Boosting the Northern Ireland price sample for the Consumer Prices Index, including experimental regional weighting

Update on the Office for National Statistics' work to produce consumer price inflation estimates for Northern Ireland through a sample boost to the price collection.

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1 . Introduction

Background

Our consumer price inflation measures track the change in price of a fixed basket of goods and services that is representative of consumer spending within the UK. This article is an update to work previously covered in our Boosting the Northern Ireland price sample for the Consumer Prices Index publication. The aim is to improve the accuracy of consumer price inflation estimates for Northern Ireland.

The Consumer Prices Index including owner occupiers' housing costs (CPIH) is our preferred headline measure of consumer price inflation in the UK; that is, the rate at which the prices of consumer goods and services rise or fall. CPIH and the Consumer Prices Index (CPI) measure the change in price of a "fixed basket" of goods and services that is representative of spending within the UK. Price changes for the goods and services in the basket are combined in line with the international Classification of Individual Consumption According to Purpose (COICOP) using a weight that reflects how much is spent on them.

Please note for this publication CPIH is not included because of data quality issues with the Northern Ireland owner occupiers' housing (OOH) cost weight and therefore will only focus on CPI. Please see Section 4, Future developments for further details.

In our first publication estimating Northern Ireland prices we highlighted the small sample size for price quotes as a challenge for constructing a Northern Ireland Consumer Prices Index. To try and overcome the issue of a small sample size we have collaborated with the Consumer Council for Northern Ireland (CCNI) to boost the sample size of the price collection in Northern Ireland, mainly the local collection (prices that are collected from local shopping outlets). We showcased the early findings of the collection boost in the first article, however, an additional limitation that was recognised is the use of UK expenditure weights to produce the Northern Ireland consumer price indices.

Since the first publication we have further improved the CPI for Northern Ireland by continuing the locally boosted data as well as recruiting new shops to collect price data in order to improve the coverage of the boost collection. To add to this, we have also investigated an approach to producing experimental region-specific expenditure weights.

Expenditure data for the UK-level weights are drawn from Household Financial Consumption Expenditure in the National Accounts. For more information on how our consumer price inflation statistics are compiled, please refer to our Consumer Price Indices Technical Manual. The price collection and weights data are optimised to give reliable estimates of inflation at the UK-level but do not necessarily support the production of regional or country breakdowns. For expenditure weights, Living Costs and Food Survey (LCF) data can be reconciled to CPI spending totals to provide a regional breakdown. However, disaggregating the LCF sample into country and regions means that the sample sizes are much smaller than the national sample size. As it was not feasible to increase the sample size of each regional breakdown in previous years of LCF data, we have come up with an experimental method of producing more robust regional weights.

In this article we use a new experimental method to produce representative Northern Ireland weights and show the effect these weights have on our experimental Northern Ireland consumer price index. In addition to the weights, we now have 15 months of locally boosted data, meaning for the first time we have produced annual inflation rates for Northern Ireland, for the months of January, February and March 2023.

2 . Methodology update

Volatility in Northern Ireland expenditure weights

Expenditure weights reflect the importance of goods and services, measured by the amount households spend on each good or service compared with their total consumption of the household. For example, the price of rice going up by 10% will not have the same impact on the economy as the price of fuel going up by 10% would. Expenditure weights are collected via the Living Costs and Food Survey (LCF) and are used to calculate the national Consumer Prices Index (CPI) and Consumer Prices Index including owner occupiers' housing costs (CPIH). However, spending habits in different areas of the UK differ, therefore it is necessary to obtain country-specific weights to produce a more accurate Northern Ireland index.

The LCF sample collection varies across regions and countries of the UK and the sample size is based on the size and the population of the region. When expenditure data are broken down by region, the sample size is small leading to greater volatility in any regional weights produced from it.

Figure 1: Northern Ireland has a much higher level of volatility across class-level weights than other UK countries and regions

The coefficient of variance of weights at class level (COICOP 4) across all UK countries and English regions compared with the UK, January 2005 to February 2022

Notes:

1. The coefficient of variance is a measure of how much variation there is between estimates, standardised onto a common scale for comparison purposes.

