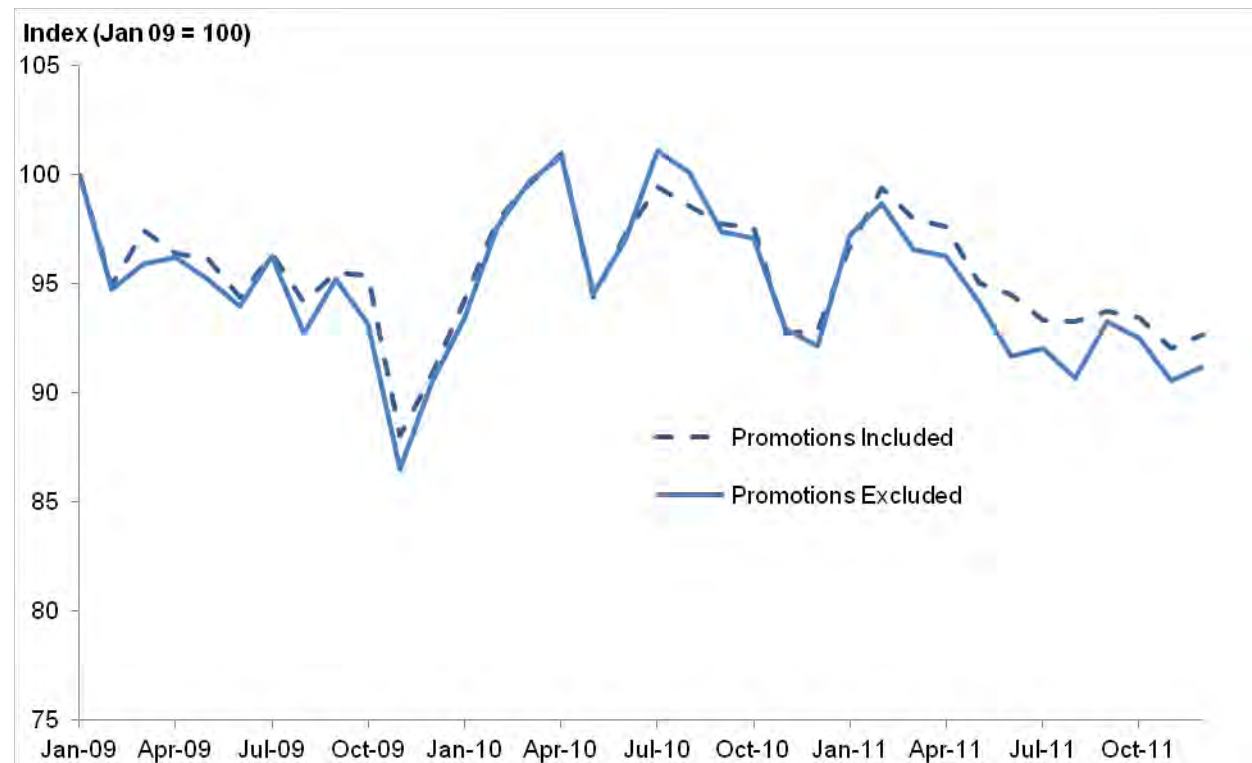


Source: ONS (2014)

**Figure 13.4: Annual growth rate when including and excluding all promotions at the 'Alcoholic Beverages' group-level, 2010-2011**
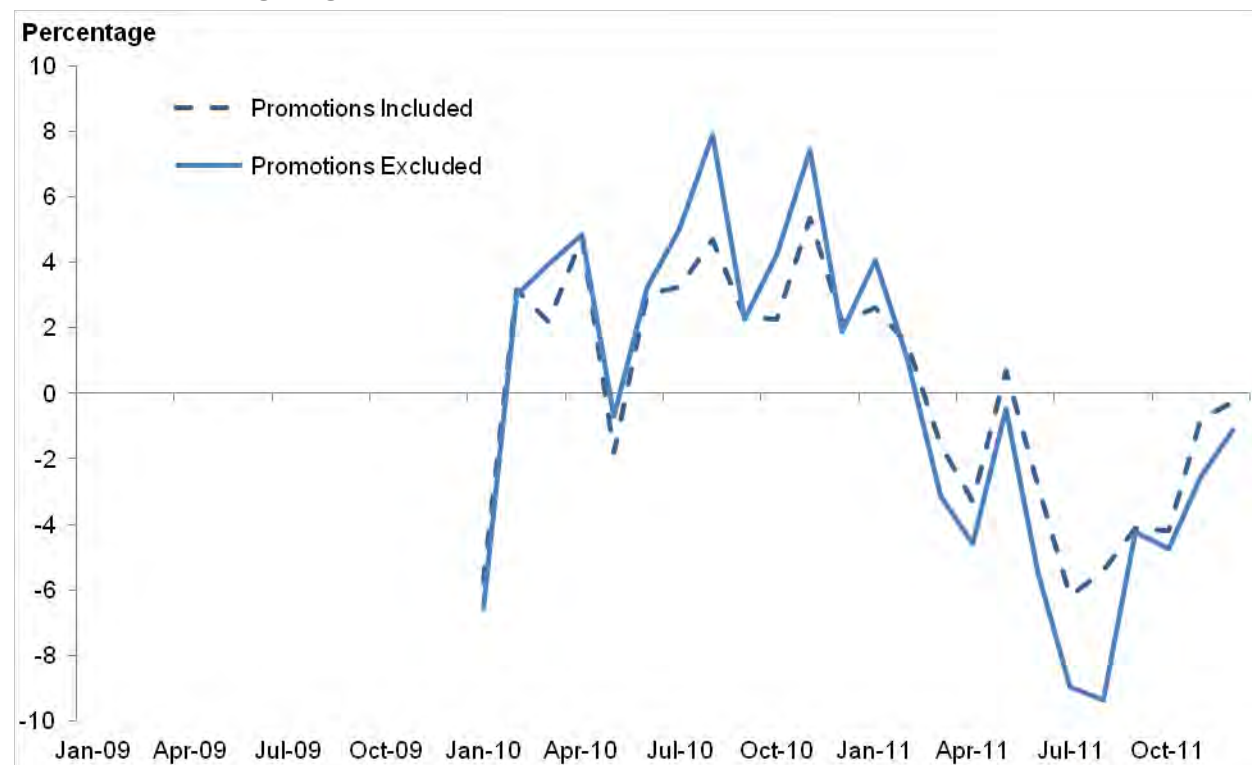


Source: ONS (2014)

## 13.9 Conclusions

Ideally a broader range of discounts should be included in consumer price statistics. There are practical problems to overcome but, given the likely importance of some of the observed discounting behaviour, there is a strong case for developing ways of incorporating many more types of discounts. Certainly ONS should seek to expand the range of discounts covered to include multi-buy discounts. These are common, can result in significant price changes and have an impact on consumer behaviour. Excluding multi-buy discounts from consumer price statistics means missing part of the pricing policy of shops. International practice is evolving towards including more forms of discounts, including multi-buy discounts.

**ONS needs to continue to examine the range and scale of different types of discounting and the extent to which this has been changing over time. It should publish estimates of the likely effects on the CPIH of different ways of dealing with these discounts.**

**ONS should seek to reflect a wider range of discounts, such as multi-buy discounts, in its consumer price statistics, based on the outcome of its studies**.

# Annex A: Evidence for quality change in private rented properties

## A.1 Introduction

Chapter 9 discusses the rental equivalence method used by ONS to estimate owner occupiers' housing costs in CPIH. The low rate at which these costs were rising triggered an investigation by ONS and VOA into the data, which identified shortcomings in the way the private rents data were being processed. However, even when these shortcomings are addressed, there is likely to be a gap between the growth in owner occupiers' housing costs (as shown by the rental equivalence method) and the growth in private rents over the same period.

One of the potential explanations for this difference is that that the quality of private rented properties has been improving over this period. Better properties potentially command higher rents. A simple average of rents would include this effect. A price index, which aims to exclude the impact of changes in quality, would not. The following sections examine the available evidence as to whether the quality of private rented housing has improved over time, and whether this might explain some or all of the differences between average private rents and the results of the rental equivalence method.

## A.2 Sources of data on quality change in private rented properties

The VOA does not collect sufficient detailed data to be able to make an assessment of whether properties have been improving in quality over time. Instead, we have turned to the English Housing Survey for further evidence.

The English Housing Survey (EHS) is an annual survey run by the Department for Communities and Local Government (DCLG). It was formed in 2008 as a result of a merger of the Survey of English Housing (SEH) and the English House Condition Survey (EHCS). The EHS runs on a financial year basis. However, DCLG refers to the results with calendar year labels (2012 representing April 2012 to March 2013) and that convention is followed in this report.

