Construction output price indices (OPIs) QMI

Quality and methodology information for Construction Output Price Indices, detailing the strengths and limitations of the data, methods used and data uses and users.

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Table of contents

1. Output information

2. About this Quality and Methodology Information report

3. Important points

4. Quality summary

5. Quality characteristics of the Construction OPI data

6. Methods used to produce Construction OPIs data

7. Other information

8. Cite this methodology

1 . Output information

- National Statistic: yes
- Data collection: various
- Frequency: quarterly
- How compiled: Producer Price Indices, Services Producer Price Index and Average Weekly Earnings
- Geographic coverage: UK

2 . About this Quality and Methodology Information report

This quality and methodology report contains information on the quality characteristics of the data (including the European Statistical System five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- help you to decide suitable uses for the data
- reduce the risk of misusing data

3 . Important points

- The Construction Output Price Indices (OPIs) provide our best estimate of inflation within the UK construction industry.
- Index values are produced for every month and are published on a quarterly basis.
- Index values are formed from a weighted ratio of aggregated values on the base period of 2015 equals 100.
- The OPIs estimate costs related to different types of construction projects, and provide aggregated indices for new work, repair and maintenance, and all construction work.
- For all projects, three types of input costs are calculated: materials, plant and labour, and a mark-up is applied, which accounts for profit; the result is then used as a measure of output prices.
- Material costs are estimated using individual Producer Price Indices (PPIs), plant costs are measured using the Services Producer Price Index (SPPI) for Rental and leasing services of construction and civil engineering machinery and equipment (CPA2.1: N7732), new work labour costs are measured using the Average Weekly Earnings (AWE) construction index, and repair and maintenance labour costs are measured using Consumer Price Indices (CPIs) for plumbers, electricians, carpenters and decorators.
- Revisions are subject to the revisions policies of component series; for routine revisions the series will remain open for a period of 12 months, in line with PPI, its main component.

4 . Quality summary

Overview

The Construction Output Price Indices (OPIs) provide a best estimate of inflation within the UK construction industry. The OPIs are compiled using existing Office for National Statistics (ONS) data sources.

This approach involves input costs, which are materials, labour and plant hire, weighted together for a selection of types of construction projects, with a mark-up being applied to account for profit by the construction firm. The result is considered a proxy for output prices. The basic concept of producing each output price index is:

$$\begin{matrix} Material\ costs\ (PPI) \\ Labour\ costs\ (AWE) \\ Plant\ costs\ (SPPI) \end{matrix} \times Mark-up\ for\ profit\ margin = Output\ price$$

The Office for National Statistics (ONS) took responsibility for publishing these statistics on 1 April 2015. The indices were previously known as the Construction Price and Cost Indices (CPCIs) and were published by the Department for Business, Innovation and Skills (BIS), before the publication was suspended in December 2014.

As a result of their suspension, the CPCIs were de-designated as National Statistics in December 2014, as detailed in a letter from the Director General for the Office for Statistics Regulation.

The first quarterly publication of the OPIs by the ONS was in June 2015, with indices published back to January 2014. Before Quarter 3 (July to Sept) 2017, the methodology that was used to compile the indices was considered to be an interim solution, while a longer-term methodology was investigated.

In September 2017, an article was published by the ONS that detailed improvements to construction statistics. As a result of the improvements that were implemented in Quarter 3 2017, as of March 2019 the methodology is no longer considered to be experimental and has received its accreditation as a National Statistic, as detailed in a letter from the Director General for the Office for Statistics Regulation.

Uses and users

Construction OPIs have a number of uses, both direct and indirect, and are used internally within the ONS as well as externally.

Construction OPIs were used to deflate Output in the construction industry for the first time in the April 2015 release, published on 12 June 2015. Further details on the impact of using these indices have been published in a separate article.

We are aware of a widespread use of ONS data in indexation clauses and even though this is a use the ONS neither encourage nor discourage, it is an acknowledged use of the data.

Strengths and limitations

The main strengths of the index include:

- the index is comprehensive, covering a wide variety of products or services
- the data provide users with valuable insight into the changing inflation within the UK construction industry

The main limitations of the index include:

- there is an inconsistency with the timeliness of input data; plant, labour and material costs are updated monthly, however, the mark-up profit margin is only available two years after the respective reference period

Recent improvements

Information on the impact of further improvements implemented in the Quarter 3 2017 release, including the impact of rebasing and the addition of annual updates to weights, are highlighted in Section 7 of the Quarter 3 2017 bulletin.

