

Article

# Multi-factor productivity estimates: Experimental estimates to October to December 2018

Growth accounting estimates for the UK market sector and 10 industry groups.

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Release date:  
5 April 2019

Next release:  
5 July 2019

## Notice

### 5 April 2019

We previously commented on the identification of notable revisions to growth in the services industries between Quarter 4 1997 and Quarter 1 1998, advising users to treat the data with caution while we investigated the revisions.

We have now completed our investigation and have discovered a discontinuity in a low-level data source feeding into the financial services industry (industry 64). Due to the annual benchmarking process, this has caused level shifts across the services sector between Quarter 4 1997 and Quarter 1 1998.

Please note that top level estimates of GDP are unaffected by this discontinuity.

These services sector series will be updated in the Blue Book consistent Quarterly National Accounts due for publication in September 2019, in line with the National Accounts Revisions Policy. In the meantime, we maintain the advice that users treat the services sector data contained within the low level aggregates spreadsheet prior to 1998 with caution.

We apologise for any inconvenience caused.

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# 1 . Main points

- This is the fourth release of experimental estimates of quarterly multi-factor productivity (MFP) for the UK market sector and the third to be published on the same timetable as our regular labour productivity estimates; a [simple guide to MFP](#) is also available.
- Compared with the same quarter in 2017, MFP in Quarter 4 (Oct to Dec) 2018 is estimated to have decreased by 0.6%; this contrasts with trend growth in MFP of around 1% per year prior to the financial crisis.
- The difference between this and the growth of labour productivity (negative 0.1% across the market sector on an output per hour basis) reflects strengthening labour composition, which in turn reflects an increase in the share of hours worked by workers with higher education qualifications.
- Capital services per hour worked has also been exceptionally weak by historic standards, reflecting sluggish growth in investment and, until recently, buoyant growth in hours worked, with zero impact on the growth of labour productivity in the year to Quarter 4 2018.
- For 2018 as a whole, growth of MFP was approximately zero as the growth of output was matched by the growth of labour and capital inputs; this was the weakest since 2013.
- Over the last decade, since the 2008 financial crisis, non-financial services have made a positive contribution to MFP, while all other sectors have made negative contributions.
- This release contains provisional MFP results for sub-sectors of manufacturing; these estimates show wide variation in output growth, input growth and MFP across manufacturing; we plan to publish further industry detail in future releases.
- Users who previously used our standalone quality-adjusted labour input (QALI) or volume indices of capital services (VICS) articles should find any previously published data alongside this article.

## 2 . Things you need to know about this release

This release presents new experimental quarterly multi-factor productivity (MFP) estimates for the UK market sector, which may not be fully consistent with our other published data. MFP estimates are compiled within a growth accounting framework, which decomposes changes in economic output (in this case, of the UK market sector) into contributions due to changes in measured inputs of factors of production (labour and capital) and a residual element known as MFP.

In the growth accounting framework, the contribution of labour to changes in economic output takes account of changes in labour composition or “quality” of the employed labour force, as well as changes in the “volume” of labour measured by hours worked.

Movements in capital inputs are captured through capital services. Conceptually, this is analogous to the treatment of labour input insofar as weights are given to different forms of capital (such as machinery and software) to reflect their estimated contribution to the production process. However, unlike labour, where hours worked can be directly observed, there is no equivalent of a standard unit of capital service and so there is no distinction between the volume and quality of capital.

This is the fourth edition of what is intended to be a routine quarterly series of MFP publications, decomposing changes in UK market sector output into contributions from measured changes in labour and capital inputs and a residual MFP component. This is the third set of estimates to be published on the same timetable as our regular labour productivity quarterly release. This timetable is usually one week after the publication of the quarterly national accounts (QNA) and around 14 weeks after the reference quarter.

Currently these experimental quarterly estimates will be restricted to the aggregate UK market sector and 10 component industries to allow us to strengthen these estimates ready for [National Statistics](#) badging. We are investigating the feasibility of publishing a more granular quarterly breakdown by industry in future releases. This release also contains experimental annual MFP estimates for the period 1970 to 2018 for the aggregate market sector and 29 component industries, including for the first time 13 sub-sections of manufacturing. Users should note that due to the use of a new more granular model of labour composition, the estimates for the manufacturing sub-sections are not wholly consistent with the quarterly and annual estimates for the aggregate manufacturing industry.

The regular quarterly MFP publications replace our previous pattern of publishing separate annual articles on quality-adjusted labour input (QALI), volume indices of capital services (VICS) and MFP.

Users should be aware that all percentage changes in this release are expressed as changes in (natural) logarithms, which can differ slightly from the discrete percentage changes typically used in our other statistical releases. The use of log changes allows our productivity decompositions to be exactly additive across components.