The fieldwork is carried out by contractors. The annual sample is designed to be around 13,300 in total; in 2012 there were around 2,100 interviews held with households in private rented properties. A sub-sample of properties is inspected by surveyors to collect information about the nature of the property, its state of repair, and its surroundings. In 2012, 1,300 private rented properties were inspected in this way.

The EHS sample is weighted for non-response, the nature of the households responding, and the nature of the dwellings. The dwelling weights are based on DCLG estimates of the stock of dwellings in each geographic area.

A very wide range of data is collected by the EHS, and DCLG publishes a great deal of analysis based on the data. In some cases, it is possible to make comparisons before and after the survey changes made in 2008, but this has created some restrictions on the analysis carried out for the review. (DCLG, 2014a)

## A.3 Size of the private rented sector

The number of privately rented dwellings rose from 2.17 million in 2001 and 2.61 million in 2006 to 4.12 million in 2012, the most recent year for which data are available. There has clearly been a significant expansion in the private rented sector, so there is at least the possibility of a major change in the quality mix.

## A.4 Rooms and floor area

Two of the clearest indications of an increase in quality would be an increase in the number of bedrooms at a property and an increase in floor area. Larger properties would, other things being equal, command higher rent.

The EHS shows that the average floor area of private rented properties has fallen from 77 square metres in 2008 to 74 square metres in 2012. If anything, this is evidence of a small decline in the quality of private rented properties.

Analysing change in the number of bedrooms is more complex. The EHS collects data on the number of bedrooms on two different bases: *households* and *dwellings*. Several households can live within the same dwelling; for example, four individuals with a bedroom each in a single property would be counted as four one-bedroom households, but one four-bedroom dwelling.

**Figure A.1** shows the make-up of private rented dwellings by number of bedrooms.

**Figure A.1: Distribution of number of bedrooms in private rented dwellings, 2005–2012**

| | | | | | | | | Percentage |
|---|---|---|---|---|---|---|---|---|
| | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** |
| 1 bed | 18 | 18 | 17 | 17 | 18 | 19 | 19 | 19 |
| 2 beds | 38 | 38 | 38 | 39 | 39 | 40 | 40 | 40 |
| 3 beds | 32 | 33 | 34 | 32 | 31 | 31 | 31 | 32 |
| 4+ beds | 11 | 10 | 12 | 13 | 11 | 10 | 10 | 10 |

Source: English House Condition Survey / English Housing Survey, DCLG.

Figure A.1 indicates a small shift towards smaller (one- and two- bed) properties and away from larger properties, again suggesting a small decline in quality. However, the picture is different if one considers households, rather than dwellings, as shown in **Figure A.2**. This analysis also excludes properties for which no rent is paid, which are generally not part of the private rental market.

**Figure A.2: Distribution of number of bedrooms in private rented households, 2005–2012**

| | | | | | | | | Percentage |
|---|---|---|---|---|---|---|---|---|
| | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** |
| 1 bed | 24 | 23 | 22 | 19 | 19 | 21 | 19 | 19 |
| 2 beds | 39 | 38 | 38 | 38 | 40 | 40 | 41 | 40 |
| 3 beds | 27 | 29 | 31 | 31 | 31 | 30 | 30 | 31 |
| 4+ beds | 10 | 10 | 10 | 12 | 10 | 10 | 10 | 10 |

Source: Survey of English Housing / English Housing Survey, DCLG. Excludes households paying zero rent

Figure A.2 indicates the opposite trend to Figure A.1; a small shift towards larger three bedroom households and away from smaller one-bedroom households.

In conclusion, over the last few years, the trend has been towards slightly smaller dwellings, both in terms of floorspace and the number of bedrooms, but towards slightly larger households. What is clear is that none of these trends indicates the substantial increase in quality of private rented housing required to explain the difference between average rents and a rent price index.

## A.5 Other indicators of property quality

The English Housing Survey collects a very wide range of information about private rented properties, many of which could be considered as demonstrating the quality of the property. These include information on energy efficiency, the standard of repair of the property, and whether the property meets the Decent Homes Standard.

The characteristics overlap each other to a degree; for example, properties need to be in a reasonable state of repair to meet the Decent Homes Standard. In this section, we consider two characteristics: the proportion of private rented properties meeting the Decent Homes Standard, and the cost of basic repairs needed to private rented properties.

To meet the Decent Homes Standard, a property must meet statutory minimum standards, be in a reasonable state of repair, provide "reasonably modern" facilities and have both effective heating and insulation (DCLG, 2014b, pp81-86). The EHS shows that the proportion of private rented properties failing the Decent Homes Standard has fallen from 47 per cent in 2006 (the first year for which comparable data are available) to 33 per cent in 2012.

Basic repair costs are measured in terms of 'standardised repair costs', the average cost per square metre (at 2001 prices) of carrying out any work deemed necessary in the next five years by the visiting EHS surveyor. In 2005, this figure stood at £28 per square metre. By 2012, it had fallen to £16 per square metre, a fall of 45 per cent in real terms. In other words, there was a substantial improvement in the state of repair of private rented properties over the period.

## A.6 Property age

The relationship between property age and property quality is not clear-cut. On the one hand, one might expect newer properties to be better in some of the ways described in Section A.5. However, property age might also capture some elements of quality that are apparent to the renter but that are not easy to quantify, such as the architectural style of the property.

**Figure A.3** sets out the profile of private rented properties by age in 2006 and 2012. It shows that there has been a shift towards properties built after 1990 in the composition of the rented sector over this time, and away from properties built before 1919.

**Figure A.3: Age profile of private rented dwellings, 2006 and 2012**
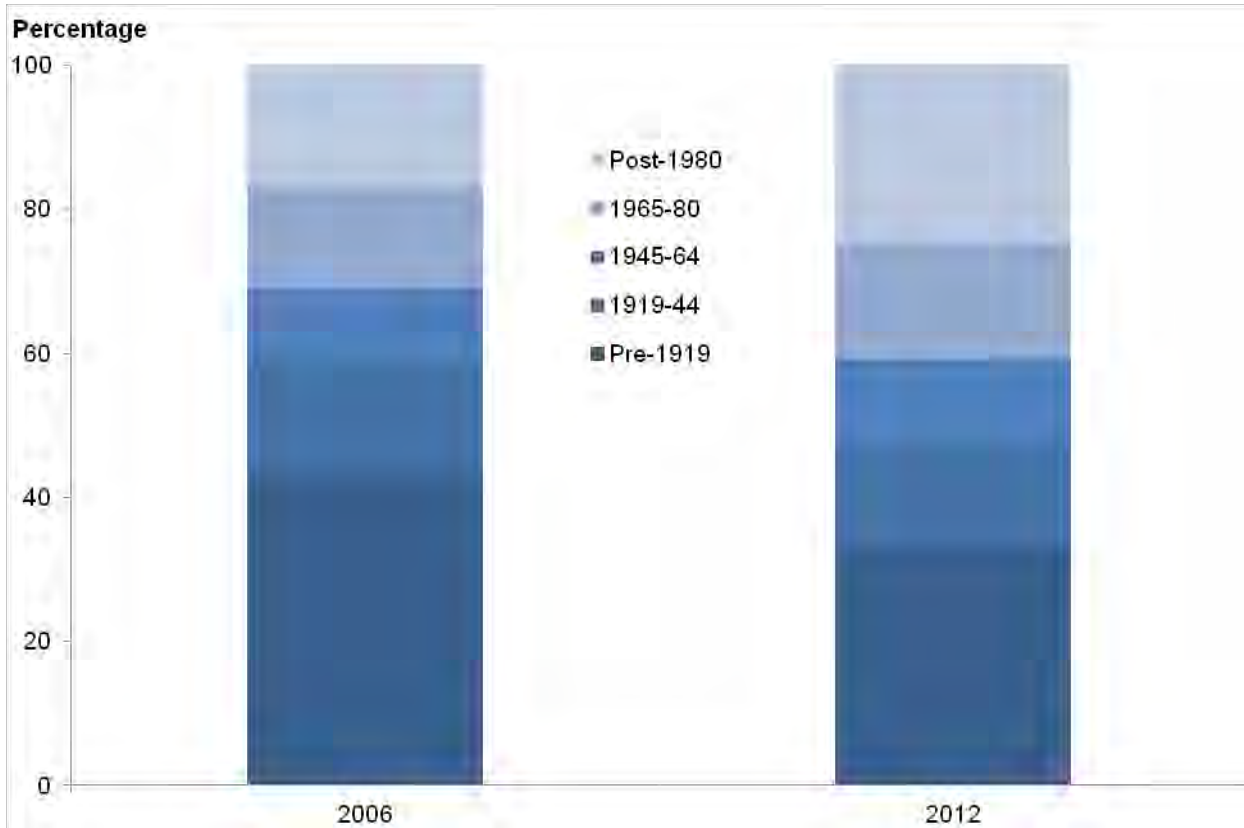


Source: 2006 – English House Condition Survey, 2012 – English Housing Survey, DCLG

If, for whatever reason, newer properties command higher rents, then the shift towards newer properties between 2006 and 2012 may have driven some of the increase in average private rents. However, more evidence is needed before this conclusion can be drawn, and this is explored in the next section.

