Office for National Statistics

Article

Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars, November 2022

Indicative impacts of the planned improvements to rail fare and second-hand car measurement in consumer price statistics between January 2018 and June 2022.

Table of contents

1 . Main changes

- Alternative data sources and new methods are planned to be introduced from 2023, as detailed in our [Transformation of consumer price statistics: April 2022](#) article; the first categories we intend to transform are rail fares and second-hand cars.

- Daily GB rail fare transaction data are sourced from the rail industry's Latest Earnings Networked Nationally Overnight (LENNON) ticket revenue system and provided by the Rail Delivery Group (RDG); we previously provided details of these new data and our methods to process them in our [Using transaction-level rail fares data to transform consumer price statistics, UK](#) article.

- Daily list prices for second-hand cars are provided by the largest digital automotive marketplace in the UK, Auto Trader; we previously provided details of these new data and our methods to process them in our [Using Auto Trader car listings data to transform consumer price statistics, UK](#) article.

- The indicative impact between January 2019 and June 2022 from transformation of these categories is small, with the largest headline difference in annual growth being 0.1 percentage points, and primarily driven by second-hand cars; there will be no revisions to consumer price statistics because of these upcoming transformations.

- Though the historic impact would have been small, following introduction the new indices will offer a quality improvement in measurement, from increased coverage of prices to a higher level of granularity available in our published data.

- Our highest priorities are improving the quality and upholding the integrity of our statistics; while we are intending to introduce these changes from February 2023 (published in March 2023), we are currently completing final quality assurance and testing of our systems and processes and, in January 2023, we will publish an update to our timelines for incorporation of these data.

- As well as the planned introduction into our headline measures: the Consumer Prices Index including owner occupiers' Housing costs (CPIH) and the Consumer Prices Index (CPI), these changes are also being proposed for the Retail Prices Index (RPI), subject to the usual governance process required as part of the [Statistics and Registration Service Act 2007](#) (section 21); further information on the transformation of consumer prices statistics on the RPI will be available in our [annual correspondence with the Bank of England](#).

- This proposal will ensure that the stable production of RPI can be effectively maintained without introducing additional risk of errors while improvements are made to CPI and CPIH; over this period the average, unrounded difference has been neutral.

2 . Overview of proposed transformation for rail fares and second-hand cars

We are currently undertaking an ambitious programme of transformation across our consumer price statistics. This includes identifying new data sources, improving methods, developing systems, and establishing new processes. The work has been in progress for several years, reflecting the complexity and intricacy of what we are aiming to achieve.

Our latest plans detail how updates will be made annually as part of a continuous improvement cycle, and that our first introduction, in 2023, prioritises the inclusion of new data for rail fares and second-hand cars. These new data will offer a substantial improvement in the coverage and granularity of our published indices for these categories.

The rail fares data for Great Britain are provided to us by the Rail Delivery Group and are sourced from the rail industry's Latest Earnings Networked Nationally Overnight (LENNON) ticket revenue system (this system does not retail, meaning it does not act as a ticket selling platform). As they are transaction level data, they contain information on the cost and quantities of purchased tickets along with associated metadata related to the journey travelled. We have been provided rail transaction data for GB dating back to January 2019. Northern Ireland data will continue to be provided separately and will become a separately published index in future consumer prices publications.

The second-hand cars data are provided by Auto Trader, currently the largest and most visited vehicle advertising website in the UK. As well as the price, they include extensive metadata on each listed car, with a database dating back to January 2018. As these data are for advertised listings, they do not contain explicit sales revenue information.

The size, information, and dynamic nature of new data mean that new methods, systems, and processes are required to enable quality and robust calculation of price indices. More details on these data and our proposed methods for measuring inflation from them can be found in our Research and developments in the transformation of UK consumer price statistics: June 2022 article. The estimates in the present analysis are indicative. There are still some minor improvements being made to the new production systems for these data, though these are expected to have an inconsequential impact on the figures presented. There are three changes still to be implemented:

- transitioning the system into a final monthly production state.

- improvements to data cleaning procedures, as discussed further in Outlier detection for dynamic price data: rail fares and second-hand cars.

- improvements to filtering and imputation procedures for multilateral index number methods. In October 2022, we presented a paper covering these methods to our Technical Advisory Panel on Consumer Prices, which we will look to publish in December 2022.

If there are significant changes to these indicative impacts because of these further improvements, these will be published as a follow-up to this article in January 2023.

Our priorities are improving the quality and upholding the integrity of our statistics. While we intend to introduce these changes from February 2023 (published in March 2023), we are also currently completing final quality assurance and testing of our systems and processes. In our follow-up article in January 2023 we will publish an update to our timelines for incorporation of these data.

3 . Indicative impact of transformation on annual consumer price inflation rates

Indicative impact on Consumer Prices Index including owner occupiers' Housing costs (CPIH)

We plan to introduce rail fares and second-hand cars transformations simultaneously from 2023. To show the indicative impact of using these data simultaneously, as GB rail fares data are only available from 2019, we have chosen to include the second-hand car data from 2019 despite having these data from 2018.

This revised series from 2019 is chain-linked to the published series pre-2019 to show the indicative impact on the expected growth rate in the year of introduction. For more information on chain-linking and existing practices for calculation of consumer price indices please refer to our [Consumer Prices Indices Technical Manual, 2019](#).