Whilst we are publishing quarterly data, we advise focusing on quarter-on-quarter a year ago, as this will better expose underlying trends that may be obscured by volatility in the quarter-on-quarter data.

Hours worked in the UK market sector are aggregated from estimates of each component industry, as set out in [Developing improved estimates of quality-adjusted labour inputs using the Annual Survey of Hours and Earnings: a progress report](#), published in July 2017. These estimates for market sector hours and the corresponding estimates for market sector output per hour currently differ slightly from those in our labour productivity release, although we are working towards aligning the two estimates in future releases.

QALI estimates in this release are updated from those in the [previous release](#) on 9 January 2019, principally to take account of updated weights in the Labour Force Survey and revisions to the distribution of employee jobs.

Estimates of capital services have been compiled using new processes and source data, as described in [Volume index of UK capital services \(experimental\): estimates to Quarter 2 \(Apr to June\) 2017](#) (published in February 2018). These changes allow estimation of capital services on a quarterly frequency, whereas previously, quarterly capital services could only be derived by interpolation of annual series. The quarterly capital services system is still subject to development and testing.

### **3 . Multi-factor productivity estimated to have increased by 0.2% in Quarter 4 2018 but still lower than in 2008**

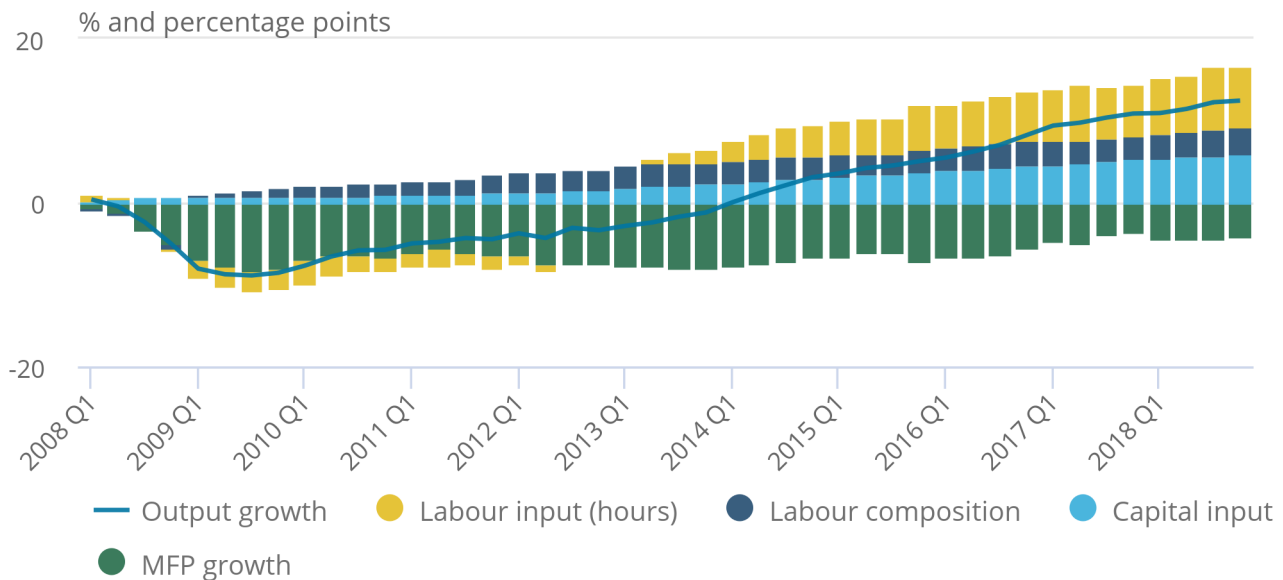
Figure 1 decomposes cumulative quarterly market sector output growth since Quarter 1 (Jan to Mar) 2008 into contributions from capital and labour input growth (the latter separated into contributions from hours and labour composition) and the residual multi-factor productivity (MFP) contribution.

**Figure 1: Output growth has been matched by input growth through 2018; multi-factor productivity has flatlined**

Decomposition of cumulative quarterly output growth, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector

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Decomposition of cumulative quarterly output growth, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector



Source: Office for National Statistics

Notes:

1. Output growth is the cumulative quarter-on-quarter log change in market sector gross value added (GVA).
2. Columns show contributions of components, calculated by weighting log changes in each component by its factor income share.
3. MFP is calculated by residual.