## A.7 Quantifying quality change

The previous sections have explored some of the ways the private rented housing stock has changed since the VOA data were first collected in 2005. Some of these changes have the potential to explain some of the increase in private rents in such a way that a price index making comparisons at constant quality would not pick up. However, it is not clear how much impact these changes could reasonably have had.

The 2012 English Housing Survey has been used to develop a regression model for private rents, based on the characteristics of the property. Similar to the hedonic regression models developed for technology goods in the CPI, the model is 'log-linear'. The results of the regression are shown in **Figure A.4**. Properties with very low rents have been excluded from this analysis.

The model can be thought of as follows. The base case (a one bedroom flat requiring no basic repairs, built after 1990, with area type of city, in the London region) has a modelled rent of £887 per month. For each of the characteristics in the table above except repair cost, the modelled rent price is the base case multiplied by the factor in question. So, for example, a property with two bedrooms would be estimated to have a rent 1.238 times (that is, 23.8 per cent higher) the rent of a property with one bedroom, other things being equal.

In the case of repair costs, the factor is 0.999 raised to the power of the cost of basic repairs. If the cost of necessary basic repairs is £100 per square metre of the property, the modelled rent would be $0.999^{100} = 0.905$ times that of a property with no need of such repairs (that is, about 9.5 per cent lower).

**Figure A.4: Model estimates for private rent prices, 2012**

| Variable | Exp (Parameter estimate) |
|---|---:|
| Intercept | 887 |
|  |  |
| Basic Repairs (£ per square metre) | 0.999 |
|  |  |
| 1 Bedroom | 1.000 |
| 2 Bedroom | 1.238 |
| 3 Bedroom | 1.402 |
| 4 Bedroom | 1.767 |
| 5+ Bedroom | 2.301 |
|  |  |
| Terrace | 0.945 |
| Semi-Detached | 0.992 |
| Bungalow | 1.012 |
| Detached | 1.098 |
| Flat | 1.000 |
|  |  |
| Pre-1850 | 0.940 |
| 1850-1899 | 0.898 |
| 1900-1918 | 0.884 |
| 1919-1944 | 0.896 |
| 1945-1964 | 0.861 |
| 1965-1974 | 0.894 |
| 1975-1980 | 0.931 |
| 1981-1990 | 0.894 |
| Post-1990 | 1.000 |
|  |  |
| City | 1.000 |
| Suburban | 0.989 |
| Rural | 0.944 |
|  |  |
| East Midlands | 0.461 |
| Eastern England | 0.579 |
| North East | 0.442 |
| North West | 0.460 |
| South East | 0.691 |
| South West | 0.557 |
| West Midlands | 0.493 |
| Yorkshire and the Humber | 0.453 |
| London | 1.000 |

Source: English Housing Survey, DCLG and ONS calculations

Unsurprisingly, properties with more bedrooms command much higher rents. Detached houses attract slightly higher rents than flats, but semi-detached and terraced houses attract lower rents. This could reflect some difference not captured in this model, such as the exact locations of different types of private rented properties. Rural rents are lower than those in urban and suburban

areas. Rents in London, and to a lesser extent south east England, are much higher than in other regions.

Interestingly, property age is also a factor. Properties built after 1990 attract the highest rents, with the next highest rents being paid for properties built before 1850. This suggests that the declining age profile of the housing stock could explain some of the increase in average rent. Similarly, there is a relationship between repair costs and rents; an improvement in the state of repair of the housing stock will also raise rents.

ONS calculated average private rents for the EHS sample for the period 2008 to 2012, adjusting for changes in the mix of properties over the period. The index was almost identical to the unadjusted price index, suggesting that changes in the quality of the private rented stock over this period were negligible. ONS has not yet been able to extend its model over a longer time period.

Finally, it should be noted that the model had an R-squared value of 0.56; that is, the model parameters only explained around 56 per cent of variation in private rents. This suggests that there may be variables that ONS has not yet tested that may improve the model. Another possibility is that a large part of what determines the rent of a property may not be easily quantified. In such circumstances, quantifying quality change is difficult.

## A.8 Conclusions

The analysis of English Housing Survey data rules out the possibility of an increase in property size explaining the difference between the private rent price index based on VOA data, and average rents. Other characteristics, such as the standard of repair of a property or whether it meets the Decent Homes Standard, do show an improvement in quality, although how far these can explain a rise in private rents is not clear.

The age profile of the housing stock has declined. Newer properties attract the highest rents, so this could possibly explain at least some of the increase in average rents that is not captured by ONS's private rents indices. However, attempts to calculate the impact of changes in the private rented stock have so far not suggested these changes have a significant impact on private rents. ONS is continuing its analysis.

# Annex B: Further analysis of implicit quality adjustment

Following the analysis of the Vacuum Cleaners item in Chapter 12 of this report, this annex shows other items analysed in the same way. These items are a tin of baked beans, a women's plain T-shirt and an armchair. The analysis seeks to explain the implicit impact of within and between year quality and specification changes on consumer price indices. To begin, this analysis will be explained again using the example of Vacuum Cleaners.

## B.1 Vacuum Cleaners

**Figure B.1: Implicit between-year quality changes in Vacuum Cleaners, 1996-2013**
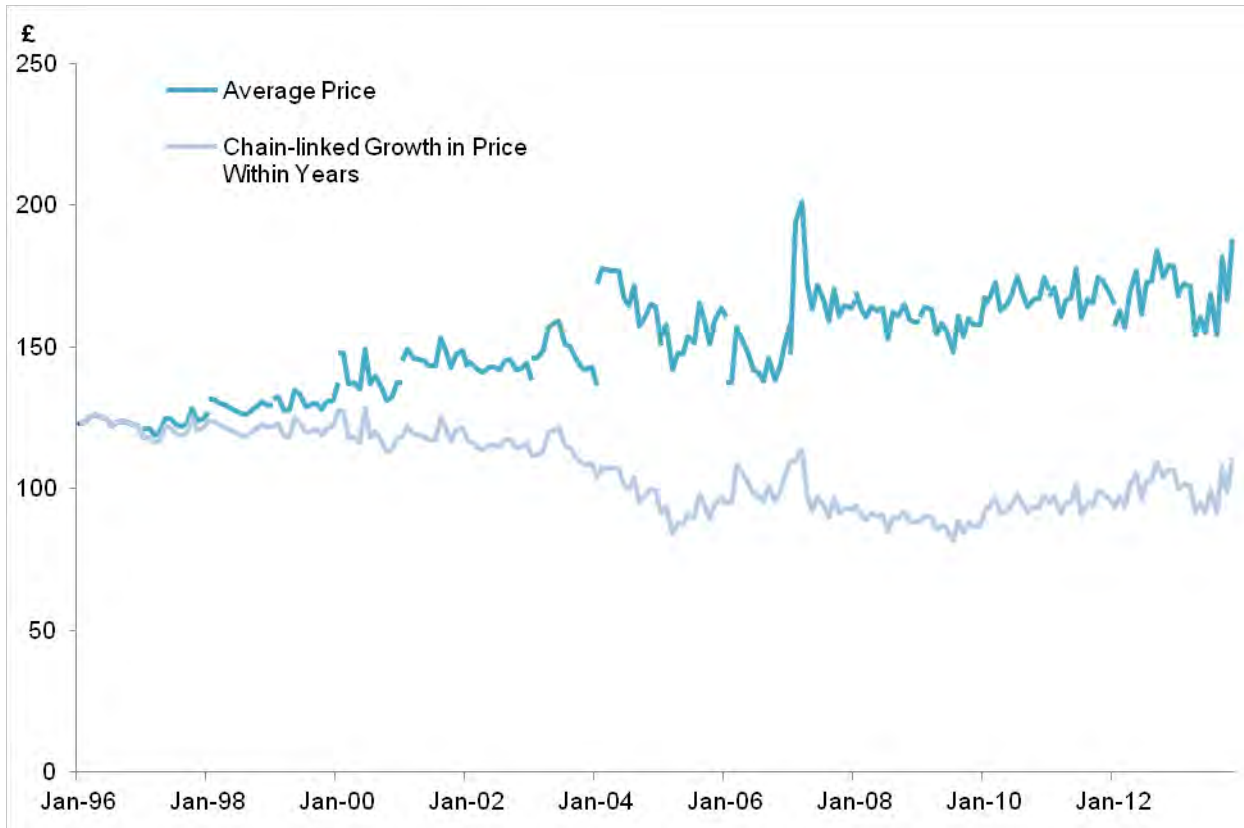


Source: ONS

**Figure B.1** is the same as Figure 12.1 and shows the effect of chain linking in within an item price index.

In the CPI, within-year (January to January) price indices are created for each item. These are then aggregated to the class level (the structure of the CPI is explained in Figure 2.2). These class level indices are chain-linked together to create a continuous time series. The analysis in this annex and Chapter 12 replicates the process of chain-linking at the item level. Chain-linking makes the

January measured as part of the previous year equal to this January of the next. The prices in the two Januarys are the same; any difference comes from the products being collected being different.