The existing, published weights for rail fares and second-hand cars are used to aggregate the new data and methods into our published consumer price statistics. The weight for rail fares in CPIH is small and has fallen over the last 4 years, ranging from 0.8% of CPIH in 2019 to just 0.3% of CPIH in 2022. The weight for second-hand cars is slightly larger, accounting for 1.4% of CPIH in 2019, 1.2% of CPIH in 2020-2021 and 2.0% of CPIH in 2022. Where new consumption segments have been introduced, the original item weights have been reallocated across the newly introduced consumption segments according to relative spending on each segment.
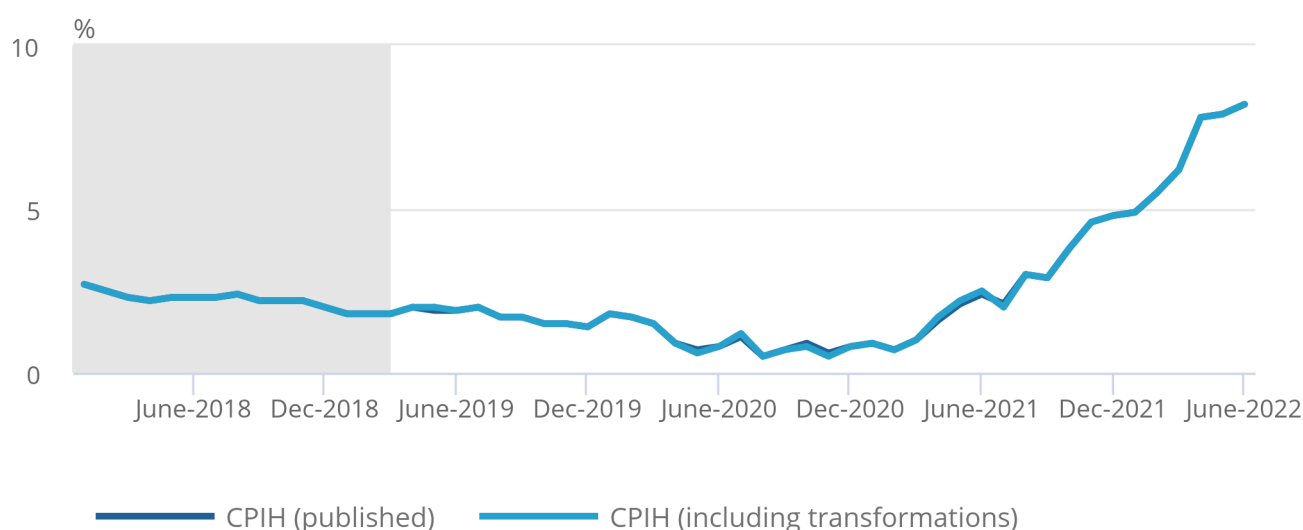
Figure 1 shows the indicative impact of transforming rail fares and second-hand cars indices on headline CPIH between January 2018 and June 2022, had they been introduced from February 2019. Over this period the average, unrounded difference has been neutral (0 percentage points to 2 decimal places). When rounded, a small positive contribution of 0.1 percentage points in five individual months and a small negative contribution of 0.1 percentage points in four individual months can be observed in the period following introduction of new data and methods. The largest unrounded difference over this period is negative 0.08 percentage points in May 2020.

Figure 1: There is minimal difference between the 12-month rate of headline Consumer Prices Index including owner occupiers' Housing costs (CPIH) including the latest transformations, compared with the currently published CPIH.

Indicative impact of transformed second-hand cars and rail fares indices on CPIH 12-month rate, UK, January 2018 to June 2022

Figure 1: There is minimal difference between the 12-month rate of headline Consumer Prices Index including owner occupiers' Housing costs (CPIH) including the latest transformations, compared with the currently published CPIH.

Indicative impact of transformed second-hand cars and rail fares indices on CPIH 12-month rate, UK, January 2018 to June 2022
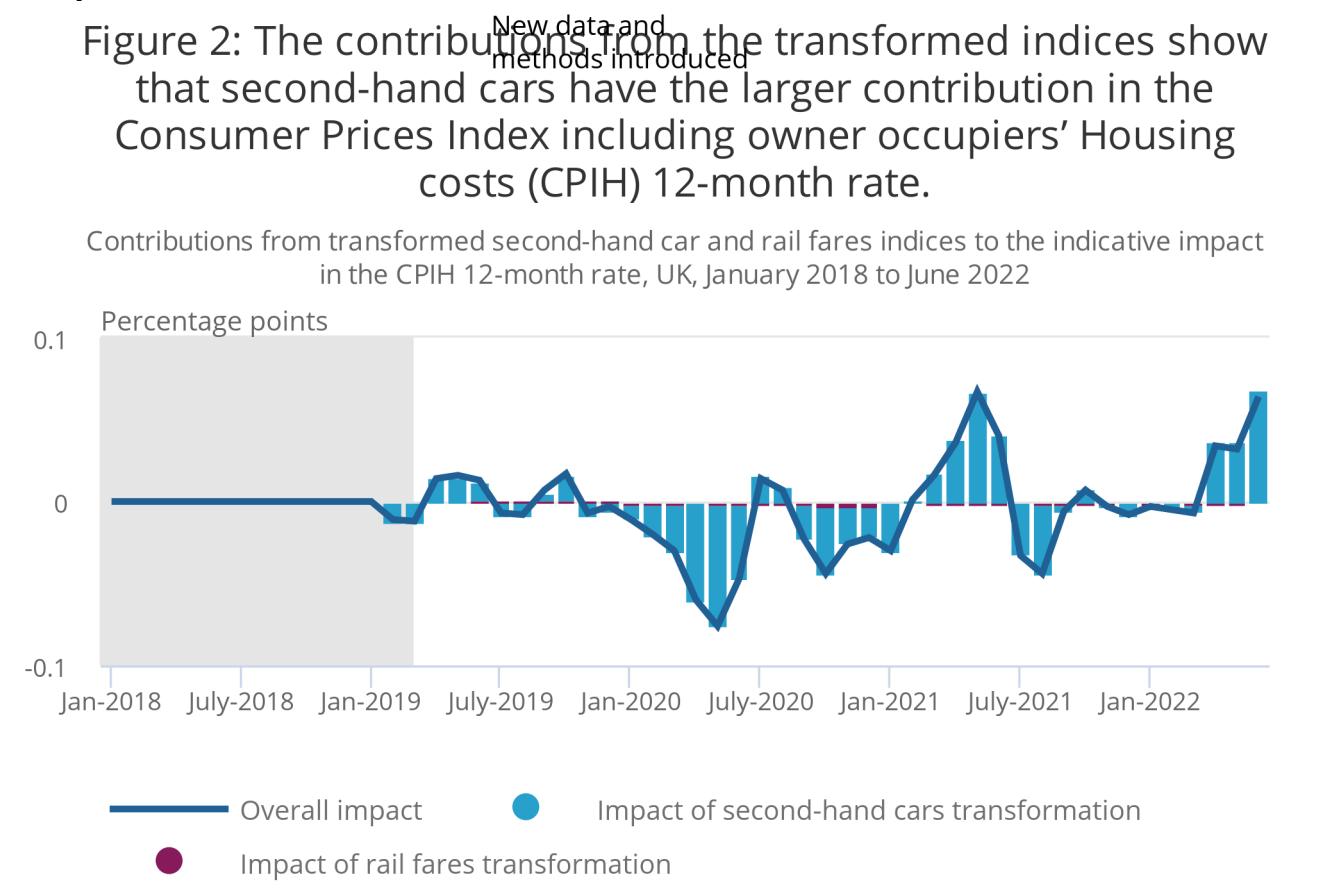
Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