Recent improvements to the Producer Price Index (PPI) and Services Producer Price Index (SPPI), including moving from fixed-base weights to annual chain-linking in 2020, has improved the quality of the OPIs and resulted in slight historical revisions to the series. The impact of these improvements is detailed in the article Impact of methodological improvements on Producer Price Inflation.

Previously the OPI statistical bulletin datasets released the latest 56 months of index values. From Quarter 2 (Apr to June) 2021, the full series of monthly values from January 2014 are included in each release.

The Construction OPIs are dependent on the revisions policies associated with their component series. For routine revisions, such as inclusion of late respondent data and monthly re-estimation of seasonal adjustment factors, the Construction OPIs will be open to revisions for a period of 12 months, in line with PPI, its main component.

From Quarter 4 (Oct to Dec) 2022, the datasets have been updated to meet the CDDO Accessibility Regulations.

Updates to the weights will take effect annually in the Quarter 1 (Jan to Mar) publication, following the processing of construction volume data and the annual weights update for PPI and SPPI. These weights are applied from January of each year.

5 . Quality characteristics of the Construction OPI data

Quality characteristics

This report provides a range of information that describes the quality of the output and details any points that should be noted when using the output.

We have developed Guidelines for Measuring Statistical Quality; these are based upon the five European Statistical System (ESS) quality dimensions. This report addresses these quality dimensions and other important quality characteristics, which are:

- relevance
- accuracy and reliability
- coherence and comparability
- accessibility and clarity
- timeliness and punctuality
- output quality

More information is provided about these quality dimensions in upcoming sections.

Relevance

(The degree to which the statistical outputs meet users' needs.)

The Construction Output Price Indices (OPIs) are produced using existing data sources, all of which are National Statistics. The Construction OPIs measure changes in the total cost of different types of construction projects, a project cost approach. Projects are split into two main categories: new work, and repair and maintenance.

Within new work we provide a measure of costs for the following types of work:

- housing
- infrastructure
- public (other than housing)
- private industrial
- private commercial

Within repair and maintenance, we provide a measure of costs for the following types of work:

- housing repair and maintenance
- non-housing repair and maintenance

Alongside these individual measures of inflation, we also provide three aggregated measures of inflation within the UK construction industry: new work, repair and maintenance, and all construction.

Accuracy and reliability

(The degree of closeness between an estimate and the true value.)

The weights for the aggregated indices are updated annually using values for construction output taken from the Office for National Statistics (ONS) Output in the construction industry release. These weights are updated in March, effective from January, ready for the Quarter 1 (Jan to Mar) publication. This is when the data for the previous year become available and coincides with the annual weights update for the Producer Price Indices (PPI) data.

Lower-level weights determine the composition of the individual Construction OPIs. This includes the specific material breakdowns, as well as the plant, labour and material aggregation. The plant, labour and material aggregation weights are updated annually for the Quarter 1 publication.

Revisions within the OPI series are also dependent on the revisions policies associated with their component series. For routine revisions, such as inclusion of late respondent data, the Construction OPIs will be open to revisions for a period of 12 months, in line with the Producer Price Indices (PPI), its main component.

For further information see:

- Producer Price Index (PPI) Quality and Methodology Information
- Services Producer Price Index (SPPI) Quality and Methodology Information
- Average Weekly Earnings (AWE) Quality and Methodology Information

The March calculation will include the revisions from both the OPI weights update as well as the PPI and SPPI weights update, both effective from January. As these data are published quarterly, these revisions should have minimal effects on users, as the preliminary values will not be published.

Coherence and comparability

(Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain, for example, geographic level.)

The Construction OPIs have been produced by the ONS after publication responsibility was transferred from the Department for Business, Innovation and Skills (BIS). The Construction price and cost indices (CPCIs) remain available to users who wish to extend the series. Guidance on how to link the series is available in Section 7: Other information.

The OPIs are reflective of the UK construction industry as a whole and regional data are not available.

Accessibility and clarity

(Accessibility is the ease with which users are able to access the data, also reflecting the format in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the release details, illustrations and accompanying advice.)

Our recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data being provided in usable formats such as CSV and Excel. Our website also offers users the option to download the narrative in PDF format. In some instances, other software may be used, or may be available on request. Available formats for content published on our website but not produced by us, or referenced on our website but stored elsewhere, may vary. For further information please refer to the contact details at the beginning of this report.