Figure B.1 shows, as an example, the effect of chain-linking has in terms of prices observed. The 'Average Price Within Years' curve shows the within year changes in average price of vacuum cleaners collected in the sample. The curve clearly shows where there has been a large change in the composition of vacuum cleaners is being collected. For example in January 2007, there is a gap between the average prices of the old and new selections of vacuum cleaners. The collected prices are the same in both; the difference comes from which products are included. It would be incorrect to say that the price change from an average of £158.05 in January 2007 to £194.17 in February 2007 is due to inflation. Chain linking makes the growth from January to February 2007 applicable to the prices experienced in the previous year. Chain-linking each year together creates the 'Chain-linked Growth in Price within Years' curve on Figure B.1. This line shows the average price observed in the sample of vacuum cleaners, controlling for change in the composition of products over time. The gap between the two curves can therefore be seen as the effect that implicit quality change, or specification change, of products has between years.

The other type of implicit quality adjustment highlighted in Chapter 12 arises from product replacement within the year. If a product in the collection drops out during the year, a replacement must be made. The options of picking a replacement item are outlined in Figure 12.3. Price collectors are advised to pick a comparable replacement product wherever possible. When this is not possible, a non-comparable replacement product is picked. When looking at vacuum cleaners, a replacement product may be deemed non-comparable if it is from a different shop or if it is a different brand. The use of a non-comparable marker explains that the observed price change may due to the product being different from the one that is replacing, not because of inflation. When a non-comparable replacement is enters the index, it is compared against a new January base price.

The 'Chain-linked Growth in Price within Years' curve and 'Average Price Within Year' curves on both Figures B.1 and B.2 will fluctuate with changes in the composition of the basket within the year. In a price index, price quotes are compared against their own base price; they do not take account of changes in the changing composition or quality of the products. The gap between the 'Price Index with Reference to Jan 1996 Price' Curve and the 'Chain-linked Growth in Price within Years' curve can therefore be seen as the effect that implicit quality has within the year has in terms of price.

The formula used to calculate the price index in the bottom line (and throughout this annex) is a Dutot index. This index has been selected because it is a ratio of average prices, so the most comparable to the change in average price being shown by the other lines in Figure B.1. Dutot, and other elementary aggregation formulae, are discussed in Chapter 10.

**Figure B.2: Implicit within- and between- year quality changes in Vacuum Cleaners, 1996-2013**
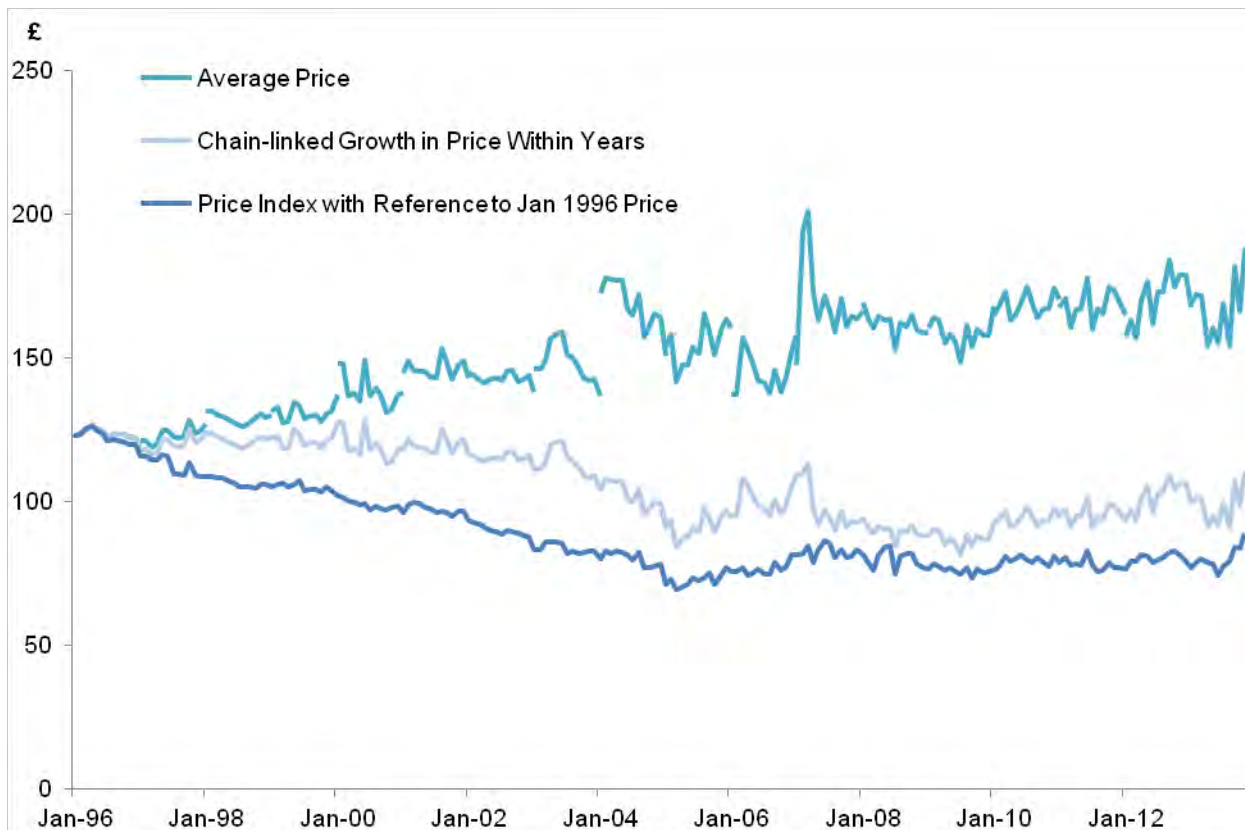


Source: ONS

**Figure B.2** clearly shows the difference between average price growth and growth in the index. This difference is caused by the products being collected within and between years changing. In the case of Vacuum Cleaners, the item index shows prices to have fallen over the period whereas the average price has risen considerably. This is due to the choice of Vacuum Cleaners being collected over time changing to include more expensive items than it had previously. This is seen as a quality improvement. In practice, quality adjustment does not control for direction of change in quality. The effect of implicit quality adjustment therefore differs depending on the products within each item and is expanded further in sections B.2, B.3 and B.4.

## B.2 Baked Beans

**Figure B.3** shows how the difference between the growth in average price and a baked beans item index can be explained by within and between year changes in the products being collected. It shows that, unlike vacuum cleaners, there is not much difference. It does however show that this implicit quality adjustment works for where the quality is deteriorating as well as improving.

In January 2003, the new set of tins of baked beans being collected is of lower average price than the ones in the previous year. As the prices are collected on the same day, the difference between

the two average prices is due to which products are being collected. The new products could be from a different shop, a different brand or in a new location. As the price has fallen in this case, this can be seen as implicit quality deterioration. As this fall in average price is not due to prices falling but different products being collected, it is not reflected in the index. Overall, the baked beans price index shows a smaller increase than the observed average price, controlling for an implied fall in the quality of baked beans over this time.