2. Class level is equivalent to classification of individual consumption by purpose (COICOP) level 4.

3. A box plot has been used to show the distribution of the coefficient of variance of class-level weights.

4. Outliers are not considered and have been removed from the box plot.

5. Here we use the coefficient of variance to look at the variation across 18 years.

6. Please note, other factors like long-term trends may cause the coefficient of variance to be high.

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Figure 1 highlights the effect sample size can have on a data series; the UK has a much shorter box plotting meaning the volatility is considerably lower than individual regions, which have a much longer box plot. This is expected as the UK is the combination of all countries and regions, meaning it has the largest sample size. Northern Ireland, one of the smallest sample sizes is one of the most volatile, with the longest box plot in Figure 1. In comparison, the Yorkshire and the Humber, the largest English region, has a larger sample size, resulting in a shorter boxplot and therefore the lowest level volatility of all the UK regions.

Reducing volatility of weights by using an average starting point

A small expenditure data sample for Northern Ireland leads to volatile Northern Ireland-specific weights. The volatility means that year-on-year movements are unlikely to represent true spending habits in Northern Ireland, it can also make it difficult to show price changes over the years, since price movements are confounded by weights effects. We have therefore looked at using an experimental methodology to reduce the volatility of the Northern Ireland weights.

Previous research by Southampton University looked at using a rolling three-year average as a smoothing technique but found the weight series were still quite volatile. We considered the trade-off of having region-specific weights, but they were excessively volatile. Alternatively, we could have used UK-specific weights that are less volatile but do not accurately represent Northern Ireland spending.

Assuming that the general distribution of spending in Northern Ireland differs to the UK, but changes over time are broadly similar, we looked to create a stable estimate of the spending distribution in Northern Ireland at an appropriate point in time and then adjust it using UK-wide annual changes. We therefore looked for a reasonable "starting point" of Northern Ireland expenditure to then adjust by UK weight changes.

The assumption that changes over time are broadly similar between the UK and Northern Ireland is unlikely to be true for certain time periods, particularly over the coronavirus (COVID-19) pandemic period. If this approach were used on an ongoing basis, it would be necessary to have a periodic benchmarking exercise to pull weights back into line. Nevertheless, the method was chosen as a way of managing the trade-off between volatility and representativeness.

Because of changes in spending habits during the pandemic period (2020 to 2021), we only considered pre-coronavirus-pandemic starting points. We also did not want to pick a year that was too far from 2023 and be unrepresentative of current spending patterns in Northern Ireland. To pick a suitable starting point as close to the present as possible we had a look at the amount of zeros (weight classes that were not recorded for Northern Ireland on a year) and outliers (defined by the Interquartile range (IQR)) surrounding the year for each class, resulting in 2015 as the least volatile year and most suitable "starting point". This method was guided by our methodology to calculate CPIH-consistent inflation rates for UK household groups.

To ensure the starting point was a good representative of each class weight, we applied a smoothing method. We investigated smoothing Northern Ireland weights around 2015 across three-, five- or seven-year periods. A five-year average was chosen as it gives a reasonable trade-off between robustness and relevancy. The series was then adjusted by annual changes in UK weights since 2015, and rescaled to sum to 1000, to create a set of Northern Ireland-specific weights.

Figure 2 shows the difference in the resulting Northern Ireland 2023 February weights, choosing a three-, five- or seven-year average surrounding 2015 as a starting weight.

Figure 2: Averaging Northern Ireland expenditure weights was investigated to smooth volatile Northern Ireland data

Three-, five- and seven-year averages of resulting Northern Ireland February 2023 weights by divisions

