Reconciliation of the differences between the Consumer Price Index and the Implied Price Deflator

SUMMARY

The Consumer Prices Index (CPI) is the preferred measure of inflation used in the application of monetary policy by the Bank of England. This index is built on principles agreed by the Member States of the European Union, which have subsequently been embedded within regulations from the European Commission. The resulting Harmonised Index of Consumer Prices is intended to be consistent with the European System of Accounts (ESA), and thus the UK CPI has been designed to be consistent with the UK national accounts. Within the System of National Accounts (SNA), and subsequently the ESA, the preferred measure of inflation is the Implied Price Deflator (IPD). Historically, the indices have behaved broadly similarly, however since around 2007 Q4 the divergence in the indices has increased and become more volatile.

This article provides a description of the two indices with a focus on the conceptual and scope differences, and empirical analyses of how and why the two indices behave differently with particular emphasis on the most recent periods.

BACKGROUND

The Consumer Price Index

The CPI is explicitly designed as a price index to measure inflation arising from the household sector. Most notably, the scope of the CPI is limited to Household Final Monetary Consumption Expenditure (HHFMCE). In application the CPI is a monthly Laspeyres-type price index, using a basket of goods and services fixed in some earlier reference period (in this case, the calendar year two years previous). The CPI is a chained price index, measuring price change from the previous December. Since the quantity reference period (two years previous) and the price reference period (previous December) are not the same, the CPI is more appropriately described as an annually chained monthly Lowe price index.

The CPI is used by the Bank of England (BoE) to inform monetary policy, in the form of inflation targeting. Beyond the use as an inflationary tool, the CPI (from June 2010) is now being used to index state pensions and benefits.

The timeliness of the CPI also allows the BoE and Her Majesty’s Treasury (HMT) to use the CPI as an early indicator of the IPD, since the CPI is available before the implied deflator and historically has tracked the IPD reasonably well. The recent divergence of the CPI and IPD has raised concerns from both the BoE and HMT.

The Implied Price Deflator

An IPD is a derived measure of price change that is produced as part of price and volume measurement under the SNA and is derived by dividing current price data by volume
measures. The volume measures in the UK national accounts are Laspeyres volume indices, the IPD is a derived Paasche price index. That is, it measures price change from the perspective of the volumes or quantities prevailing in the current period. Whilst the IPD measure of price change between the current period and the price reference period (in this case, the previous calendar year) is always a measure of pure price change, comparisons of different Paasche indices differ not only due to change in price but also due to change in the quantities used in the implicit fixed basket. The resultant quarterly IPD series is a series of chained Paasche indices, using current period quantities, with price reference period changing each year. Therefore, the IPD is an annually chained quarterly Paasche price index.

Whilst IPD measures are available for many parts of the national accounts, of interest here is the IPD for Household Final Consumption Expenditure (HHFCE), as part of the use of income account.
What are driving the indices?

Figure 1 below shows how the difference between the CPI and the IPD (re-referenced to 2005=100 for comparability) has changed in magnitude and direction over the period shown. From 2000 Q1 annual inflation as measured by the IPD has on average been slightly higher than that measured by the CPI. The CPI on average between 2000 Q1 and 2011 Q2 has been 0.3 percentage points lower than the IPD. Of interest is the considerable volatility in the movement in the measures since the end of 2007 and how this has affected the difference between them. Between the fourth quarter of 2007 and the first quarter of 2010 annual CPI inflation was an average of 0.9 percentage points higher than that measured by the IPD. However, since around the second quarter of 2010 and up to the second quarter of 2011, the situation has reversed with IPD inflation on average 0.9 percentage points higher than CPI inflation. These two time periods will be examined separately to determine how conceptual and scope differences have influenced this behaviour.

Figure 1 - Difference between the CPI 12 month rate and the IPD 12 month rate

Source: Office for National Statistics
Figures 2 and 3 below examine the period between 2007 Q2 and 2010 Q1 in greater detail. Figure 2 shows inflation on ‘Total Domestic Expenditure’ as measured by the CPI averaging 2.9 percentage points over the period compared with 1.7 percentage points for the IPD. Also shown are the contributions to the total rate coming from each of the distinct Classification Of Individual COsumption by Purpose (COICOP) divisions. It can be seen that the main positive contributions to the rates for both the CPI and the IPD came from Food and non-Alcoholic Beverages, Housing, Transport (which includes fuel costs for motor vehicles) and Restaurants and Hotels. Negative contributions to the CPI and IPD rates came from Clothing and Footwear. Additional negative contributions to the IPD rate come from Recreation and Culture and Miscellaneous Goods and Services. The latter is of considerable interest as it is driven mainly by Financial Intermediation Services Indirectly Measured (FISIM), which will be discussed in greater detail later.