**Figure B.3: Implicit within- and between-year quality changes in Baked Beans, 1996-2013**
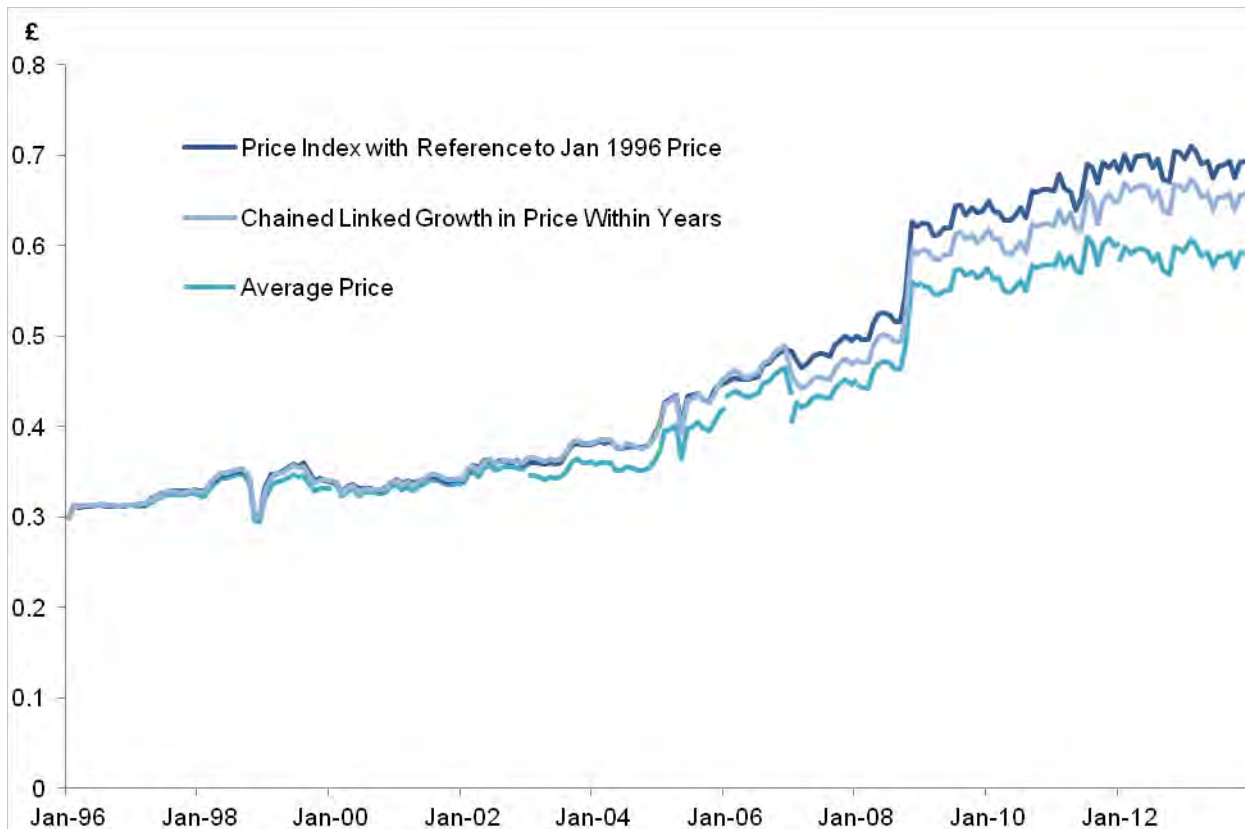


Source: ONS

# B.3 T-Shirts

As discussed in Chapters 3 and 10 in the main text, a decision to change how clothing was collected for the index was made in 2010. Originally, if a priced item of clothing that was on sale was no longer available a replacement item that was not on sale would be deemed non-comparable. This means that there was a trend of falls in price due to sales being included in the index, but the post-sale rise back to original price not being included. The decision in 2010 asked price collectors to relax what was deemed as comparable, so that the price index captured more of the 'bounce back' to full price after a period of sales. This decision can be understood using **Figure B.4**.

**Figure B.4: Implicit within- and between-year quality changes in T-Shirts, 1996-2013**
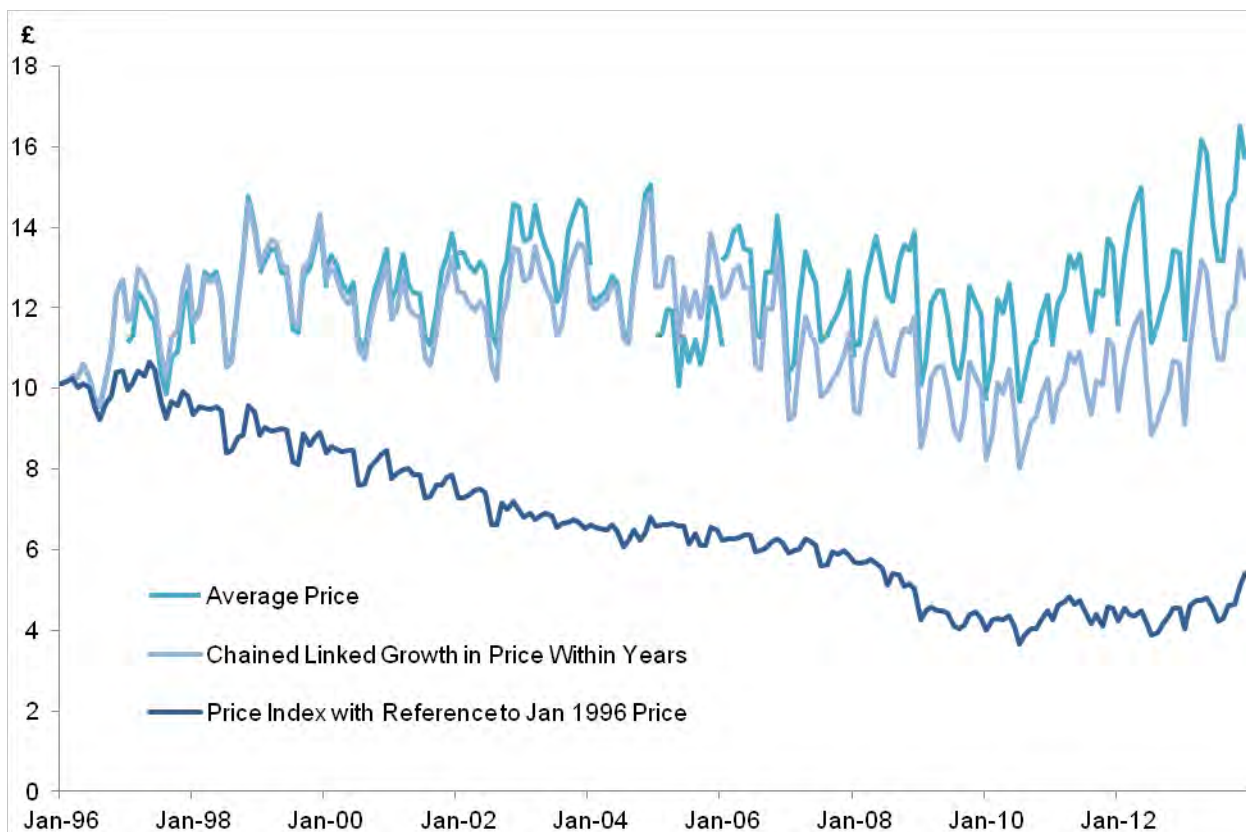


Source: ONS

Figure B.4 suggests that chain-linking does not make a lot of difference to the average price. There are some differences in the composition of the different products over the years – for example 2005 compared with 2004. However the majority of the difference between the index and the growth in average prices is accounted for by the compositional changes within years, i.e. the high price of non-comparable replacements compared with the original products being monitored.

A Dutot price index of women's plain T-shirts falls rapidly until 2010, and the change of collection method. Since price collectors have been allowed to replace sale items with non-sale items, the index has remained relatively flat.

## B.4 Armchairs

**Figure B.5** completes this item analysis, showing the same curves for the armchair price collection.

**Figure B.5: Implicit within- and between-year quality changes in Armchairs, 1996-2013**
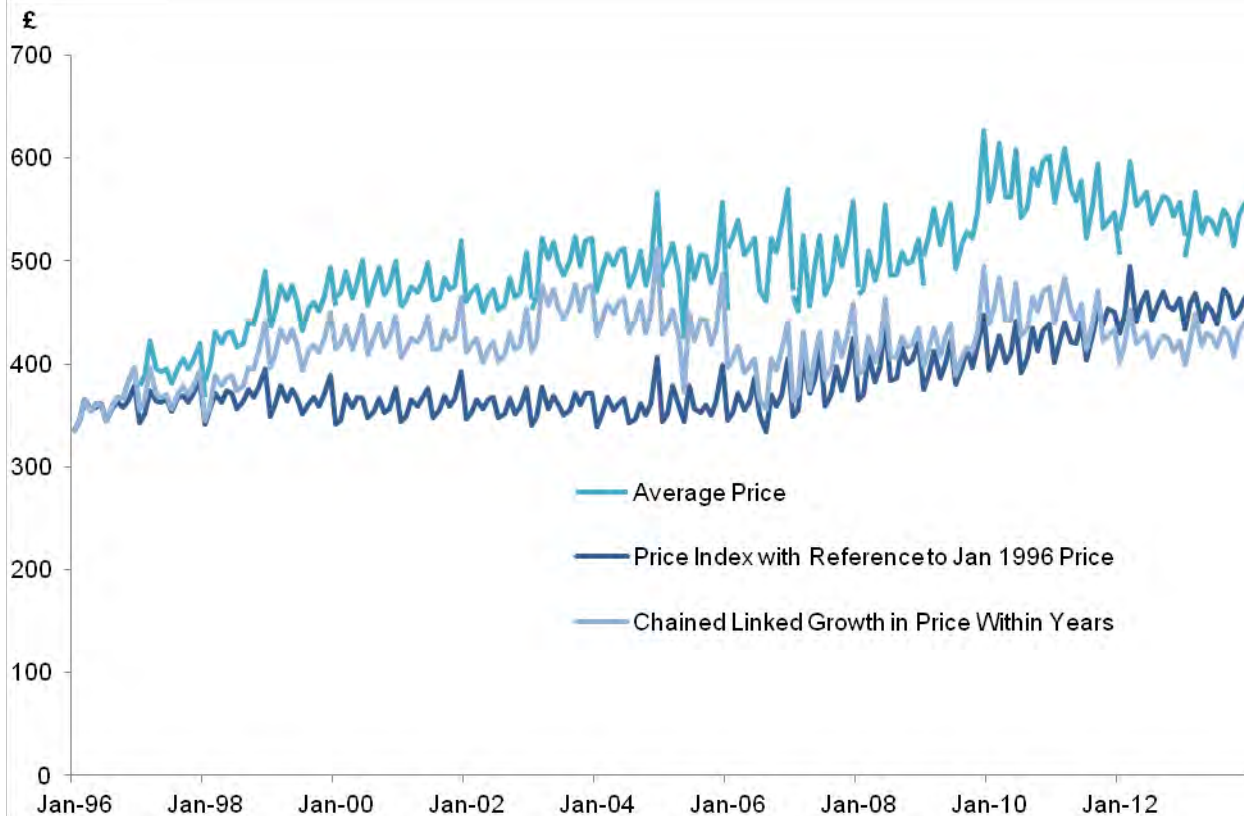