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Three-, five- and seven-year averages of resulting Northern Ireland February 2023 weights by divisions
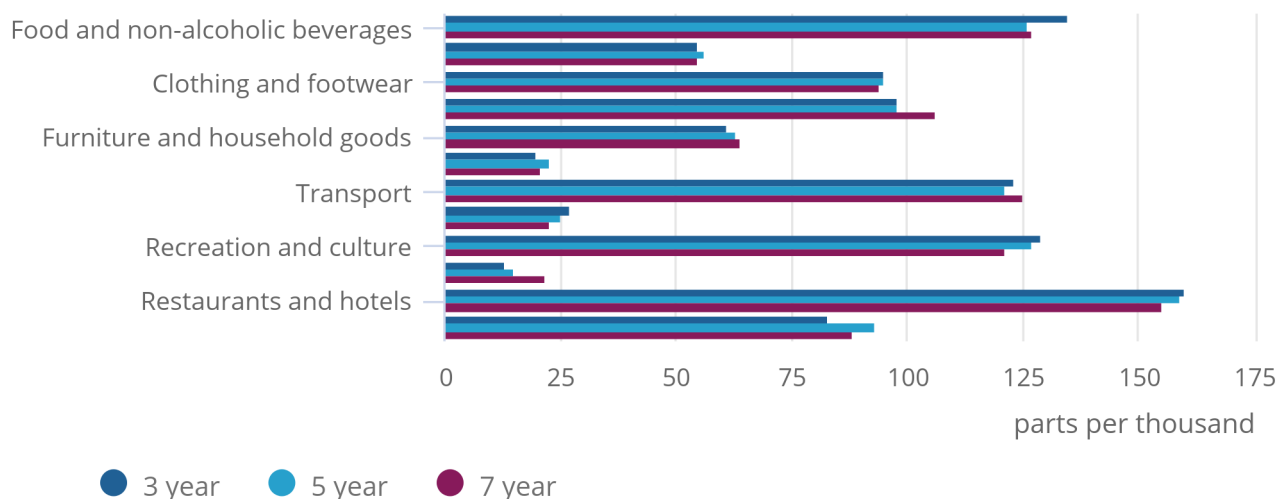
Source: Office for National Statistics

Notes:

1. Three-year average range: 2014 to 2016.

2. Five-year average range: 2013 to 2017.

3. Seven-year average range: 2012 to 2018.

4. Weights may not sum to 1,000 because of rounding.

Based on this methodology, we have produced experimental Northern Ireland weights at division level. Table 1 shows these new weights for CPI aggregated to division, and how they compare to the UK. It is important to note that the UK weights also contain the Northern Ireland raw expenditure data before any alterations are made. The table is not a comparison of Northern Ireland against the rest of the UK, it is a comparison of Northern Ireland against the UK including Northern Ireland. It is also worth noting that weights show the proportion of spending in each category. A higher Northern Ireland weight for clothing and footwear does not necessarily imply that Northern Ireland households buy more clothing and footwear, it suggests that these consumers proportionally spend more on this category than those in the UK as a whole.

Table 1: Experimental Northern Ireland expenditure weights compared with the weights used in headline UK CPI inflation (parts per thousand), February 2023

Division	Northern Ireland CPI weights	UK CPI weights	Difference
Food and non-alcoholic beverages	126	119	7
Alcoholic beverages and tobacco	56	42	14
Clothing and footwear	95	58	37
Housing, water, electricity, gas and other fuels	98	141	-43
Furniture, household equipment and maintenance	63	68	-5
Health	23	24	-1
Transport	121	137	-16
Communication	25	23	2
Recreation and culture	127	138	-11
Education	15	29	-14
Restaurants and hotels	159	138	21
Miscellaneous goods and services	93	83	10

Source: Office for National Statistics

Notes

1. Columns may not add to 1000 because of rounding

2. The difference presented in the "Difference" column is the UK CPI weights subtracted from the Northern Ireland CPI weights.

Outlier treatment and data cleaning

When creating a starting weight for 2015, outliers were investigated. We identified outliers within the seven years surrounding the starting point of 2015; from 2012 to 2018 using the IQR outlier method on the whole series from 2005 to 2023. It is important to note that this does not mean that prices in Northern Ireland are lower than in the UK, it just means that prices are currently rising at a slower rate in Northern Ireland than in the UK as a whole

If an outlier is flagged within the seven-year gap, we manually inspected it to see if the outlier was because of a national trend (using UK data as comparison) or high volatility in the class. When necessary, outliers were replaced by the average of the remaining Northern Ireland data in the seven-year gap series for their respective class. Please note there is a degree of subjectivity using this approach.

Limitations

A larger sample size in expenditure data would support a more accurate weight for Northern Ireland, but this was not possible to obtain. The method we use here overcomes a small sample size in expenditure data using a methodology that is a trade-off between having Northern Ireland-specific weighting and having volatility in the data. However, there are still limitations to this experimental method.