- For information regarding conditions of access to data, please refer to our terms and conditions (for data on the website) and guidance on accessibility.
- In addition to this Quality and Methodology Information, basic quality information relevant to each release is available in the Measuring the data section of the relevant statistical bulletin.

Timeliness and punctuality

(Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the gap between planned and actual publication dates.)

The Construction OPIs are monthly index values that are published on a quarterly basis. Publication is approximately six weeks after the end of the quarterly period. Quarter 4 (Oct to Dec) data are published in the second or third week of February.

For the up-to-date release schedule and related releases, please see the Office for National Statistics (ONS) release calendar.

Output quality

The Construction OPI is designated as a National Statistic, in accordance with the Statistics and Registration Service Act 2007 and signifying compliance with the Code of Practice for Statistics.

6 . Methods used to produce Construction OPIs data

How we collect the data, main data sources and accuracy

The Construction Output Price Indices (OPIs) are produced using existing data sources, all of which are National Statistics. Material costs are estimated using individual Producer Price Indices (PPIs). Plant costs are measured using the Services Producer Price Index (SPPI) for Rental and leasing services of construction and civil engineering machinery and equipment (CPA2.1 : N7732). New work labour costs are measured using the Average Weekly Earnings (AWE) construction index, and repair and maintenance labour costs are measured using Consumer Price Indices (CPIs) for plumbers, electricians, carpenters and decorators. From Quarter 4 (Oct to Dec) 2020, all input values for PPI and SPPI have been chain-linked, and as such there were slight historical revisions to the series to reflect this increase in accuracy.

How the output is created

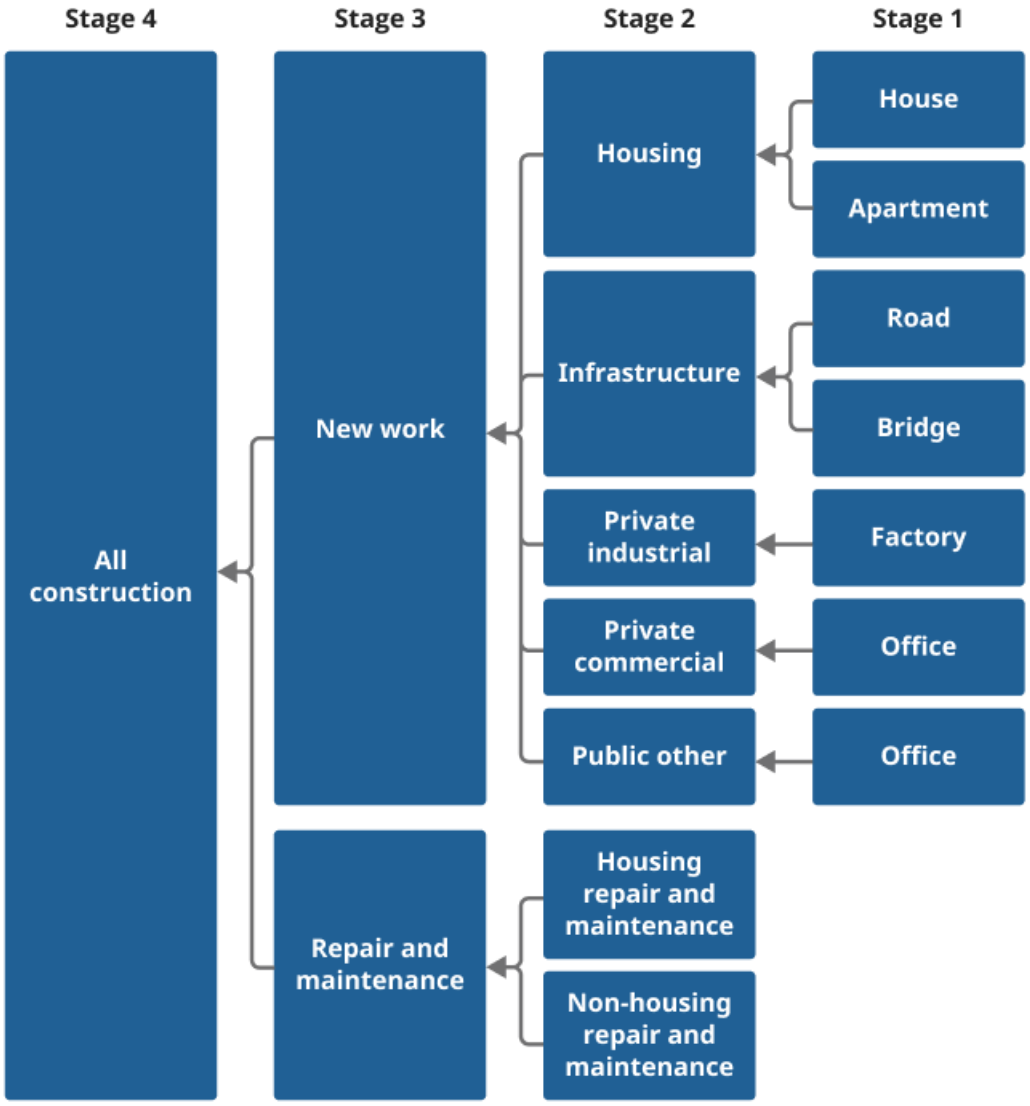
The Construction OPIs are based on an aggregation of cost indices for several theoretical construction projects, representative of each type of new work construction, as well as housing and non-housing repair and maintenance.