The upward trend in market sector gross value added (GVA) over recent quarters has been roughly matched by increases in hours worked and improvements in labour composition. Capital inputs have also increased, albeit at a very slow pace by historic standards. This implies that the faint upward trend in MFP that began in late 2015 has stalled in recent quarters. Further information is available in the [dataset](#) published alongside this release.

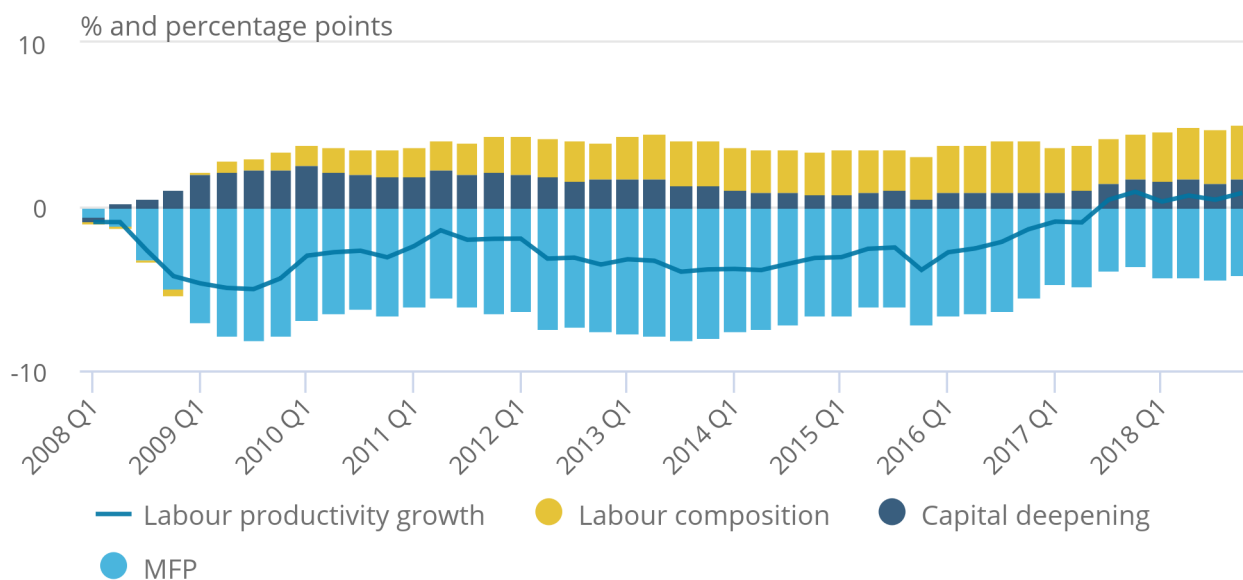
The growth accounting framework can be re-arranged to provide a decomposition of movements in labour productivity measured by output per hour, as shown in Figure 2. In this presentation, the capital contribution reflects changes in capital services per hour worked (known as capital deepening). The contributions of labour composition and of MFP are identical between Figures 1 and 2.

## Figure 2: Market sector output per hour has barely increased in the last 11 years

Decomposition of cumulative quarterly growth of output per hour worked, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector

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Decomposition of cumulative quarterly growth of output per hour worked, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector



Source: Office for National Statistics

#### Notes:

1. Labour productivity growth is the cumulative quarter-on-quarter log change in market sector gross value added (GVA) per hour worked.
2. Columns show contributions of components, calculated by weighting log changes in each component by its factor income share.
3. Multi-factor productivity (MFP) is calculated by residual.

Figure 2 highlights the prolonged weakness of market sector labour productivity since the 2008 financial crisis. More than 10 years on, output per hour worked is only just ahead of its level at the end of 2007 and MFP is still 4 percentage points lower, having grown only slowly and intermittently since 2009. This contrasts with trend growth in MFP of around 1% per year prior to the financial crisis (Figure 3).

Capital deepening has also been exceptionally weak by historic standards, reflecting sluggish growth in investment and, until recently, buoyant growth in hours worked. On the other hand, labour composition has steadily improved over the last 10 years.