Firstly, when using this experimental method, the Northern Ireland expenditure trends are not used once adjustment begins in 2015. Also, any differences in spending patterns between the UK and Northern Ireland response to the pandemic will not have been captured.

Secondly, the weights are calculated at class level only and volatility at item level is not inspected. However, it is worth noting this aligns with the method used in our CPIH-consistent inflation rate estimates for UK household groups publication.

Thirdly, the sample size for Northern Ireland in LCF is small and though averaging across five years reduces volatility, the combined sample size should still be treated with caution.

3 . Results

In this section, we present the experimental Northern Ireland Consumer Price index (CPI) produced using experimental weights and how it compares to the UK CPI. We showcase 15 months of data, including three months of annual rates and their contributions.

These estimates reflect the current outcome of this pilot and our research on sample sizes and weights. We have not identified an optimal sample size and as a result there may be volatile or unusual effects that are not genuine movements for Northern Ireland, but instead are a result of sampling issues. We do not recommend the use of these metrics for policy or decision-making purposes.

Our first publication showed the first six months of the index using a sample boost on locally collected data in an attempt to overcome the issue of having a regional small price sample size. Here we improve the index further by accounting for regional weights. The index is constructed using Northern Ireland locally collected price sample data, centrally collected price sample data and the corresponding weights. Figure 3 compares the Northern Ireland CPI using the experimental weights with the published UK CPI. As usual, the UK CPI is based on all expenditure data including unadjusted Northern Ireland data and does not include the boosted price sample.

The results show a combination of price change and expenditure weights. For example, prices for individual items in Northern Ireland might be going up at the same rate as those in the UK. However, if spending patterns differ between Northern Ireland and the UK, this will cause a difference between the Northern Ireland and the UK index. Note this does not indicate how the absolute level of prices in Northern Ireland compares with the UK as a whole – it only reflects changes in the level of prices since the start of 2022.

Figure 3: Experimental Northern Ireland Consumer Price Index is higher than the UK through 2022 before dropping below the UK in 2023

Consumer Prices Index (CPI), UK and Northern Ireland, index (January 2022=100), January 2022 to March 2023