To measure price change for all new work, and repair and maintenance projects, price changes for three categories of inputs are measured: materials, plant and labour. These are weighted together for each construction project, and a profit mark-up is applied. Each of these steps is explained in more detail.

Index structure

The Construction OPIs are aggregated at four stages. The Stage 1 indices are theoretical construction projects comprising weighted aggregations of plant, labour and material components. These are aggregated into the Stage 2, 3 and 4 indices, as shown in Figure 1, which are included in the quarterly publication.

Construction output price indices



Project structure

Each theoretical construction project comprises a weighted aggregation of specific labour, plant and material components.

Material prices

New work

Relevant PPIs are used to measure changes in material costs for new work projects. PPIs measure changes in the price received by UK companies for goods they have produced that are sold within the UK. The selection of PPIs used is based on the data the Office for National Statistics (ONS) submitted to Eurostat as part of the European Price Comparison Programme used to calculate the purchasing power parities (PPPs).

The projects are intended to be representative of UK construction. The projects for which the UK was asked to return prices to Eurostat as part of the PPPs are:

- detached house
- "Nordic"-style housing development (a single-family home consisting of one and a half storey)
- apartment
- factory building
- new office building
- asphalt road
- a bridge

The representative projects chosen for use in the Construction OPIs for each type of work, selected as they are considered to be reflective of the type of work undertaken in each category, are shown in Table 1. These input costs are also reflected within repair and maintenance projects.

Table 1: Representative projects selected for each type of new work, UK

Type of work	Project
Housing	Detached house and apartment
Infrastructure	Roads and bridges
Public other	New office building
Private industrial	Factory building
Private commercial	New office building

Source: Office for National Statistics

The weighting of materials into each project is determined using Bills of Quantities (BoQs). Each BoQ provides details of the quantities of different materials needed for each project type, with materials grouped into nine material categories. These categories are the same for each of the BoQs and are:

- earthwork
- concrete
- masonry
- joinery and metal work
- finishings
- sanitary fittings
- heating and ventilation
- electrical installations
- drainage

Indices are compiled for materials for each of the representative projects using a selection of PPIs. The overall index for all material costs is then created by weighting the material categories by their relative estimated cost in the whole project. It is worth noting, however, that the values that are submitted in the BoQs represent the total "work cost" so include the costs associated with the materials and plant required to use the materials within the construction project.

Repair and maintenance

The method used to aggregate material prices for repair and maintenance construction differs from new work and are aggregated separately for housing and non-housing repair and maintenance.

Since there are no BoQs for repairs and maintenance, materials have been selected using information collected from the Annual Purchases Survey, which collects data on business' expenditure on energy, services, goods and materials that are used up or transformed by the business activity.

The categories of materials that are used for housing repairs and maintenance are:

- plastic products
- fabricated metal products
- cement, plaster and concrete
- wood products
- furniture
- electrical equipment
- glass, porcelain and ceramic products
- textiles
- paints, varnishes, printing ink and mastics
- mining and quarrying products
- other basic metals and casting

Non-housing repair and maintenance uses a similar approach to that of housing repair and maintenance. However, since the materials used for non-housing will be different, the list of PPIs selected has been amended to better represent non-housing materials.

To do this, the materials that are most representative of repair and maintenance work have been combined separately for an office, a factory and for infrastructure, and then combined into an overall index for materials.