Source: ONS

Originally following a similar pattern to women's plain T-shirts, the majority of the difference between observed average price and the index until 2006 is due to non-comparable replacements when items drop out of the collection. The difference in average price accounted for by the compositional change of what is being collected between years by price collectors is more noticeable after 2006; the price index grows faster than the chain-linked growth index.

## B.5: The use of non-comparable markers

Although it is interesting to see the effect that implicit within and between year quality adjustments could have in the context of individual items, it is difficult to see the scope of the impact on the CPI in general. **Figure B.6** shows the incidence of replacement items, and the proportion of these that

are non-comparable, by COICOP (Classification of Individual Consumption by Purpose) Division for 2013.

The 'replacement products' series are the percentage of price quotes where a product has dropped out of the sample and has to be replaced. If the replacement item is comparable, then the price quote is seen as a change from the base price as if there has been no change in product. If the replacement product is non-comparable, then the base price must be imputed in order for the new product and price quote to contribute to the index, as explained in Section B.1. The use of non-comparable markers is an implicit way of adjust for the quality of the products collected within the year.

In Figure B.6, the replacement products series shows, for each Division, the proportion of products within the 2013 that had to be replaced.  Clothing and Footwear products (COICOP Division 3) have the highest proportion of products replaced, at 19.4 per cent of all price quotes in 2013.

**Figure B.6: Replacement rates and percentage of non-comparable markers by division, 2013**
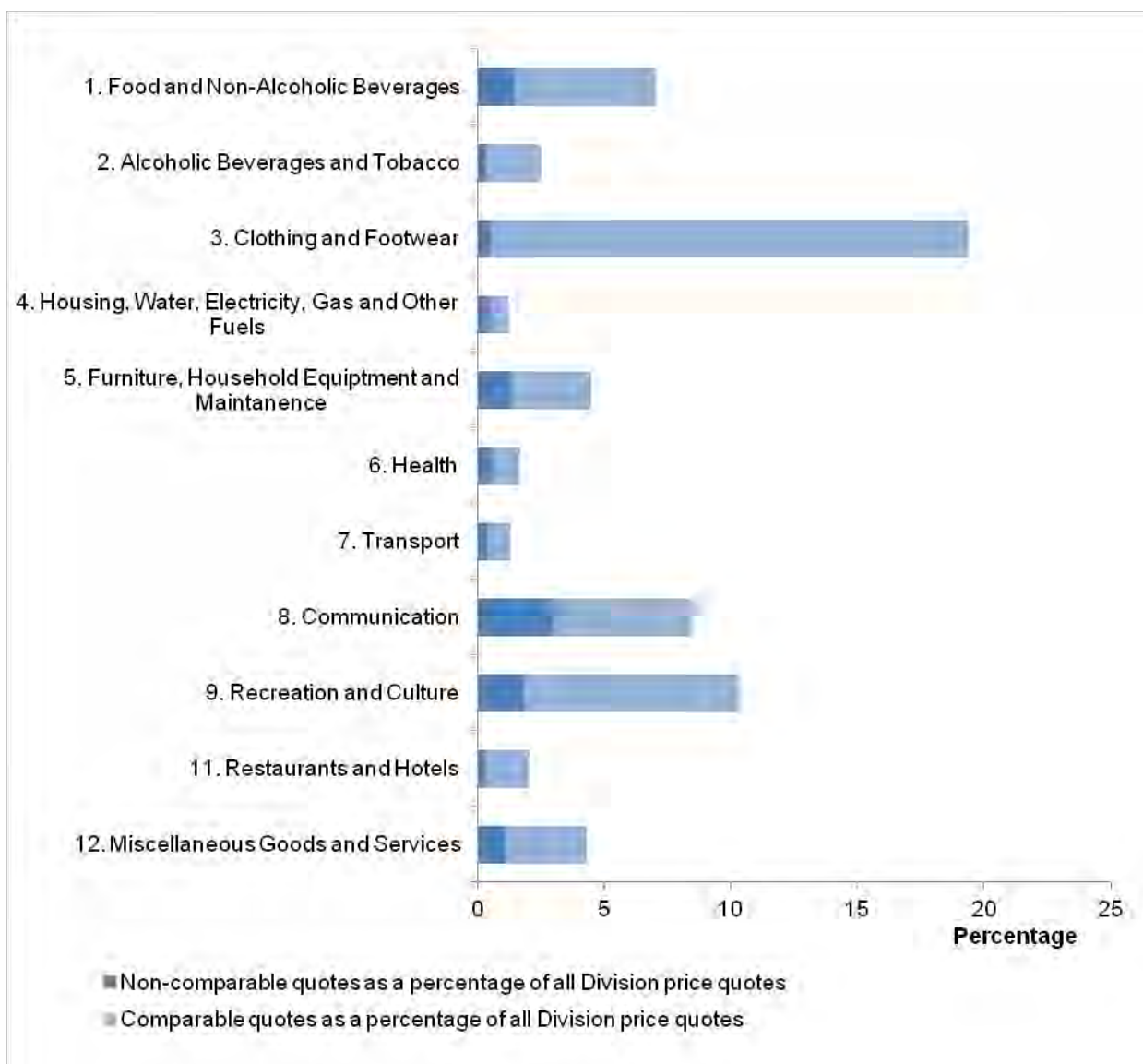


Source: ONS. Based on price quotes for locally collected items only

**Figure B.7** takes this analysis further, to the COICOP Class level. This shows which classes with the divisions have the highest replacement rates and non-comparable replacements and therefore the highest contributors to the proportions in Figure B.6. So in the previously discussed case of Clothing and Footwear, garments have a much higher rate of replacement throughout the year than footwear. This analysis has been conducted using the local price quotes data. The centrally collected price quotes inform 140 of the approximately 700 items in the basket (ONS, 2014). This means that some goods and services are not included in this analysis, including the whole of Division 10 – Education.

**Figure B.7: Replacement rates and percentage of non-comparable markers by class, 2013**

| COICOP | Description | Non-comparable quotes as a percentage of all price quotes | Replacement products as a percentage of all price quotes | Non-comparable quotes as a percentage of replacement products |
|---|---|---|---|---|
| 1 | Food and Non-Alcoholic Beverages | 1.5 | 7.0 | 21.1 |
| 1.1 | Food | 1.6 | 7.7 | 21.0 |
| 1.1.1 | Bread and Cereals | 0.7 | 1.6 | 40.8 |
| 1.1.2 | Meat | 1.6 | 2.6 | 61.9 |
| 1.1.3 | Fish | 1.8 | 2.8 | 67.0 |
| 1.1.4 | Milk, Cheese and Eggs | 0.9 | 2.1 | 45.9 |
| 1.1.5 | Oils and Fats | 0.4 | 1.2 | 34.4 |
| 1.1.6 | Fruit | 3.8 | 25.6 | 14.8 |
| 1.1.7 | Vegetables including Potatoes and Tubers | 1.6 | 12.0 | 13.5 |
| 1.1.8 | Sugar, Jam, Syrups, Chocolate and Confectionery | 0.9 | 1.8 | 51.4 |
| 1.1.9 | Food Products Not Elsewhere Covered | 0.9 | 2.4 | 35.8 |
| 1.2 | Non-Alcoholic Beverages | 0.4 | 1.4 | 27.5 |
| 1.2.1 | Coffee, Tea and Cocoa | 0.4 | 1.1 | 38.1 |
| 1.2.2 | Mineral Water, Soft Drinks and Juice | 0.4 | 1.5 | 24.3 |
| 2 | Alcoholic Beverages and Tobacco | 0.4 | 2.5 | 15.4 |
| 2.1 | Alcoholic Beverages | 0.5 | 3.1 | 15.4 |
| 2.1.1 | Spirits | 0.2 | 0.8 | 22.5 |
| 2.1.2 | Wine | 0.6 | 4.9 | 11.5 |
| 2.1.3 | Beer | 0.6 | 1.4 | 40.3 |
| 2.2 | Tobacco | 0.1 | 0.4 | 16.7 |
| 3 | Clothing and Footwear | 0.5 | 19.4 | 2.5 |