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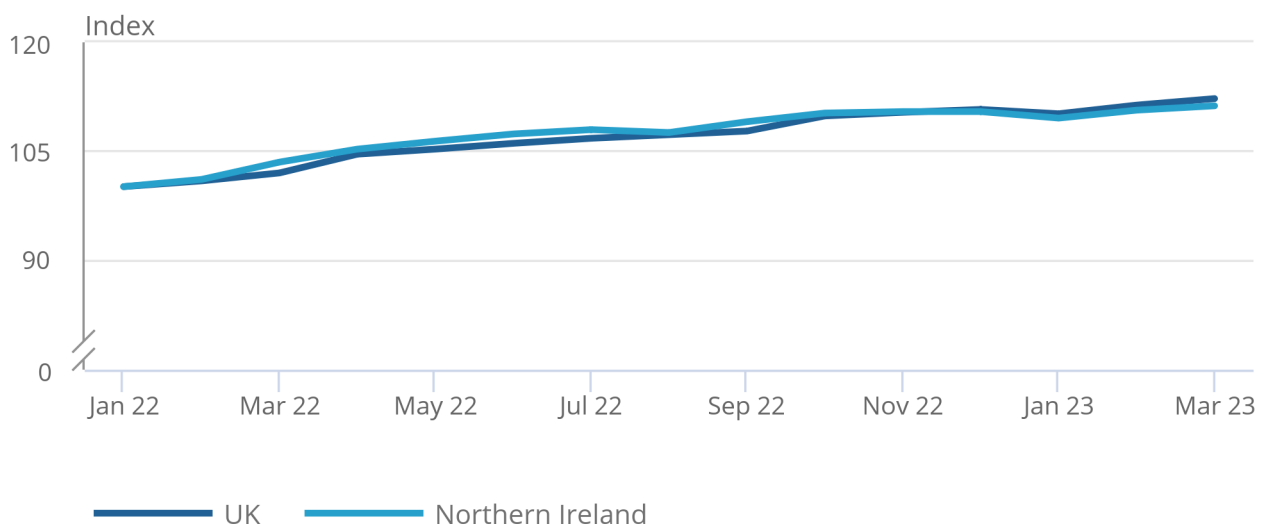
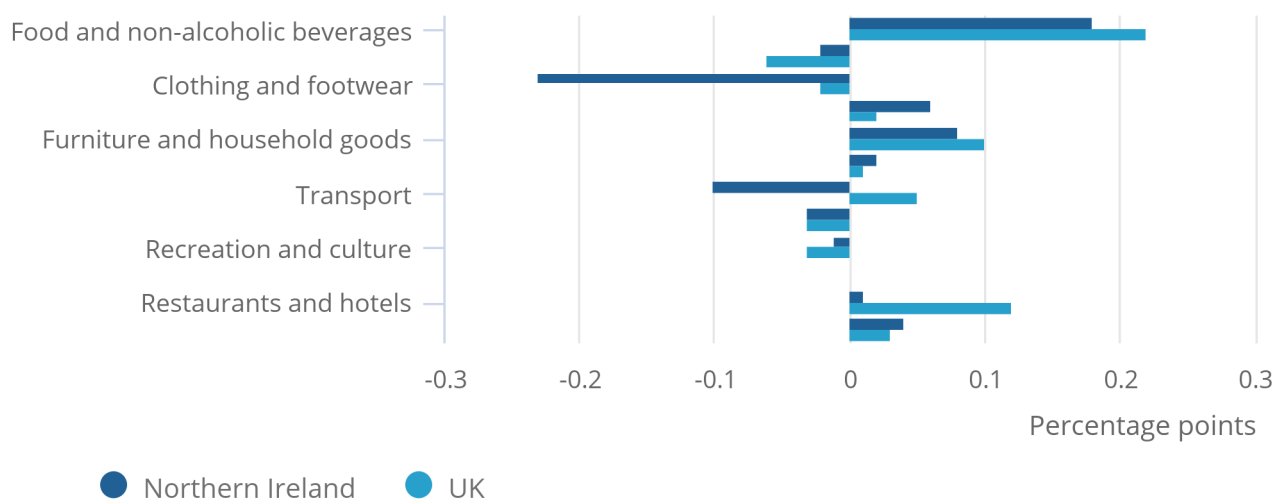**Source: Office for National Statistics**

Figure 3 shows the experimental Northern Ireland CPI as higher than the UK CPI until December 2022, when it then drops below the UK. Figure 4 explains the reasons why this crossover happens.

Figure 4: Clothing and footwear was one of the contributors to the Northern Ireland CPI crossing below the UK CPI between November and December 2022

Percentage-point contributions to change in the Northern Ireland and the UK Consumer Prices Index (CPI), between November and December 2022

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Percentage-point contributions to change in the Northern Ireland and the UK Consumer Prices Index (CPI), between November and December 2022

Source: Office for National Statistics

Each bar represents how the index for each division has changed from November to December, if a bar is on the positive side, it means that the index was higher in December than it was in November, and vice versa for negative values.

The change in the Northern Ireland index compared with the UK index from November to December 2022 is because of clothing and footwear, and transport. Clothing and footwear made a contribution of negative 0.23 percentage points in Northern Ireland, whereas for the UK it was negative 0.02 percentage points. While transport in the UK made a positive contribution of 0.05 percentage points, in Northern Ireland this division made a contribution of negative 0.10 percentage points.

These two divisions are the main contributors to Northern Ireland CPI falling below the UK CPI between these two months. The difference to contributions, for both clothing and footwear, and transport, is because of a combination of differences in the prices between Northern Ireland and the UK, as well as the weights for both regions. However, for clothing and footwear, this difference is largely because of a difference in price, whereas for transport, this difference is largely because of expenditure weights.

The difference between the two series fluctuates every month and will be influenced by different divisions throughout the timeseries. By looking at the contributions to the difference between UK CPI and Northern Ireland CPI, we can understand what causes the differences across the 12 months, from March 2022 to March 2023.