Figure 2 – Comparison of contribution to the annual rate (2007 Q4 to 2010 Q1) by COICOP division

Source: Office for National Statistics
Figure 3 shows the difference between the contributions of the individual divisions to the overall rate. The differences for this period are displayed as IPD minus CPI and hence appear as a negative value. The main differences are within Miscellaneous Goods and Services, Recreation and Culture, Housing, and Food and non-Alcoholic Beverages. The average difference between the CPI and IPD for the period (as shown in figure 3) is roughly 1.1 percentage points with almost half of this difference (0.5 percentage points) attributable to Miscellaneous Goods and Services. Again FISIM is the main contributing factor causing a difference for Miscellaneous Goods and Services.

**Figure 3** – Difference in contribution to the annual rate of change (2007 Q4 to 2010 Q1) by COICOP division

*Source: Office for National Statistics*
Moving on to the period between 2010 Q2 to 2011 Q2, figure 4 shows CPI inflation averaging 3.7 percentage points over the period compared with 4.6 percentage points for the IPD. It can be seen that the main positive contributions to the rates for both the CPI and the IPD come from Transport, Restaurants and Hotels, Food and particularly for the IPD, Housing.

**Figure 4** – Comparison of contribution to the annual rate (2010 Q2 to 2011 Q2) by COICOP division

Source: Office for National Statistics
Figure 5 shows the difference between the contributions of the individual divisions to the overall rate. The main differences on this occasion are within Housing and Transport. The average difference between the CPI and IPD for the period is roughly 0.9 percentage points and almost wholly attributable to Housing. Interestingly the direction of the difference has reversed since the period between 2007 Q4 and 2010 Q1, examined above, which represents an overall shift of 2 percentage points in the difference between the indicators.

Figure 5 – Difference in contribution to the annual rate of change (2010 Q2 to 2011 Q2) by COICOP division

Source: Office for National Statistics
EMPIRICAL ANALYSIS AND QUANTIFICATION OF DIFFERENCES

Overview of the approach to reconcile the indices

The CPI and IPD differ for a range of conceptual and practical reasons. The work carried out for this article attempts to quantify these differences individually by stripping them out from the IPD to create a “hybrid Lowe” index, in order to make the IPD more comparable with the CPI. In a Lowe price index the quantities are fixed and predetermined.

The following is a summary of the adjustments made to the CPI and IPD for the purposes of this analysis:

- Rebasing the IPD from a base year of 2008 to 2005 for comparability with the CPI.
- Expressing the Paasche index as an arithmetic mean using hybrid weights to form a Lowe index.
- Presenting the CPI as a quarterly measure using the previous quarter four as the price reference period.
- Changing the linking process of the IPD to link through quarter four rather than the preceding year.
- Converting the linked IPD to a base weighted Lowe price index using quantity weights implicit to the Paasche index.
- Restricting the scope of the base weighted Lowe index to match that of the CPI.

The reasoning and analysis undertaken hopefully provides enough evidence for the difference between the CPI and IPD. The residual difference remaining stems from the limitations of the approach taken to calculate comparable indices.

Further Points for Consideration

National Accounts deflation of current price expenditure data used in the construction of the IPD is now based predominately on CPI indices. Previously this had been carried out using Retail Price Indices (RPI). Because of the inherent differences in the CPI and the RPI this has led to changes in the level of the IPD. There will not be any attempt to quantify these changes in this analysis. Additionally, for Blue Book 2011, HHFCE introduced a number of improvements in relation to classifications (SIC2007), methodology, revisions, Supply Use balancing and IT systems. It is difficult to fully assess the impact of the change to the use of the CPI from the RPI on the IPD because of all the interlinked changes introduced at the same time but these improvements are worth mentioning.