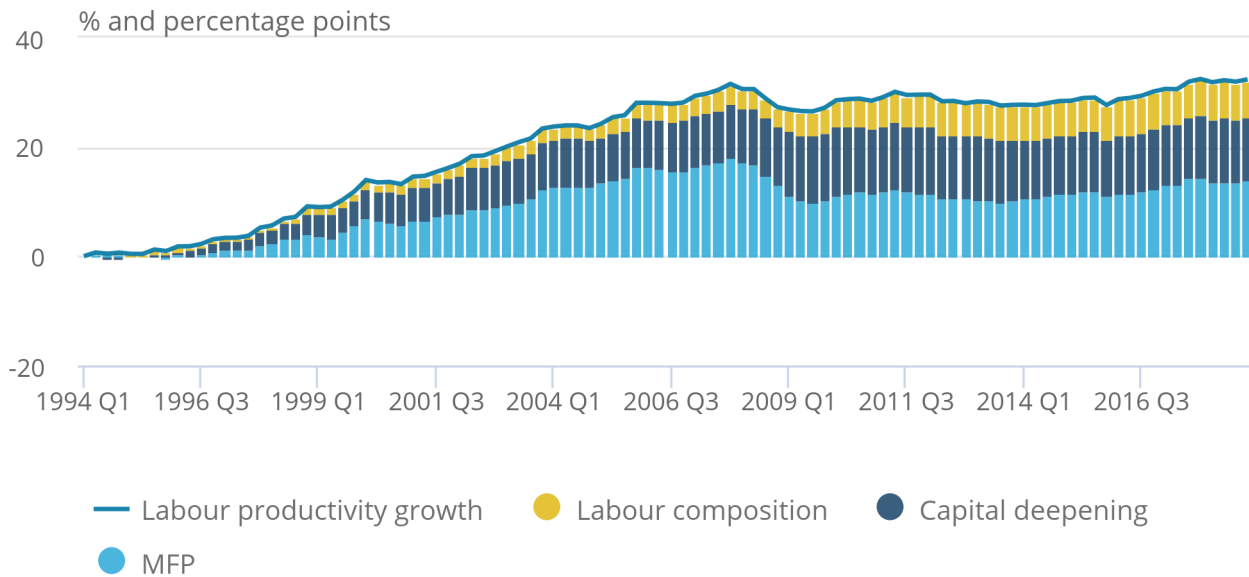
Further information is available in the MFP01 [dataset](#) published alongside this release.

### Figure 3: Strengthening labour composition propping up productivity growth

Decomposition of cumulative quarterly growth of output per hour worked, Quarter 1 (Jan to Mar) 1994 to Quarter 4 (Oct to Dec) 2018, UK, market sector

### Figure 3: Strengthening labour composition propping up productivity growth

Decomposition of cumulative quarterly growth of output per hour worked, Quarter 1 (Jan to Mar) 1994 to Quarter 4 (Oct to Dec) 2018, UK, market sector



Source: Office for National Statistics

#### Notes:

1. Labour productivity growth is the cumulative quarter-on-quarter log change in market sector gross value added (GVA) per hour worked.
2. Columns show contributions of components, calculated by weighting log changes in each component by its factor income share.
3. Multi-factor productivity (MFP) is calculated by residual.

Figure 3 highlights the structural break at the time of the 2008 recession, where capital deepening ceased growing and MFP demonstrated a level-shift downwards, which incremental growth from labour composition and MFP has so far failed to exceed.

## 4 . Labour quality grew strongly in the year to Quarter 4 2018

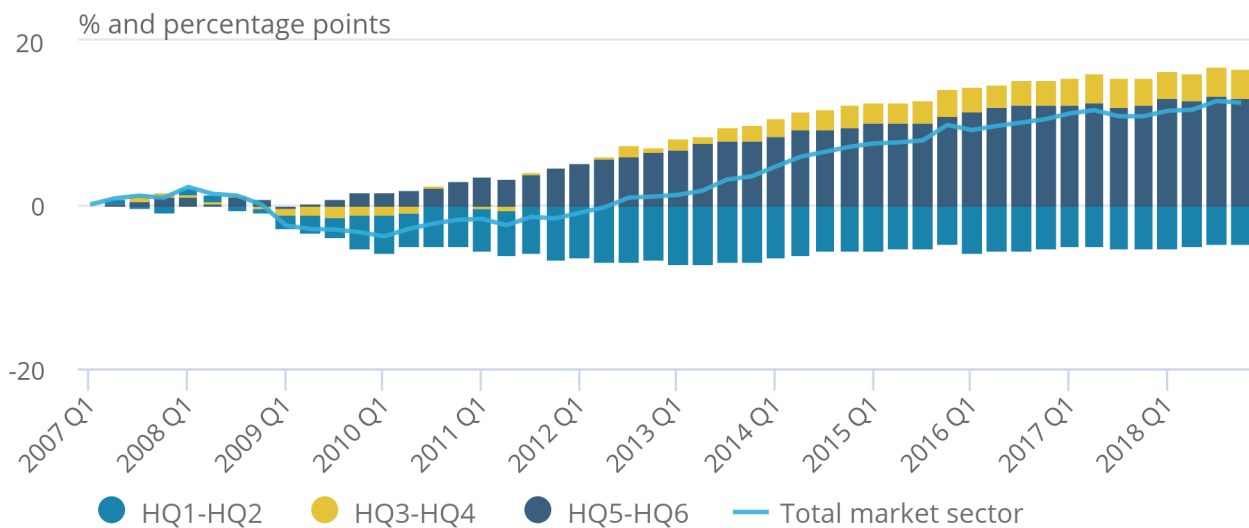
Labour composition (or quality) was unchanged in Quarter 4 (Oct to Dec) 2018 but was still 0.8% higher than in the same quarter of 2017. This reflects a continuing trend for the share of hours worked by workers with higher educational qualifications (and hence, on average, higher wages) to increase.