Figure 5: Clothing and footwear causes the largest difference between the UK and Northern Ireland CPI in 2023

Percentage-point contributions to the difference between the change in the Northern Ireland CPI and the change in the headline UK CPI, index (January 2022=100), March 2022 to March 2023

Figure 5: Clothing and footwear causes the largest difference between the UK and Northern Ireland CPI in 2023

Percentage-point contributions to the difference between the change in the Northern Ireland CPI and the change in the headline UK CPI, index (January 2022=100), March 2022 to March 2023
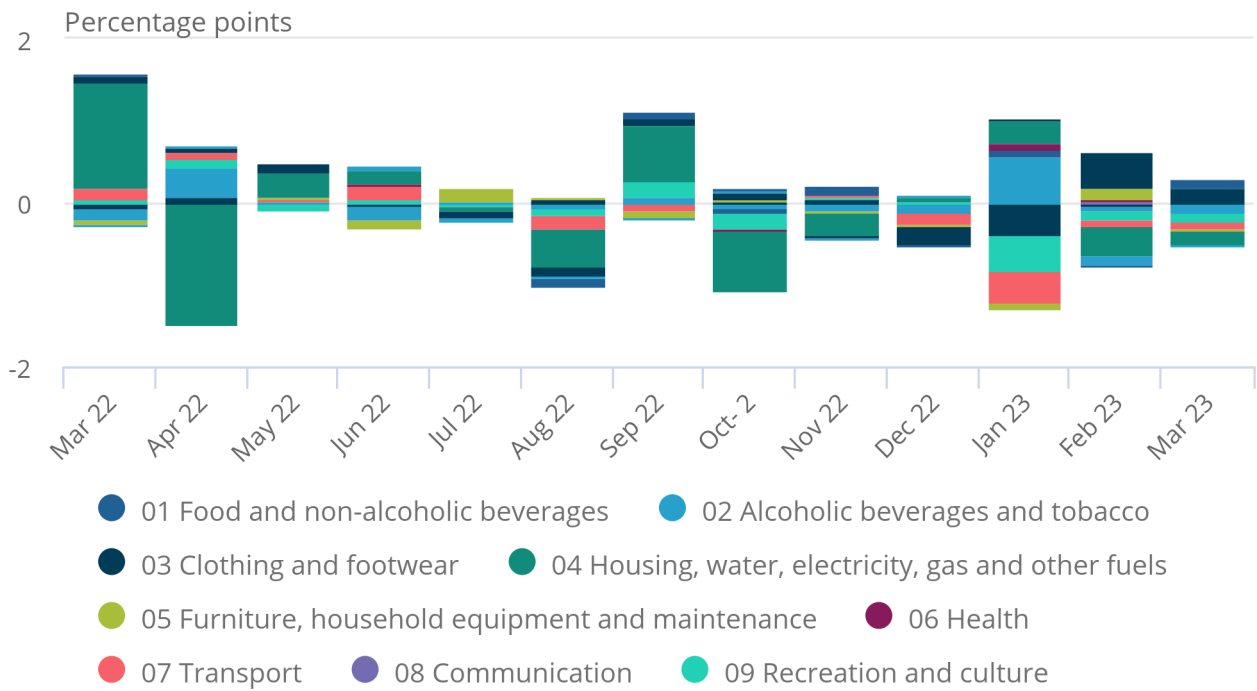
Source: Office for National Statistics

Figure 5 is an extension of Figure 4 and shows the contribution to change from one month to the next, between the Northern Ireland and the UK-published CPI. For example, in April 2022, the negative dark green bar shows that housing in the UK has contributed to an increase more from March to April than it did in Northern Ireland. Differences will be a combination of the price differences between Northern Ireland and the UK as well as different expenditure patterns between Northern Ireland and UK.

Annual inflation

With over a year's worth of data, for the first time we have been able to produce annual inflation figures and what the contributions are for these rates.

Table 2: Annual Northern Ireland CPI inflation rate slowed more than that of the whole UK, in March 2023
Consumer Prices Index (CPI), UK and Northern Ireland, annual inflation rate (%), January 2023 to March 2023

Date	Northern Ireland CPI annual inflation rate (%)	UK CPI annual inflation rate (%)
Jan 2023	9.5	10.1
Feb 2023	9.5	10.4
Mar 2023	7.5	10.1

Source: Office for National Statistics

The experimental Northern Ireland CPI shows that the inflation rate in Northern Ireland slowed more than the UK in the 12 months to March 2023, with the latest figure at 7.5% compared with the UK's 10.1%. It is important to note that this does not mean that prices in Northern Ireland are lower than in the UK, it just means that prices are currently rising at a slower rate in Northern Ireland than in the UK as a whole.