Through 2020 and 2021 there were several unavailable items because of the coronavirus (COVID-19) pandemic that had to be imputed in some periods. For this impact analysis, we have not recalculated these imputations for the revised series, but we would expect the impact of these to be small (as the headline rate was used to impute missing items during this period, and there is little change to the headline rate using these new data).

The primary contributor to the difference between the published 12-month inflation rate and the comparable inflation rate with the revised indices came from second-hand cars, as seen for CPIH in Figure 2. Note that some differences may not add to the overall difference because of rounding

Figure 2: The contributions from the transformed indices show that second-hand cars have the larger contribution in the Consumer Prices Index including owner occupiers' Housing costs (CPIH) 12-month rate.

Contributions from transformed second-hand car and rail fares indices to the indicative impact in the CPIH 12-month rate, UK, January 2018 to June 2022

Figure 2: The contributions from the transformed indices show that second-hand cars have the larger contribution in the Consumer Prices Index including owner occupiers' Housing costs (CPIH) 12-month rate.

Contributions from transformed second-hand car and rail fares indices to the indicative impact in the CPIH 12-month rate, UK, January 2018 to June 2022
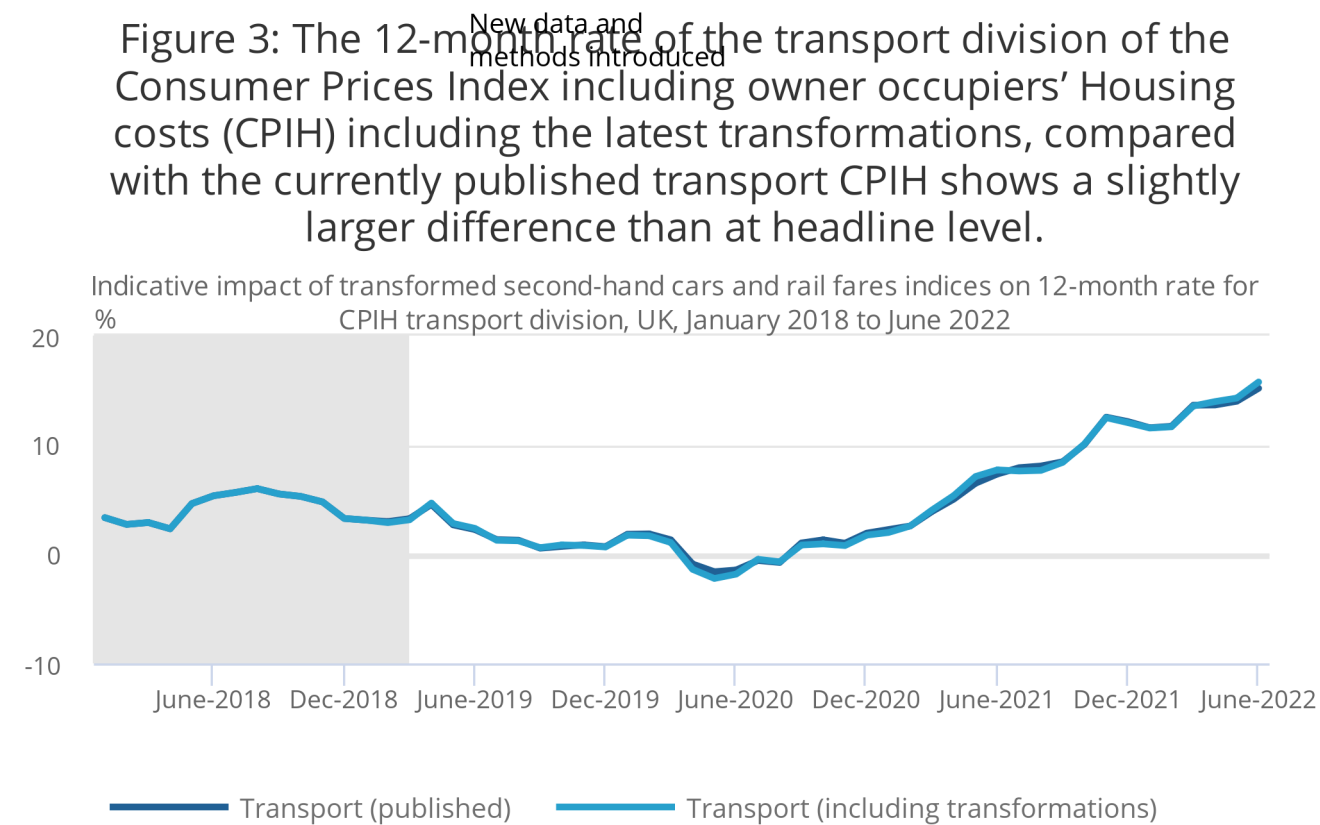
Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

The transport division of CPIH (and Consumer Price Index (CPI)) contains consumption categories including the purchase of vehicles, both new and second-hand cars, operation of personal transport equipment, including motor fuels, and transport services, including air fares. This means that the transport division often provides a notable contribution to the change in the 12-month inflation rate.

Impacts on the index for the transport division of the CPIH (and CPI), of which second-hand cars and rail fares account for between 14% and 18%, are intuitively larger, ranging between negative 0.6 and positive 0.7 percentage points. The impact of the latest transformations to the transport division level index are shown in Figure 3.

Figure 3: The 12-month rate of the transport division of the Consumer Prices Index including owner occupiers' Housing costs (CPIH) including the latest transformations, compared with the currently published transport CPIH shows a slightly larger difference than at headline level.