This list of materials is similar to those used for housing repair and maintenance, but excludes wallpaper, particle boards and central heating radiators, and includes:

- tiles, flagstones and bricks of cement, concrete and artificial stone (instead of ceramic and clay as in the housing list)
- aggregates (gravel, sand, stone, granules, chippings and powder, pebbles, bituminous mixtures based on natural and artificial stone, articles of asphalt)
- glass (surface ground, polished, mirrors and insulating units)
- ceramic sanitary wares
- articles of cement, concrete, plaster or artificial stone and prefabricated structural components for buildings or civil engineering
- paints and varnishes (acrylic and polyester based)
- metals (tubes, pipes, hollow profiles and related fittings, metal structures and parts of structures, grills, netting, fencing, aluminium bars, rods and profiles)
- tubes, pipes, hoses and fittings

Plant prices

The SPPI for Rental and leasing services of construction and civil engineering machinery and equipment (CPA2.1: N7732) is used to measure changes in the price of plant used in construction. This index measures changes in the price received by UK plant hire companies when providing plant without an operator to other UK companies and government. It includes items such as cranes, earth-moving equipment and site accommodation and, since it is compiled on a quarterly basis, interpolation is used to produce estimates on a monthly basis.

Similarly to the labour component, the plant data are not available for specific construction work types, so the same index is used for each of the sub-indices produced. Plant costs are measured using the same index for new work, and repair and maintenance.

Labour prices

The AWE Construction Index: seasonally adjusted total pay excluding arrears is used to measure changes in the price of labour in all new work projects. AWE measures money paid to employees in Great Britain in return for work done before tax and other deductions from pay.

The estimates do not include earnings of self-employed people and are not just a measure of pay settlements since they also reflect compositional changes within the workforce. Since the AWE is not available at a more detailed level than all construction, the same index is used to represent labour costs for each of the sub-indices produced.

During the coronavirus (COVID-19) pandemic, the AWE ceased to be a representative measure of labour costs. Between March 2020 and September 2021 inclusive, the monthly Consumer Prices Index including owner occupiers' housing costs (CPIH) inflation rate was used to uprate the index. From October 2021, the AWE has been reinstated.

For housing repair and maintenance, a combination of the CPIs for plumbers, electricians, carpenters and decorators are used to measure changes to labour costs.

The CPIs therefore measure the price paid by consumers when hiring tradespeople to carry out repairs and maintenance on their homes. This index does not include the price paid for builders, which is why it is used for repairs and maintenance only and not for new work.

Aggregation

Weights are applied to account for the varying balance of material, labour and plant costs related to each individual project. Weights are then applied at each level of the index structure, as seen in Figure 1:

- Stage 1: weights of plant, labour and material components into each project
- Stage 2: weights of each project into each type of work (where applicable)
- Stage 3: weights of each type of work into the aggregate new work, and repair and maintenance indices
- Stage 4: weights of the aggregate indices into the top-level All Construction Index

The weights for Stage 1, 3 and 4 are updated annually, while Stage 2 weights remain constant.

Stage 1

Data used to weight the individual labour, materials and plant components for a construction business come from the Annual Business Survey (ABS). Information from the monthly construction survey is used to calculate the sector split of all construction work.

To calculate the labour, material and plant weights for the housing indices, the median cost is calculated from the labour, material and plant ratios of businesses that focus on housing work. The same process is repeated for the other sectors. The median measurement is used, rather than a weighted mean, because there is already a potential bias towards large companies in making this calculation. The calculation requires data from both the annual and monthly survey for the same year, and it is only the largest companies that are fully enumerated in both surveys.

Stage 2

For new work, two representative projects have been used for both housing and infrastructure. The resulting indices have been weighted together using weights estimated from data provided by Barbour ABI, a construction intelligence service.

The weights are fixed and are as follows:

- housing - detached house (65%) and apartment building (35%)
- infrastructure - road (90%) and bridge (10%)

Stage 3 and 4

Stage 3 and Stage 4 weights are updated annually using values for construction output taken from the Office for National Statistics (ONS) Output in the construction industry release. These weights are updated annually in March, effective from January, ready for the Quarter 1 publication. This is when the data for the previous year become available and coincides with the annual weights update for the PPI data. Weights can be viewed in Table 2.

Table 2: Weights used to compile indices for all new work, all repair and maintenance and all construction, 2023, UK

Component	Weight into stage 3 (parts per 1,000)	Stage 3 index	Weight into stage 4 (parts per 1,000)	Stage 4 index
Housing	423	New work	647	All construction
Private industrial	62			
Private commercial	194			
Public other	76			
Infrastructure	245			
Housing repair and maintenance	506	Repair and maintenance	353	
Non-housing repair and maintenance	494			

Source: Office for National Statistics

Mark-up for profit margin

As announced in the Construction development: Impact of improvements to construction statistics article in September 2017, a mark-up method was introduced in collaboration with University College London (UCL). The mark-up addressed a limitation of the old methodology, which assumed that input costs move in the same way as output prices.