Figure 6 compares the contribution with the annual rates between the new Northern Ireland CPI and the published UK CPI. Each chart shows how each of the 12 spending categories contribute to the annual inflation rate for the first three months of 2023. The sum of the contributions in any given month is equal to the overall annual inflation rate.

Figure 6: Contributions to the annual CPI inflation rate are similar for both the UK and Northern Ireland

Contributions to the annual Consumer Prices Index (CPI) inflation rate, Northern Ireland and UK, January to February 2023

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While the biggest contributors to annual inflation in Northern Ireland are similar to the rest of those in the UK, housing, water, electricity, gas and other fuels had a greater impact on the UK inflation rate than on that in Northern Ireland. This is the biggest contributor to the difference between Northern Ireland and UK inflation rates.

The biggest contributors to the difference in the housing, water, electricity, gas and other fuels division between Northern Ireland and the UK is gas and liquid fuels. The proportion of homes heated by gas in Northern Ireland is lower than in the rest of the UK, where a larger proportion of houses in Northern Ireland use liquid fuel to heat their homes.

In March 2023, in the UK, gas contributed positive 1.9 percentage points to the total annual inflation figure, whereas in Northern Ireland gas contributed positive 0.45 percentage points to the total inflation figure. In contrast liquid fuels made a contribution of negative 0.45 percentage points for Northern Ireland and for the UK it made a contribution of negative 0.02 percentage points. The negative contribution of liquid fuels is because of the fall in prices seen in the most recent month. In March 2023, the Northern Ireland CPI annual inflation for gas and liquid fuels were positive 129.4 and negative 17.5, respectively. In contrast, the UK CPI annual inflation rates for gas and liquid fuels were positive 129.4 and negative 22.5, respectively, for the same period.

4 . Future developments

While some stakeholders have expressed interest in regional inflation estimates across the UK, we at the Office for National Statistics (ONS) do not currently plan to publish any further updates on the development of regional price indices. This is to enable resources to be focussed on broader improvements to the measurement of consumer prices through our transformation programme. We intend to continue our price collection boost in Northern Ireland through the remainder of 2023 and we are currently exploring options for use of this data in the future.

This pilot project has proven that it is possible to produce indicative regional CPI figures. However, it is important to note that this is still early work for producing a regional inflation figure and the estimates produced thus far are not yet considered robust enough for regular experimental production. In this section, we discuss possible next steps to improve estimates of consumer price inflation for Northern Ireland.

For this publication, Consumer Prices Index including owner occupiers' housing costs (CPIH) was not included because of data quality issues with the Northern Ireland owner occupiers' housing (OOH) cost expenditure. Further work could be done to understand how this area of expenditure can be better captured for Northern Ireland.

The methodology to create these experimental weights would need to undergo a benchmarking exercise in the future. Over an extended period of time the use of 2015 as a starting point would make the Northern Ireland weights less relevant to current expenditure. This method fails to capture divergence between Northern Ireland and the UK past a certain point. A method of using a three-, five- and seven-rolling-year average for regional expenditure weights was investigated, but volatility was still apparent in the results. It should be considered that there is a trade-off between having region-specific weights, with volatility over time, suggesting error, or using UK-specific weight changes that are reliable over time, but not relevant to Northern Ireland changes over time.

Another point to consider is that with this experimental methodology, our focus was on class weights. Future development could look into producing regional item-level weights. Initial work was also conducted for item-level analysis, investigating a different method of identifying volatility in price data, specifically looking at the frequency and magnitude of prices changes for each item in the fixed basket of goods. The analysis was not in the scope of this publication; however, it would be beneficial for future developments of this work.

Finally, we have not yet investigated how much the boosted sample size is benefiting the results. It is clear that it improves the quality of the Northern Ireland CPI, however, work that we have been doing with Southampton University on using standard errors will help us to define the true impact of the boost and what sample sizes are needed per region or country.

5 . Cite this methodology

Office for National Statistics (ONS), released 19 May 2023, ONS website, methodology, Boosting the Northern Ireland price sample for the Consumer Prices Index including experimental regional weighting: May 2023.