Indicative impact of transformed second-hand cars and rail fares indices on 12-month rate for CPIH transport division, UK, January 2018 to June 2022

Figure 3: The 12-month rate of the transport division of the Consumer Prices Index including owner occupiers' Housing costs (CPIH) including the latest transformations, compared with the currently published transport CPIH shows a slightly larger difference than at headline level.

Indicative impact of transformed second-hand cars and rail fares indices on 12-month rate for CPIH transport division, UK, January 2018 to June 2022

New data and methods introduced

%

20

10

0

-10

June-2018 Dec-2018 June-2019 Dec-2019 June-2020 Dec-2020 June-2021 Dec-2021 June-2022

— Transport (published)   — Transport (including transformations)

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

For most periods, the contribution from the transport division to the change in the headline CPIH 12-month rate is either maintained or marginally amplified (either positively or negatively) following the transformation of rail fares and second-hand cars indices. There is one period, in July 2021, where the transport division previously had a positive contribution to the change in the headline rate but following the transformation of rail fares and second-hand cars had a slightly negative contribution.
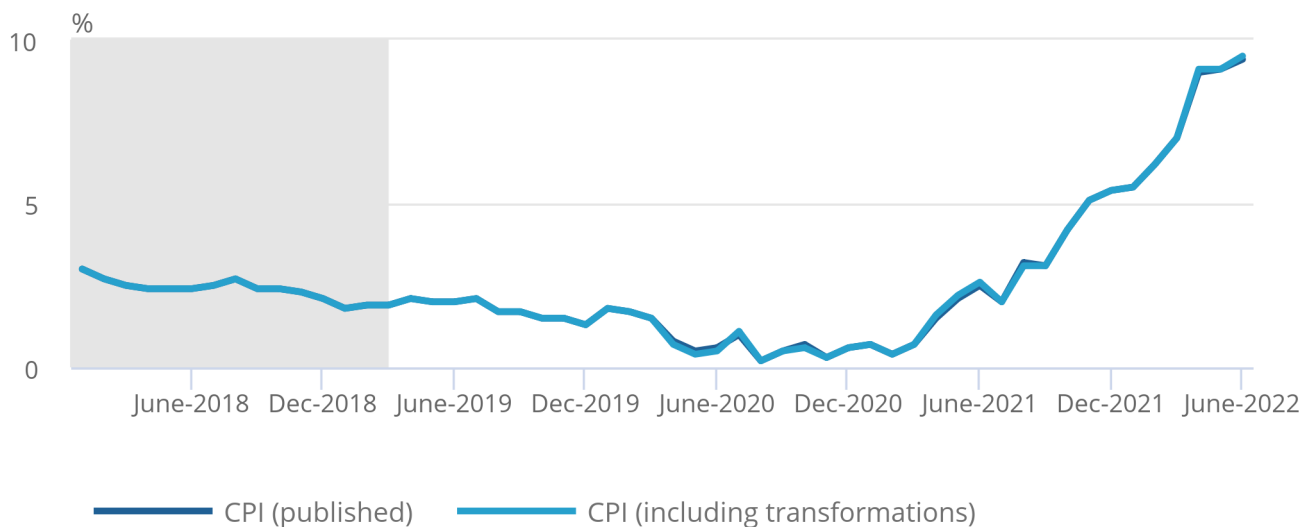
Indicative impact on CPI

Figure 4 shows the indicative impact of transforming rail fares and second-hand cars indices on headline CPI between January 2018 and June 2022, had they been introduced from February 2019. Over this period the average, unrounded difference has been minimal (negative 0.01 percentage points to 2 decimal places). When rounded, a small positive contribution of 0.1 percentage points in six individual months and a small negative contribution of 0.1 percentage points in five individual months can be observed in the period following introduction of new data and methods. The largest unrounded difference over this period is negative 0.09 percentage points in May 2020.

Figure 4: There is minimal difference between the 12-month rate of headline Consumer Price Index (CPI) including the latest transformations, compared with the currently published CPI.

Indicative impact of transformed second-hand cars and rail fares indices on CPI 12-month rate, UK, January 2018 to June 2022

Figure 4: There is minimal difference between the 12-month rate of headline Consumer Price Index (CPI) including the latest transformations, compared with the currently published CPI.

Indicative impact of transformed second-hand cars and rail fares indices on CPI 12-month rate, UK, January 2018 to June 2022

New data and methods introduced

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

## Indicative impact on Retail Price Index (RPI)

Figure 5 shows the indicative impact of transforming rail fares and second-hand cars indices on headline RPI between January 2018 and June 2022, had they been introduced from February 2019. Over this period the average, unrounded difference has been neutral (0 percentage points to 2 decimal places). When rounded, a small positive contribution of 0.1 percentage points in ten individual months and a small negative contribution of 0.1 percentage points in 11 individual months can be observed in the period following introduction of new data and methods. The largest unrounded difference over this period is 0.14 percentage points in May 2021.

Figure 5: There is minimal difference between the 12-month rate of headline Retail Price Index (RPI) including the latest transformations, compared with the currently published RPI

Indicative impact of transformed second-hand cars and rail fares indices on RPI 12-month rate, UK, January 2018 to June 2022

Figure 5: There is minimal difference between the 12-month rate of headline Retail Price Index (RPI) including the latest transformations, compared with the currently published RPI