| COICOP | Description | Non-comparable quotes as a percentage of all price quotes | Replacement products as a percentage of all price quotes | Non-comparable quotes as a percentage of replacement products |
|---|---|---|---|---|
| 3.1 | Clothing | 0.3 | 20.5 | 1.7 |
| 3.1.2 | Garments | 0.3 | 20.7 | 1.5 |
| 3.1.3 | Other Clothing and Clothing Accessories | 1.2 | 20.4 | 5.7 |
| 3.1.4 | Cleaning, Repair and Hire of Clothing | 0.1 | 0.1 | 66.7 |
| 3.2 | Footwear including Repairs | 1.3 | 13.2 | 9.6 |
| 4 | Housing, Water, Electricity, Gas and Other Fuels | 0.5 | 1.2 | 37.9 |
| 4.1 | Actual Rentals for Housing | 1.1 | 3.5 | 31.0 |
| 4.3 | Regular Maintenance and Repair of the Dwelling | 0.5 | 1.1 | 40.1 |
| 4.3.1 | Materials for Maintenance and Repair | 0.6 | 1.6 | 38.9 |
| 4.3.2 | Services for Maintenance and Repair | 0.1 | 0.1 | 100.0 |
| 4.5 | Electricity, Gas and Other Fuels | 0.1 | 0.3 | 46.2 |
| 4.5.3 | Liquid Fuels | 0.1 | 0.1 | 100.0 |
| 4.5.4 | Solid Fuels | 0.2 | 0.4 | 41.7 |
| 5 | Furniture, Household Equipment and Maintenance | 1.4 | 4.5 | 30.2 |
| 5.1 | Furniture, Furnishings and Carpets | 1.3 | 4.0 | 32.4 |
| 5.1.1 | Furniture and Furnishings | 1.5 | 4.4 | 33.6 |
| 5.1.2 | Carpets and Other Floor Coverings | 0.7 | 2.7 | 24.9 |
| 5.2 | Household Textiles | 1.1 | 6.6 | 17.0 |
| 5.3 | Household Appliances, Fitting and Repairs | 2.6 | 7.3 | 35.5 |
| 5.3.1/2 | Major Appliances and Small Electrical Goods | 2.7 | 7.7 | 35.5 |
| 5.3.3 | Repair of Household Appliances | 0.0 | 0.0 | |
| 5.4 | Glassware, Tableware and Household Utensils | 1.2 | 4.9 | 25.5 |
| 5.5 | Tools and Equipment for House and Garden | 0.9 | 2.5 | 35.8 |
| 5.6 | Goods and Services for Routine Maintenance | 0.7 | 1.8 | 37.0 |
| 5.6.1 | Non-Durable Household Goods | 0.8 | 2.3 | 36.3 |
| 5.6.2 | Domestic Services and Household Services | 0.1 | 0.1 | 100.0 |
| 6 | Health | 0.5 | 1.7 | 31.6 |
| 6.1 | Medical Products, Appliances and Equipment | 0.6 | 2.1 | 28.9 |

| COICOP | Description | Non-comparable quotes as a percentage of all price quotes | Replacement products as a percentage of all price quotes | Non-comparable quotes as a percentage of replacement products |
|---|---|---|---|---|
| 6.1.1 | Pharmaceutical Products | 0.7 | 2.0 | 37.9 |
| 6.1.2/3 | Other Medical and Therapeutic Equipment | 0.5 | 2.4 | 20.6 |
| 6.2 | Out-Patient Services | 0.3 | 0.4 | 71.4 |
| 6.2.1/3 | Medical Services and Paramedical Services | 0.2 | 0.2 | 75.0 |
| 6.2.2 | Dental Services | 0.5 | 0.7 | 69.2 |
| 6.3 | Hospital Services | 0.2 | 0.2 | 100.0 |
| 7 | Transport | 0.4 | 1.3 | 29.9 |
| 7.1 | Purchase of Vehicles | 1.3 | 5.3 | 24.0 |
| 7.1.2/3 | Motorcycles and Bikes | 1.3 | 5.3 | 24.0 |
| 7.2 | Operation of Personal Transport Equipment | 0.3 | 0.7 | 36.5 |
| 7.2.1 | Spare Parts and Accessories | 0.3 | 1.3 | 22.6 |
| 7.2.2 | Fuels and Lubricants | 1.5 | 2.8 | 53.5 |
| 7.2.3 | Maintenance and Repairs | 0.3 | 0.5 | 60.0 |
| 7.2.4 | Other Services | 0.1 | 0.2 | 35.3 |
| 7.3 | Transport Services | 0.1 | 0.1 | 100.0 |
| 7.3.2 | Passenger Transport by Road | 0.1 | 0.1 | 100.0 |
| 8 | Communication | 1.9 | 8.5 | 35.4 |
| 8.2.0 | Telephone and Telefax Equipment and Services | 3.0 | 8.5 | 35.4 |
| 9 | Recreation and Culture | 3.1 | 10.4 | 18.0 |
| 9.1 | Audio-Visual Equipment and Related Products | 3.1 | 11.2 | 27.6 |
| 9.1.1 | Reception and Reproduction of Sound and Pictures | 3.6 | 10.5 | 33.8 |
| 9.1.2 | Photographic, Cinematographic and Optical Equipment | 2.8 | 7.0 | 40.3 |
| 9.1.4 | Recording Media | 2.3 | 14.6 | 15.8 |
| 9.1.5 | Repair of Audio-Visual Equipment and Related Products | 0.1 | 0.1 | 100.0 |
| 9.2 | Other Major Durables for Recreation and Culture | 0.5 | 2.2 | 21.4 |
| 9.2.1/2 | Major Durables for In/Outdoor Recreation | 0.5 | 2.2 | 21.4 |

| COICOP | Description | Non-comparable quotes as a percentage of all price quotes | Replacement products as a percentage of all price quotes | Non-comparable quotes as a percentage of replacement products |
|---|---|---|---|---|
| 9.3 | Other Recreational Items, Gardens and Pets | 1.4 | 7.8 | 18.3 |
| 9.3.1 | Games, Toys and Hobbies | 1.9 | 10.6 | 17.7 |
| 9.3.2 | Equipment for Sport and Open-Air Recreation | 1.5 | 7.6 | 19.4 |
| 9.3.3 | Gardens, Plants and Flowers | 1.3 | 8.1 | 15.9 |
| 9.3.4/5 | Pets, Related Products and Services | 0.7 | 2.4 | 27.1 |
| 9.4 | Recreational and Cultural Services | 0.8 | 9.1 | 8.5 |
| 9.4.1 | Recreational and Sporting Services | 0.2 | 0.4 | 64.0 |
| 9.4.2 | Cultural Services | 1.8 | 25.0 | 7.0 |
| 9.5 | Books, Newspaper and Stationery | 1.5 | 13.9 | 10.8 |
| 9.5.1 | Books | 2.2 | 24.2 | 9.1 |
| 9.5.3/4 | Misc. Printing Matter, Stationery, Drawing Materials | 1.0 | 5.9 | 16.1 |
| 11 | Restaurants and Hotels | 0.3 | 2.0 | 16.1 |
| 11.1 | Catering Services | 0.3 | 2.1 | 15.9 |
| 11.1.1 | Restaurants and Cafes | 0.3 | 1.9 | 17.3 |
| 11.1.2 | Canteens | 0.3 | 4.1 | 7.6 |
| 11.2 | Accommodation Services | 0.5 | 0.5 | 100.0 |
| 12 | Miscellaneous Goods and Services | 0.5 | 4.3 | 25.3 |
| 12.1 | Personal Care | 1.2 | 2.9 | 42.3 |
| 12.1.1 | Hairdressing and Personal Grooming Establishments | 0.2 | 0.2 | 66.7 |
| 12.1.2/3 | Appliances and Products for Personal Care | 1.5 | 3.5 | 41.9 |
| 12.3 | Personal Effects Not Elsewhere Covered | 1.3 | 9.4 | 13.6 |
| 12.3.1 | Jewellery, Clocks and Watches | 1.0 | 7.5 | 13.8 |
| 12.3.2 | Other Personal Effects | 1.7 | 13.1 | 13.4 |
| 12.4 | Social Protection | 0.1 | 0.2 | 93.3 |
| 12.7 | Other Services Not Covered Elsewhere | 0.3 | 0.4 | 93.5 |

Source: ONS. Based on price quotes for locally collected items only

## B.6 Conclusions

What can be seen in this analysis is that the method used to create the price index implicitly adjusts the index for quality change, and can affect different items very differently. The mechanisms of chain-linking and non-comparable replacements ensure that only comparable prices are used to create the index, but in the case of clothing this has previously been seen as understating the level of inflation and has been monitored more carefully.