Summary of the Differences

The following is a brief summary of the key differences between the two measures that have already been detailed and which will be considered in the reconciliation exercise that follows.

a. Differences in conceptual basis and underlying quantities:
   • Laspeyres-type Lowe price index using quantities from two years previous for the CPI
• Paasche price index using current period quantities for the IPD

b. Differences in price reference period:
• previous December for the CPI
• previous year for the IPD

c. Differences in scope:
• HHFMCE for the CPI, dropping imputed rents, FISIM and some aspects of Life Insurance, and the different treatment of package holidays.
• HHFCE for the IPD

By recompiling the IPD index in these ways, differences between the CPI and IPD are removed sequentially and the effect of each difference can be quantified. In the first recompilation the effect of the conceptual differences between CPI and IPD has been removed making the two indices more comparable. The second recompilation aligns the scope of the two indices by removing the classes of expenditure from the IPD which are out of scope for the CPI.

**Conceptual differences (underlying quantities, price reference period, and timing)**

From the above description there are some key differences between the IPD and the CPI:

• IPD is quarterly, CPI is monthly. A quarterly series can be determined for the CPI, and will be used here for purposes of comparison.
• IPD is a Paasche (current period) fixed basket price index, CPI is Lowe (year 2) fixed basket price index.

Although both indices are annually chained, the IPD has a price reference period of the previous calendar year, whilst the CPI has a price reference period of the previous December. That is, the indices not only link through different periods, they have different types of price reference period (a month for CPI but a full year for the IPD).
To begin with, the most relevant difference is that of the Paasche and the Lowe index. Price index theory tells us that under usual economic circumstances, a Paasche price index should be lower than a Laspeyres price index (or in this case a Lowe price index) that is based on the same measures of price change. Yet this conceptual difference has not been observed when we look at the CPI and IPD series', as shown in Figure 6 below. Immediately, it is certain that the differences between the CPI and IPD are being driven by more than just underlying price index theory. The following section introduces the differences that exist between the two measures.

**Figure 6** – Comparison between the CPI 12 month rate and the IPD 12 month rate

![Graph showing comparison between CPI and IPD 12 month rate]

*Source: Office for National Statistics*
Linking through quarter four

As noted, the price reference period for the CPI is the last month in the previous year as opposed to the price reference period for the IPD which is a full calendar year. The IPD has been recalculated using the previous quarter four as the price reference period. The effect of this recalculation shows how the different price reference periods account for differences between the CPI and IPD, as illustrated in figure 7. From this chart we can see that the impact (which is the original IPD minus the new quarter four link IPD) of linking through quarter four is generally positive. The positive result is from the general trend of IPD being upwards and so the quarter four of the original IPD is greater than the average of its respective calendar year. Overall, the direction of the impact has changed in line with the reversal of the general trend in the IPD rate over this time period. This comment is with the exclusion of the period prior to 2003 Q2 and from 2007 Q2 to 2010 Q1 where the difference between CPI and IPD is negative. The impact of linking through quarter four is positive in most cases. Therefore the removal of linking through an annual value does not show an overall decline in all cases.

Figure 7 – Contribution to the difference between the CPI and the IPD – the impact of linking through quarterly values compared to annual values

Source: Office for National Statistics
Changing the base weighting

As a Laspeyres index, the CPI is constructed using base period weights using expenditure data from two years previously. The IPD is a Paasche price index constructed using the current period weights. The Paasche IPD has been recalculated using the same expenditure data that is used to build the CPI. Figure 8 illustrates this recalculation and shows how the different quantity weights account for differences between the CPI and IPD. The base weighted IPD inflation rate is greater than the Paasche which is due to the known difference between the Laspeyres and the Paasche type indices. Here the difference between the original IPD and the base weighted IPD is negative. Since the difference is negative, the impact of linking through quarter four only appears to explain the difference between the CPI and the IPD when the CPI has been above the IPD, particularly during the periods between 2000 Q1 to 2003 Q3, and 2007 Q2 to 2010 Q1.

Figure 8 – Contribution to the difference between the CPI and the IPD – the impact of changing the base weighting period

Source: Office for National Statistics
Combined impact of linking through quarter four and changing the base weighting

The recalculation for the conceptual differences can only partially explain the difference between the CPI and the IPD. Changing the base reference period has a positive impact on the difference between the CPI and IPD rate and changing to the base weighted method has a negative impact. The combined effects of the change to linking through quarter four and base weighting is a negative impact and this is illustrated in figure 9.

**Figure 9** – Contribution to the difference between the CPI and the IPD – the combined impact of linking through quarter four and changing the base weighting

*Source: Office for National Statistics*
Scope and Coverage Differences

The scope of the IPD covers all the expenditure under HHFCE in the national accounts. Compared with the IPD, the CPI has restricted scope, only covering monetary consumption expenditures or HHFMCE. A detailed comparison of these two types of consumption expenditure is provided in table 1, with the key difference being the exclusion of non-monetary (or imputed) expenditures.