Indicative impact of transformed second-hand cars and rail fares indices on RPI 12-month rate, UK, January 2018 to June 2022
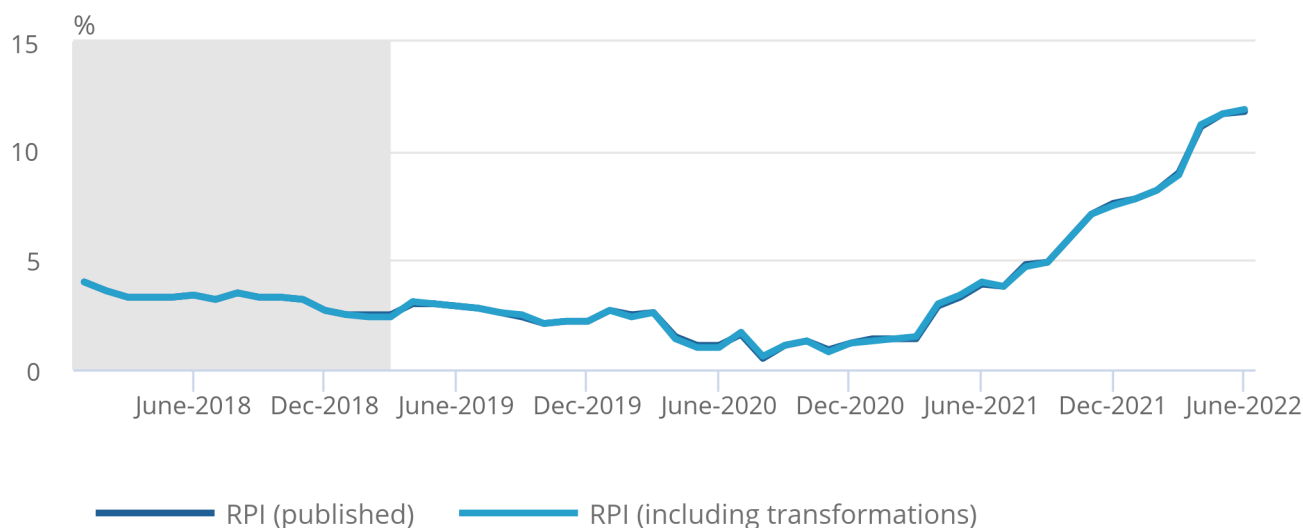
Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

4 . Improved granularity of published indices

While the indicative impact of the latest transformations on headline consumer price inflation measures is small, there are many improvements arising from use of the new data sources. A notable improvement is that users will have access to a greater level of detail in the published indices once these transformations are incorporated.

Rail fares

For rail fares, we will begin to publish six new indices based primarily on ticket type, instead of the previous single-item index. These six new indices will be item-level subsidiaries of the Passenger transport by train sub-class index within the Classification of Individual Consumption by Purpose (COICOP) hierarchy.

The published item-level indices for UK rail fares will be:

- Great Britain: peak

- Great Britain: off-peak

- Great Britain: super off-peak

- Great Britain: advance

- Great Britain: short season

- Northern Ireland (the index for Northern Ireland will continue to be produced using data from our current provider and existing methods)

The Great Britain indices are further stratified by the individual regions in Great Britain (such as London, Scotland, etc.). These regional data will not be published; however, the indices will be instrumental in forming subnational consumer price inflation measures in future.

While we have data for long season tickets (greater than one month), more research is needed on how to calculate their consumption price. If we can calculate these effectively in future, they will then be added as a new item-level index.

Consumption segment indices for rail fares are shown in comparison to the published index in Figure 6, with annual growth rates for these indices shown in Figure 7. The growth rate is lower for most regulated tickets but offset by a higher growth rate for advance tickets.

Figure 6: The different ticket type indices compared with the currently published rail fares index all experience a similar price change.

Rail fare indices by ticket type compared to the currently published index, UK, January 2019 to June 2022

Figure 6: The different ticket type indices compared with the currently published rail fares index all experience a similar price change.