Gross profit was chosen as the most appropriate profit measure to base the mark-up on. This is because it is tailored only towards direct costs of goods sold and not indirect fixed costs such as rent and insurance. According to economic theory, firms set a mark-up given labour, capital and intermediate inputs, with a view to maximise profits. The mark-up is the difference between the price that the firm charges and its marginal cost, that is, the cost of producing an additional unit of output.

The Fame dataset, from Bureau van Dijk, has been used to access the financial information of construction businesses. A criterion was defined to identify appropriate businesses, leading to the selection of 715 currently active firms, from which the mean average for turnover and gross profit has been calculated. The mark-up is then produced using the following formula:

$$M = \frac{AVG\ Gross\ Profit}{(AVG\ Turnover - AVG\ Gross\ Profit)}$$

The non-parametric cubic spline approach is then used to fit a smooth curve between points on the annual series to calculate a quarterly series, taking into account movements in the mark-up in neighbouring periods. Linear interpolation is subsequently used to calculate a monthly mark-up figure.

Chain-linking

Each time a weight (for aggregation) is altered, this impacts the aggregate price index value. As price index changes should only reflect changes in price, the effect of this weight change should be removed.

The output index values at each link period (the date following a weight change) are calculated using both the new and old weights. The ratio of the index value calculated using the old weight divided by that using the new weight is used to create a link factor. These link factors are cumulatively multiplied, before being applied to the output indices as multiplication factors.

How we quality assure and validate the data

Rigorous quality assurance is carried out at all stages of production. Specific procedures include:

- scrutinising input data to investigate the accuracy of any abnormal values
- comparing current Construction OPIs with previous Construction OPIs, to see where large changes are taking place and understand the reasons for these
- checking output tables to ensure that there are no errors or inaccuracies during the creation of the published tables and figures
- other government departments also have regular opportunities to analyse the data and share feedback with ONS colleagues

How we disseminate the data

Monthly Stage 3 and 4 Construction OPIs are published on a quarterly basis.

The latest Construction OPI dataset can be downloaded from our website at 9:30am on the day of publication. Future publication dates can be found in the release calendar on the ONS website.

7 . Other information

Linking to a previous series

Users wishing to link the Department for Business, Innovation and Skills (BIS) Construction Price and Cost Indices (CPCIs) (before 2014) and our new Construction Output Price Indices (OPIs) (from 2014 onwards) to create longer-running time series have many options. One approach would be to use a linking factor based on a common time period.

To do this, select the nearest equivalent index published in the OPI (2005 equals 100) series and then calculate a linking factor as follows.

Users wishing to link the BIS CPCIs (until Quarter 2 (Apr to June) 2014) and our new Construction OPIs (from January 2014) to create longer-running time series can create a linking factor on a common period. The purpose of this is to create an equivalence between the value for the common period while maintaining the growth rates from both series. For example, for users who are using the BIS (2005 equals 100) indices in long-term contracts and wish to extend the series beyond Quarter 2 2014 (the last quarter for which CPCI data are available), the following approach would be suitable.

To do this, select the nearest equivalent index published in both series (Quarter 1 (Jan to Mar) 2014, March 2014) and then calculate a linking factor as follows:

$$\frac{Index\ Value\ for\ BIS\ 2005\ =\ 100\ series,\ Quarter\ 1\ (Jan\ to\ Mar)\ 2014}{Index\ Value\ for\ ONS\ 2005\ =\ 100\ series,\ March\ 2014\ for\ nearest\ equivalent\ index} = Linking\ factor$$

Then multiply the Office for National Statistics (ONS) (2015 equals 100) index values beyond March 2014 by this linking factor to extend the BIS (2005 equals 100) time series.

Alternatively, you could calculate the inverse linking factor (dividing the ONS index value by the BIS index value) and multiply the BIS data by this factor to extend the current series backwards. Both of these methods would calculate the same growth between any two periods, the only difference is the reference period (the year that the index values are set to average 100, 2005 for the BIS values, and currently 2015 for the ONS values).

Further information

For further information, please contact the Business Prices team via email at business.prices@ons.gov.uk

8 . Cite this methodology

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