Table 1 – Comparison of the scope differences between HHFMCE and HHFCE

<table>
<thead>
<tr>
<th></th>
<th>CPI HHFMCE</th>
<th>Excluded</th>
<th>IPD HHFCE</th>
<th>Excluded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of dwelling</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Alterations and additions</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Dwelling insurance</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Dwelling services provided to owner occupiers’ (Imputed Rents)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure by residents abroad</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure by non-residents in the UK</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FISIM</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Income in kind</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Lotteries and gambling (service charge)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life insurance implicit service charge</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor repairs &amp; maintenance</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Major repairs and maintenance</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Non-life insurance implicit service charge</td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>Prostitution &amp; Narcotics</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Transfer costs accruing to the buyer (housing)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Office for National Statistics

In particular the CPI excludes Games of Chance, Life Insurance and imputed expenditures for owner occupiers’ housing (Imputed Rents) and FISIM. These four components will be examined separately to show what impact these have individually and what impact they have when they are combined together on the difference between the CPI and IPD.
All scope

In order to assess the full impact of the scope differences between the two indices the scope of the base-weighted IPD index has been restricted to match that of the CPI. The results of the overall scope differences are illustrated in figure 10. The combination of all of the scope exclusions in most periods goes some way towards explaining the difference between the CPI and IPD rate with the exception being the period prior to 2003 Q2. Further information and a breakdown of the contribution from each of the four components (Games of Chance, Imputed Rents, Life Insurance and FISIM) can be found in figures 11 to 14.

Figure 10 – Contribution to the difference between the CPI and the IPD - the impact of excluding all scope

Source: Office for National Statistics

Games of Chance and Life Insurance

Of the scope differences the exclusion of Games of Chance and Life Insurance has very little impact on the difference between the CPI and IPD. These exclusions are detailed below in figures 11 and 12. Both exclusions from the IPD show a very slight positive impact but are not sufficient enough on their own to explain the differences between the CPI and IPD.
Figure 11 – Contribution to the difference between the CPI and the IPD - the impact of excluding Games of Chance

Source: Office for National Statistics

Figure 12 – Contribution to the difference between the CPI and the IPD - the impact of excluding Life Insurance

Source: Office for National Statistics
**Imputed Rents**

Where housing costs for owner occupiers are currently excluded from the CPI, their treatment in HHFCE is through imputing rent from equivalent types of properties in the private rental market. Imputed Rent is the value of a good that is more a matter of what the buyer is willing to pay than the cost the seller incurs to create it. Roughly, this could be considered as HHFCE attempting to account for all household expenditures whereas HHFMCE accounts for monetary expenditures only. As a general case, the different treatments of Imputed Rents and FISIM between them almost wholly explain the impact of the scope exclusions. These impacts are illustrated in figure 13 and figure 14. Between these two components both the magnitude and the direction of the gap are approximately the same as the impact of their exclusion from the IPD.

The exclusion of Imputed Rent is the dominating feature for the increase in the difference of CPI and IPD between 2010 Q2 and 2011 Q2. Although there is still a positive impact between 2007 Q2 and 2010 Q1 when the difference between the CPI rate and the IPD rate is negative, the contribution from Imputed Rents shows a decline during this period.

**Figure 13** – Contribution to the difference between the CPI and the IPD - the impact of excluding Imputed Rents

Source: Office for National Statistics
FISIM

The last scope difference between the CPI and IPD to be examined is non-monetary expenditure that occurs as part of FISIM, as illustrated in figure 14. The exclusion of FISIM from the CPI covers the negative difference between CPI and IPD between the period of 2007 Q2 and 2010 Q1. The difference between the CPI and IPD generally coincides with a major change in the FISIM component of the IPD over this period, reflecting a change associated with the global financial crisis at that time.

Figure 14 – Contribution to the difference between the CPI and the IPD - the impact of excluding FISIM

Source: Office for National Statistics
Combined all scope exclusions, impact of linking through quarter four and changing the base weighting

The recalculations for the scope differences explain a large proportion of the difference between the CPI and the IPD. There has been little impact of the difference from Games of Chance and Life Insurance but Imputed Rent and FISIM have helped to explain the difference between the CPI and IPD. The contribution to the gap between CPI and IPD can be accumulated for scope and coverage differences, linking through quarter four and changes in the base weighting, as shown in figure 14. The accumulative differences seem to account well for the difference between CPI and IPD in recent periods but over the longer term still leave some residual differences.