Rail fare indices by ticket type compared to the currently published index, UK, January 2019 to June 2022
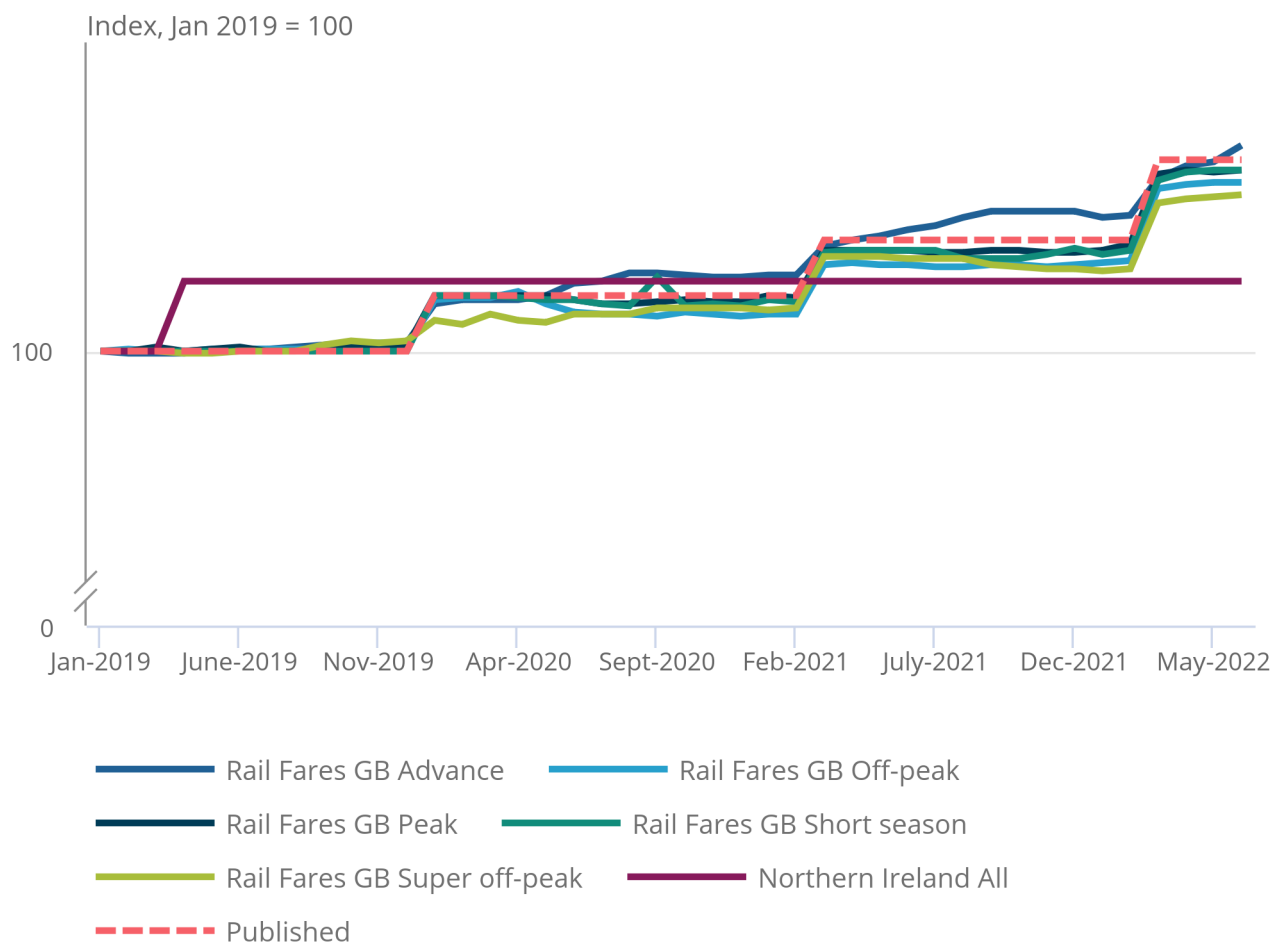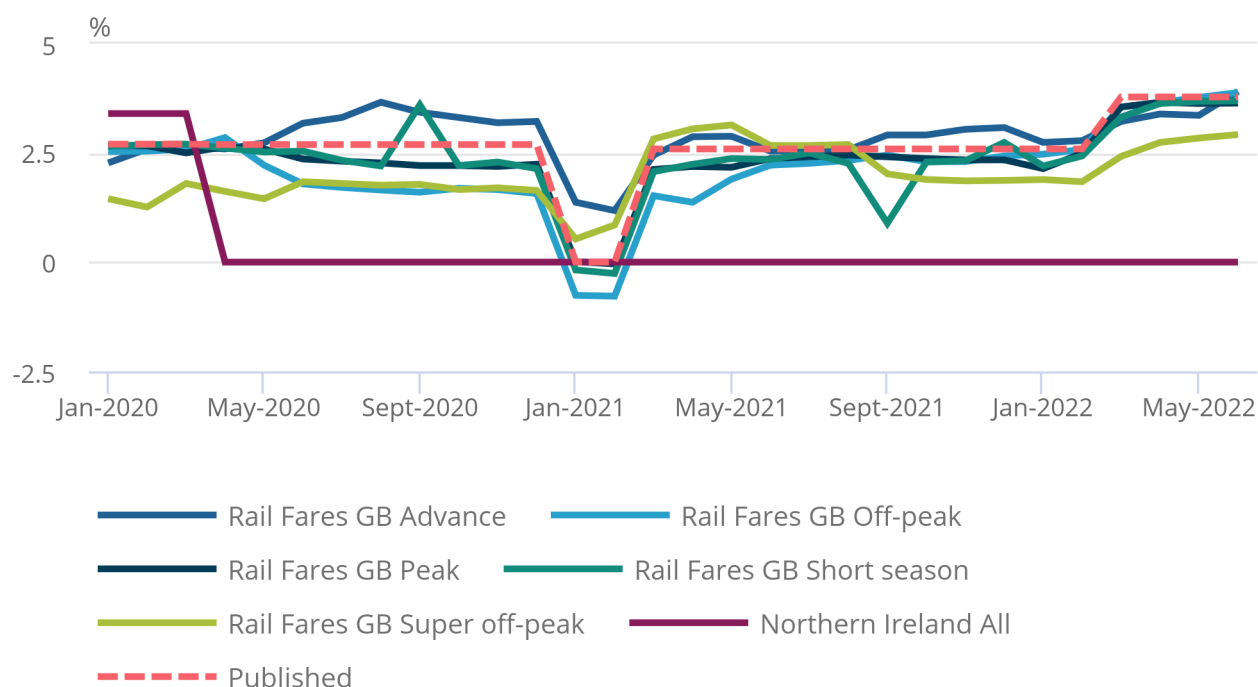

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

Figure 7: The rail fare 12-month growth rates by ticket type, are more dynamic than the currently published 12-month growth rate for rail fares.

The rail fare 12-month growth rates by ticket type compared with the currently published 12-month growth rate for rail fares, UK, January 2020 to June 2022

Figure 7: The rail fare 12-month growth rates by ticket type, are more dynamic than the currently published 12-month growth rate for rail fares.

The rail fare 12-month growth rates by ticket type compared with the currently published 12-month growth rate for rail fares, UK, January 2020 to June 2022

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

All ticket type indices (except Northern Ireland who have not had a price change since April 2019 in the existing series), see a decline in annual growth in January 2021 that quickly reversed in March, this was because of the change in timing of the annual fares uplift from January to March.

The GB rail indices will be based on regional aggregates, so we will also be able to provide users with detail (through the detailed briefing note) as to what regions are contributing to the change in inflation for each fare product group, although the regional indices themselves will not be published. These regional indices will also help us to produce regional consumer price indices more readily in future.

Second-hand cars

We will begin to publish the inflation rate of second-hand cars with different fuel types, replacing the existing item indices for: two-year-old and three-year-old second-hand cars.

These two new published indices will be for petrol second-hand cars, and diesel second-hand cars, as subsidiaries of the Second-hand cars subclass within the Classification of Individual Consumption by Purpose (COICOP) hierarchy.

These indices are further stratified into the ages of the cars, ranging from one to two years to ten years, but the data are not published.

The indices for different ages of second-hand cars are further stratified into the makes of the cars, such as Vauxhall, Ford, and others, but the data are not published.

While we have data for second-hand hybrid and electric cars, the number of cars in the sample is still small. Those two consumption segments will be added as part of the annual basket update once they gain a significant proportion of the second-hand car market.

Indices for petrol and diesel second-hand cars using new data and methods are shown in comparison to the currently published COICOP5 index for second-hand cars in Figure 8, with the annual growth rate for these indices shown in Figure 9.

Figure 8: The second-hand cars indices by fuel type experience similar trends in price change, although petrol is more in line with the currently published index.

Second-hand cars indices by fuel type compared with currently published second-hand cars index, UK, January 2019 to June 2022

Figure 8: The second-hand cars indices by fuel type experience similar trends in price change, although petrol is more in line with the currently published index.