To reiterate what is already concluded in Chapter 12, we recommend greater monitoring of the use of non-comparable markers and the impact this may have on the index. This should enable ONS to better understand and explain changes in implicit quality adjustment.

# Annex C: Index number formulae used in this report

Consider a set of M products.

$p^t = (p_1^t, p_2^t \dots, p_M^t)$ refers to a set of *prices* collected for the M goods in period t.

$q^t = (q_1^t, q_2^t \dots, q_M^t)$ refers to a set of *quantities* collected for the M goods in period t.

$s^t = (s_1^t, s_2^t \dots, s_M^t)$ refers to a set of *expenditure shares* collected for the M goods in period t.

Expenditure shares at time t can be derived from prices and quantities using the formula

$$s_i^t = \frac{p_i^t q_i^t}{\sum_{k=1}^{M} p_k^t q_k^t}$$

Let t = 0 be the base period and t = 1 be the current period.

$P_{XX}(p^0, p^1)$ is a price index that calculates the change in price between the base and current period.

The weighted index number formula have been given in terms of expenditure shares, as these are how they are typically used operationally by ONS and other national statistical institutes.

## C.1 Unweighted index number formulae

**Carli:** $\qquad\qquad\qquad P_{CA}(p^0, p^1) = \frac{1}{M} \sum_{i=1}^{M} \frac{p_i^1}{p_i^0}$

**Dutot:** $\qquad\qquad\qquad P_{DU}(p^0, p^1) = \frac{\sum_{i=1}^{M} p_i^1}{\sum_{i=1}^{M} p_i^0}$

**Jevons:** $\qquad\qquad\quad P_{JE}(p^0, p^1) = \prod_{i=1}^{M} \left(\frac{p_i^1}{p_i^0}\right)^{\frac{1}{M}} = \frac{\prod_{i=1}^{M}(p_i^1)^{\frac{1}{M}}}{\prod_{i=1}^{M}(p_i^0)^{\frac{1}{M}}}$

## C.2 Weighted arithmetic index number formulae

**Young:** $\qquad\qquad\qquad P_{YO}(p^0, p^1) = \sum_{i=1}^{M} \left(s_i^b \times \frac{p_i^1}{p_i^0}\right)$

Where b is the period of time to which the weights refer.

**Laspeyres:** $\quad\quad\quad P_{LA}(p^0, p^1) = \sum_{i=1}^{M} \left( s_i^0 \times \frac{p_i^1}{p_i^0} \right)$

The Laspeyres index is the special case of the Young index where b = 0, in other words, the period to which the weights refer is the price base period.

**Lowe:** $\quad\quad P_{LO}(p^0, p^1) = \sum_{i=1}^{M} \left( s_i^{0b} \times \frac{p_i^1}{p_i^0} \right)$, where $s_i^{0b} = \frac{p_i^0 q_i^b}{\sum_{k=1}^{M} p_k^0 q_k^b}$

The expenditure shares in the Lowe index are formed from base period prices and quantities observed in some other period b. In practice, the expenditure shares in the Lowe may be calculated by multiplying the period b expenditures by the change in price between period b and the price base period (period 0), a process known as *price updating*. If period b is the price base period 0, the Lowe index is identical to the Laspeyres index.

**Paasche:** $\quad\quad P_{PA}(p^0, p^1) = \dfrac{1}{\sum_{i=1}^{M} \left( s_i^1 \times \frac{p_i^0}{p_i^1} \right)}$

The Paasche index is current weighted; the expenditure shares refer to the current period 1.

## C.3 Weighted geometric index number formulae

**Geometric Laspeyres:** $\quad\quad\quad P_{GL}(p^0, p^1) = \prod_{i=1}^{M} \left( \frac{p_i^1}{p_i^0} \right)^{s_i^0}$

The geometric Laspeyres is calculated by raising each price relative to the power of the relevant period 0 expenditure share, and then multiplying the weighted price relatives together.

## C.4 Symmetric index number formulae

The following two indices combine current and base period weights and so are known as symmetric indices.

**Fisher:** $\quad\quad\quad P_{FI}(p^0, p^1) = \left( P_{LA}(p^0, p^1) \times P_{PA}(p^0, p^1) \right)^{1/2}$

The Fisher is calculated by multiplying the Laspeyres and Paasche indices together, and taking the square root. It is a geometric average of the Laspeyres and Paasche indices.

**Törnqvist:** $\quad\quad\quad P_{TO}(p^0, p^1) = \prod_{i=1}^{M} \left( \frac{p_i^1}{p_i^0} \right)^{(s_i^0 + s_i^1)/2}$

The Törnqvist uses the same basic formulation as the geometric Laspeyres, except that the price relatives are raised to the power of the average of period 0 and period 1 expenditure shares (the Geometric Laspeyres uses only period 0 expenditure shares).

# Annex D: Axioms for unweighted averages

These tests are taken from pages 363-364 of Chapter 20 of '*Consumer Price Index Manual: Theory and Practice',* published in 2004 by the International Labour Office.

Consider a set of M products. Prices are collected for each product in each period.

$p^t = (p_1^t, p_2^t \ldots, p_M^t)$ refers to a set of prices for the M goods in period t.

$P(p^{t_1}, p^{t_2})$ is a price index that calculates the change in price between periods $t_1$ and $t_2$.

Let t = 0 be the base period and t = 1 be the current period, so $P(p^0, p^1)$ calculates price change between the base and current period.

**T1: Continuity:** The price index $P(p^0, p^1)$ is a continuous function of $p^0$ and $p^1$.

**T2: Identity:** If the prices in the base and current period are the same, the index shows no change. (Note that a published UK price index would be 100 under these circumstances)

$$P(p, p) = 1$$

**T3: Monotonicity in current period prices:** If any of the current period prices are increased, then the resulting price index also increases.

If $p > p^1$,     $P(p^0, p) > P(p^0, p^1)$

**T4: Monotonicity in base period prices:** If any of the base period prices are increased, then the resulting price index decreases.

If $p > p^0$,     $P(p, p^1) < P(p^0, p^1)$

**T5: Proportionality in current period prices:** If all current period prices are multiplied by the same number β, then the price index is multiplied by the same number.

$$P(p^0, \beta p^1) = \beta P(p^0, p^1)$$

***T6: Proportionality in base period prices:*** If all base period prices are multiplied by the same number β then the price index is divided by the same number.

$$P(\beta p^0, p^1) = \frac{P(p^0, p^1)}{\beta}$$

***T7: Mean value test:*** The price index lies between the minimum and maximum of the price relatives.

$$\min\left\{\frac{p_m^1}{p_m^0}, m = 1, \dots, M\right\} \le P(p^0, p^1) \le \max\left\{\frac{p_m^1}{p_m^0}, m = 1, \dots, M\right\}$$

***T8: Symmetric treatment of prices:*** Changing the order of prices in $p^0$ and $p^1$ (but retaining the same pairing of prices) does not change the price index.

***T9: Price bouncing:*** Changing the order of prices in $p^0$ and $p^1$ (and allowing the pairings to be different) does not change the price index.

***The Carli index fails this test.***

***T10: Time reversal:*** If the data for periods 0 and 1 are swapped, then the resulting index is the inverse of the original price index.

$$P(p^1, p^0) = \frac{1}{P(p^0, p^1)}$$

***The Carli index fails this test.***

***T11: Circularity:*** The price index from going from period 0 to period 1 directly is the same as the price index for period 0 to period a multiplied by the price index for period a to period 1, where a is a time period between periods 0 and 1.

$$P(p^0, p^a) \times P(p^a, p^1) = P(p^0, p^1) \qquad \text{where } 0 < a < 1.$$

***The Carli index fails this test.***

***T12: Commensurability (or change in units of measurement):*** Changing the units of measurement of each of the M items (represented by multiplying by a different value $\beta_m$ for each of the M items) should not change the result of the price index.

$$P(p^0, p^1) = P(p_m^0, p_m^1) = P(\beta_m p_m^0, \beta_m p_m^1)$$

***The Dutot index fails this test.***

# Annex E: Organisations that have contributed to the Review

Bank of England

Consumers' Association (Which?)

Debt Management Office

Department for Business, Innovation and Skills

Department for Transport

Department for Work and Pensions

HM Treasury

Low Pay Commission

Ministry of Defence

National Association of Pension Funds

Office for National Statistics

Office of Communications (Ofcom)

Royal Statistical Society

RPI / CPI User Group

Water Services Regulation Authority (Ofwat)

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