Figure 15 – Contribution to the difference between the CPI and the IPD – the combined impact of linking through quarter four, changing the base weighting and all scope exclusions

Source: Office for National Statistics
Residual difference

This analysis, though detailed, is only a close approximation to the actual process to calculate IPD. There are still some residual differences between the CPI rate and the IPD rate, as examined in figure 16. The analysis has been completed at the COICOP class level, the level at which consistent IPD and expenditure data were readily available. HHFCE data is deflated at a level below this; therefore undertaking analysis at a broader level gives different results than that which would be evident if deflation was applied at the lower classification level. Undertaking this analysis at a broader level gives a slightly different result but does not change the overall story. Furthermore, the quarterly base weighted Lowe index for the IPD is calculated using quarters as reference periods whilst the CPI price measurement is from the month of December. The difference in this methodology produces a slight discrepancy which has not been accounted for in this analysis. Thirdly, the component IPD data used to produce the series underpinning this analysis is rounded to one decimal place. This is seen as a limitation in precision due to a small amount of noise introduced into the analysis but does not affect the overall accuracy of results. Finally, the order that the decomposition has been undertaken has an impact on the results. Undertaking scope adjustments after base weighting has been applied effects the overall results but does not change the final outcome. The order of analysis presented in this article avoids making unnecessary assumptions i.e. if the sources are aligned before scope is adjusted; it would be necessary to geometric mean price indices for FISIM and Imputed Rents. These do not exist in any form.

Figure 16 – Contribution to the difference between the CPI and the IPD – the residual difference left over after analysis

![Graph showing contribution to the difference between the CPI and the IPD](source: Office for National Statistics)
The aim of this article was to explain the gap between the CPI and IPD and why this gap has changed direction and path for the periods between 2007 Q2 to 2010 Q1 and 2010 Q2 to 2011 Q2. To enable comparison between the two indices a “hybrid Lowe” price index has been created from the IPD series. The analysis has presented a combination of conceptual and scope differences with an inclusion of detailed empirical evidence. The conceptual differences that have been examined are the impact of linking through quarter four rather than linking through a calendar year and the impact caused from changing the base weighting. The scope differences that were examined were the exclusion of Games of Chance, Life Insurance, Imputed Rent and FISIM.

The main contributing factors to the difference between the CPI rate and the IPD rate over the whole period are from linking through quarter four, changing the base weight, and the exclusion of Imputed Rents and FISIM. Changing the base weighting and FISIM give negative percentage points differences of 0.64 and 0.2. Linking through quarter four has a positive difference of 0.28 percentage points and Imputed Rents has a 0.39 percentage point difference.

For the period between 2007 Q2 and 2011 Q2 the main contributing factor explaining the difference between the CPI and the IPD is the inclusion of Imputed Rents and FISIM in the IPD as shown in table 2. FISIM has a strong negative value of - 0.64 percentage points in the period between 2007 Q2 and 2010 Q1. Imputed Rents has a high positive impact of 0.79 percentage points difference between the CPI and IPD from 2010 Q2 and 2011 Q2. Other minor differences can be explained by calculations for rebasing, calculations for reweighting and scope differences for Games of Chance and Life Insurance. The overall conceptual impact on the difference between CPI and IPD was -0.42 percentage points between 2007 Q2 and 2010 Q1. Each of these factors has had some contribution in explaining the difference between the CPI and IPD.

Table 2 – The difference between CPI and IPD inflation rate and the contributions to this difference across each indicator

<table>
<thead>
<tr>
<th>Source</th>
<th>Contribution / Percentage points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
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<tr>
<td>Conceptual</td>
<td></td>
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<tr>
<td>Linking through quarter four</td>
<td>-0.36%</td>
</tr>
<tr>
<td>Changing the base weighting</td>
<td>-0.64%</td>
</tr>
<tr>
<td>Scope</td>
<td></td>
</tr>
<tr>
<td>Games of Chance</td>
<td>0.07%</td>
</tr>
<tr>
<td>Life Insurance</td>
<td>0.05%</td>
</tr>
<tr>
<td>Imputed Rents</td>
<td>0.39%</td>
</tr>
<tr>
<td>FISIM</td>
<td>-0.20%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-0.08%</td>
</tr>
</tbody>
</table>

Source: Office for National Statistics
FURTHER INFORMATION

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REFERENCES