Second-hand cars indices by fuel type compared with currently published second-hand cars index, UK, January 2019 to June 2022
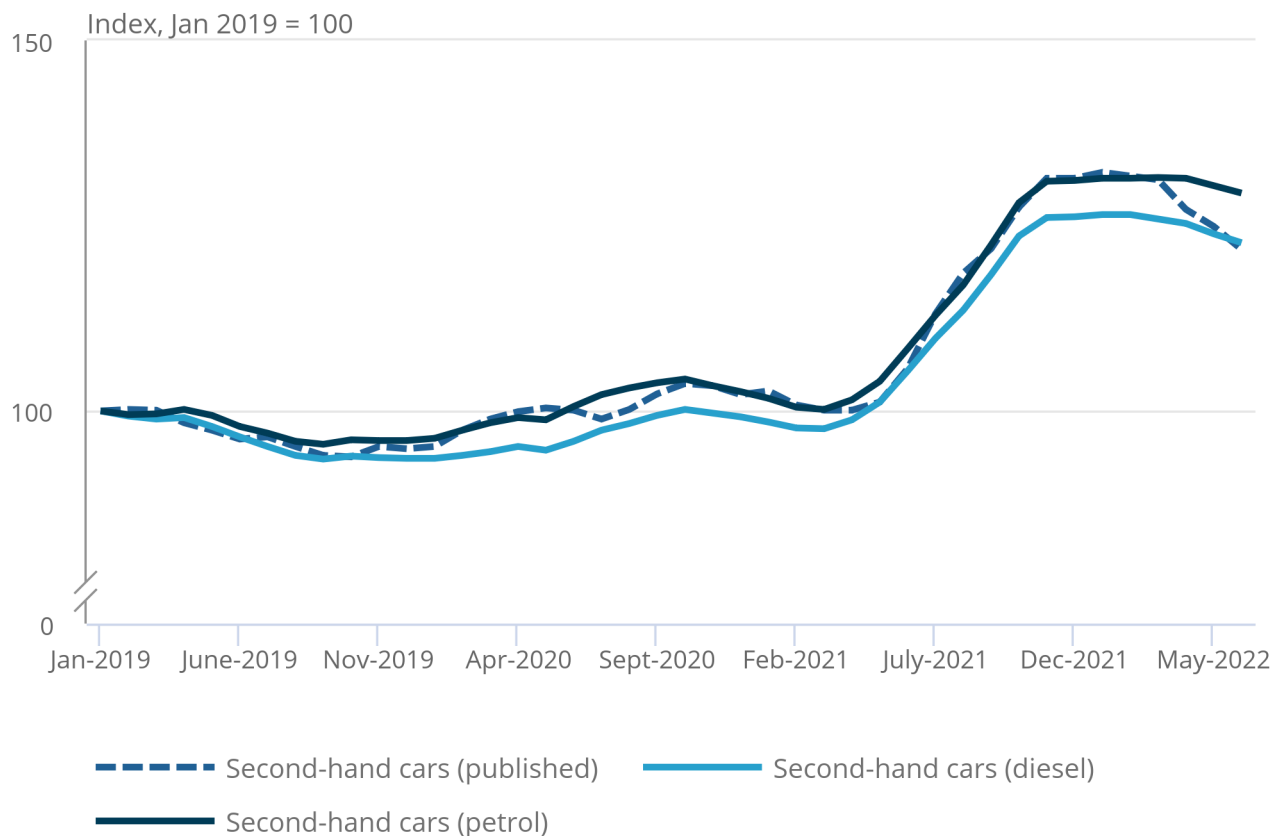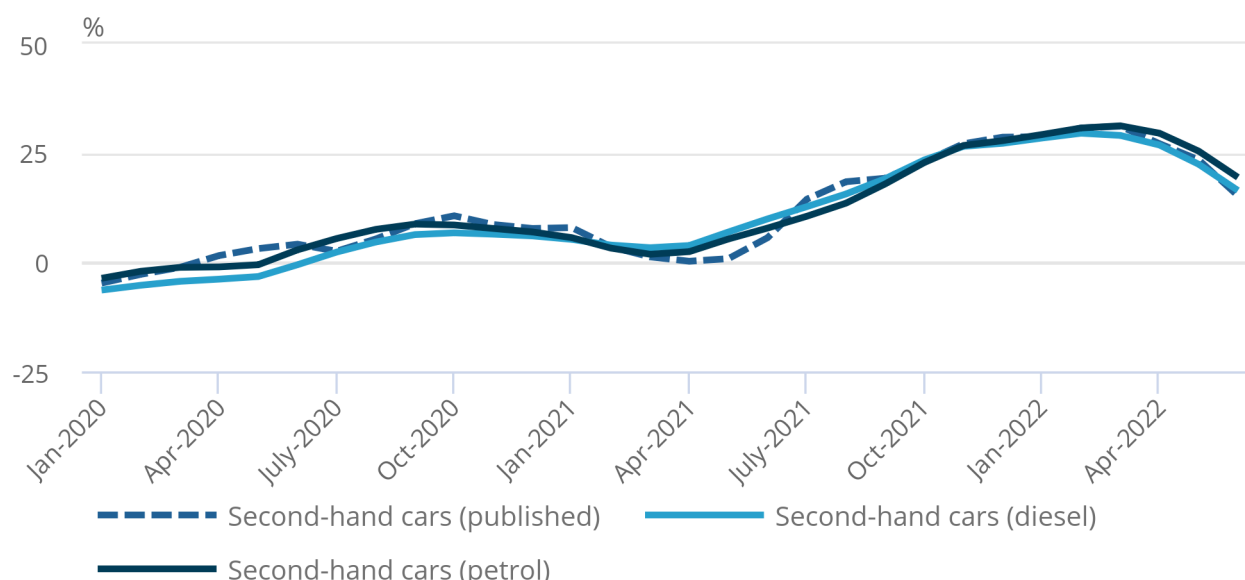

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

Figure 9: The second-hand cars 12-month growth rates by fuel type experience similar trends compared with the currently published 12-month growth rate for second-hand cars

Second-hand cars 12-month growth rates by fuel type compared with the currently published 12-month growth rate for second-hand cars, UK, January 2020 to June 2022

Figure 9: The second-hand cars 12-month growth rates by fuel type experience similar trends compared with the currently published 12-month growth rate for second-hand cars

Second-hand cars 12-month growth rates by fuel type compared with the currently published 12-month growth rate for second-hand cars, UK, January 2020 to June 2022

Source: Office for National Statistics - Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars

The indices show that diesel cars have experienced slower growth over this period than petrol cars. While broadly similar trends to the published series are observed, the published series has been more in line with the inflation rate of petrol cars since January 2019. This has not been the case since March 2022, where we have seen a sharp downward trend in the published series. While the annual growth rate for the revised series has also slowed, the decline has not been as sharp. There are many potential reasons for differences between the published and revised series. In particular, the revised series have substantially increased coverage (both temporal and market coverage), meaning that the price indices are less sensitive to sudden price movements of individual makes or models of car.

The new petrol and diesel second-hand car indices are stratified by age (between 1 and 10 years) and make (approximately 25 makes per fuel type). We will therefore be able to provide users with more detailed information (through the monthly detailed briefing note) as to, for example, the age of second-hand cars that are contributing to the change in inflation, although these stratum level indices will not be published as part of the regular inflation tables.

5 . Further methodological improvements

Since our methodology publications in June 2022, a series of small improvements have been made to our calculations of both rail fares and second-hand cars indices, as detailed further in this section.

Rail fares

Our previously published indices showed a substantial fall of 0.6% in the rail fares index in October 2021 that was attributed to the London region, showing a drop of 2.2% in peak tickets and a 4.0% drop in off-peak tickets. This was found to be because of the reclassification of a particular ticket type between a contactless pay ticket and a pay as you go ticket, rather than being a genuine price decrease. We were able to identify these reclassified tickets based on their issuing business and have now combined these ticket types, eliminating the previously seen fall in the index in this month that was not reflecting a genuine price decrease.

Through this analysis, we also discovered that we were capturing "un-started" and "unfinished tickets". This is where a passenger would have started a journey by swiping through a ticket gate but not swiped out, or vice versa. In these cases, the passenger is charged a fixed maximum fare for the journey. As we consider this journey cap a distinct product from rail fares, we have excluded any rows where the origin and destination stations are the same, since we cannot confirm that a journey has taken place. In future, we will look to explore whether these fares should be included in our inflation measures as a separate consumption segment.

Second-hand cars

We have improved our method of calculating weights for second-hand car indices, from using quantities of cars present in the data, to using approximates of expenditure based on the quantities of car types assumed sold and their average prices. While this change had a small impact on the resulting indices, using expenditure to aggregate indices aligns with international best practice.

As part of the hierarchy restructuring, we have also reselected the most representative car makes for each fuel type. We select all car makes with over 1% market share within the Auto Trader data to be representative of each fuel type, resulting in approximately 90% of the approximated expenditure being captured across all included age strata (1 to 10 years).

Cars that are listed as belonging to write-off categories have been removed from the data. This change is important in making sure only comparable cars are priced over time. However, given the small proportion of the data that belong to these write-off categories (around 1.5%), the impact of this improvement has been negligible.

6 . Future developments

Our highest priorities are improving the quality and upholding the integrity of our statistics. We are completing the final quality assurance checks of our systems and processes and will publish an update to our timelines in January 2023 for incorporation of these data. This quality assurance involves a readiness assessment covering five areas: the quality of our data, methods, systems, processes, and user readiness. The outcome will be announced in January 2023, along with a decision of whether these data will be included in the Retail Prices Index following the annual governance process. Given the variety of factors that need to be taken into consideration, these decisions should not be seen as establishing a precedent for the kinds of changes that could be made to RPI in future years as we implement further transformational changes into our consumer price inflation statistics. We are developing a framework to determine which other changes we will propose for RPI for implementation from 2024 onwards and will be engaging with users on this in 2023.

Following these transformations for rail fares and second-hand cars there remain further improvements that can and may be made in future years. The most notable potential improvements are related to coverage of the consumer price inflation basket, for example, for second-hand cars the coverage of hybrid and electric vehicles will improve once market share of these increase, and for rail fares we can look to include maximum capped fares for London travel if they account for a significant portion of expenditure. We could also look to include other categories from within the data, such as second-hand bikes using the Auto Trader data.

Another area we will look to improve is in the measurement of season ticket prices for rail fares. Currently we have chosen to only include short season tickets, of less than a month, because there is less of a discrepancy with regards to when the ticket is purchased and when the journey is consumed. As we are looking at the price of consumption in Consumer Prices Index including owner occupiers' Housing costs (CPIH) and the Consumer Price Index (CPI), we will further explore how this can be calculated for longer season tickets and incorporate in a future update. We are also exploring the treatment of refunds in the rail fares data and whether this can be further improved in future updates.

These transformations are part of a wider work programme looking to improve consumer price inflation measurement, primarily through alternative data sources. Our plans for this ongoing transformation work are outlined in our [Transformation of consumer price statistics](#) article. Other ongoing work and our priorities in consumer price statistics development can be found in the [Consumer Prices Development Plan](#).

7 . Related Links

[Transformation of consumer price statistics: April 2022](#) Article | Released 27 April 2022 Our plans to transform UK consumer price statistics by including new improved data sources and developing our methods and systems for production from 2023.

[Outlier detection for dynamic price data: rail fares and second-hand cars](#) Methodology | Released 28 November 2022 We are applying data cleaning techniques to web-provided and transaction data to remove out-of-scope observations and errors when calculating our consumer price indices.

[Introducing multilateral index methods into consumer price statistics](#) Methodology | Released 28 November 2022 How we will use the GEKS-Törnqvist to introduce alternative data into our consumer price statistics, including how the method works and its advantages.

[Research and developments in the transformation of UK consumer price statistics: June 2022](#) Article | Released 28 June 2022 Research to modernise the measurement of consumer price inflation in the UK: fourth in a series of biannual articles to update users.

[Consumer price inflation, UK: October 2022](#) Statistical bulletin| Released 16 November 2022 Price indices, percentage changes, and weights for the different measures of consumer price inflation.

[Consumer Prices Indices Technical Manual, 2019](#) Methodology | Released 18 September 2019 This technical manual is a reference tool for anyone wanting to understand how measures of consumer price inflation and associated indices are compiled.

8 . Cite this methodology

Office for National Statistics (ONS), released 28 November 2022, ONS website, methodology, Impact analysis on transformation of UK consumer price statistics: rail fares and second-hand cars, November 2022