**Figure 4: Since the financial downturn, growth in market sector hours worked has been driven by degree holders**

Cumulative contributions to changes in hours worked by highest level of education, Quarter 1 (Jan to Mar) 2007 to Quarter 4 (Oct to Dec) 2018, UK, market sector, seasonally adjusted

Figure 4: Since the financial downturn, growth in market sector hours worked has been driven by degree holders

Cumulative contributions to changes in hours worked by highest level of education, Quarter 1 (Jan to Mar) 2007 to Quarter 4 (Oct to Dec) 2018, UK, market sector, seasonally adjusted



Source: Office for National Statistics

Notes:

1. HQ1 is No qualifications.
2. HQ2 is GCSEs and equivalent.
3. HQ3 is A-levels or trade apprenticeships.
4. HQ4 is Certificates of education or equivalent.
5. HQ5 is First and other degrees.
6. HQ6 is Masters and doctorates.
7. Total is the total market sector.

Figure 4 shows quarterly changes in hours worked broken down by highest education qualification. In general, there is a strong positive correlation between level of education and hourly earnings, so a shift in hours worked towards workers with higher qualifications will typically materialise as an increase in labour quality.

Further information on hours worked and labour composition, including industry components, is available in the QALI00, QALI01 and QALI02 [datasets](#) published alongside this release.



We no longer publish standalone articles on [quality-adjusted labour input \(QALI\)](#) but we are publishing all the estimates previously included in QALI articles alongside this article. These include a full set of QALI estimates at the whole economy level (including QALI estimates by industry, education, age group and sex), as well as a full set of QALI estimates for the market sector. Users should note that market sector estimates for labour composition used in multi-factor productivity (MFP) are seasonally adjusted, while those in the QALI standalone datasets are not seasonally adjusted.

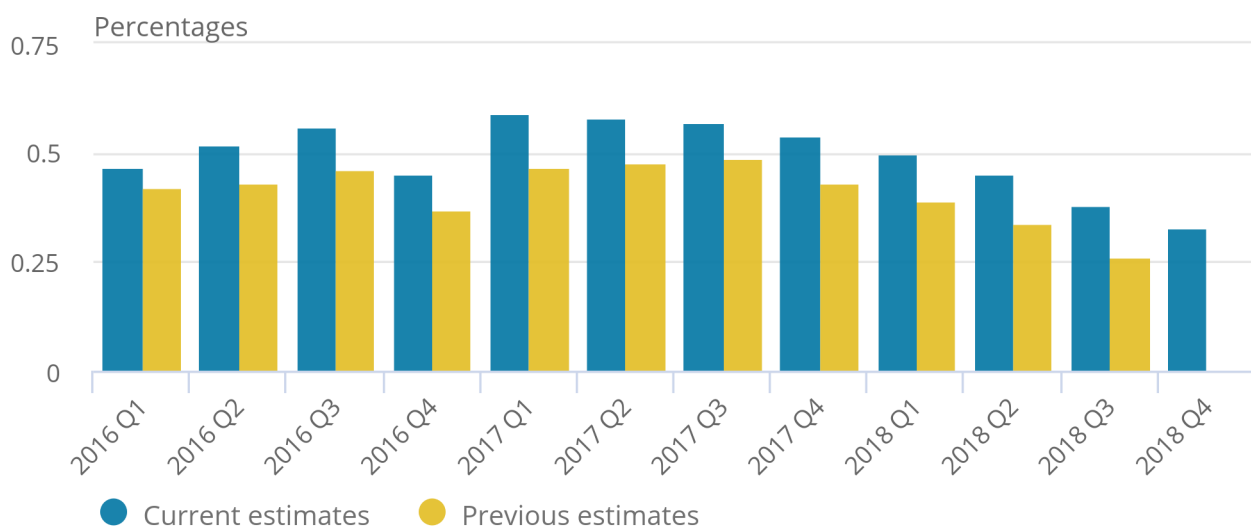
## 5 . Capital services grew in Quarter 4 2018 but at a decelerating pace

**Figure 5: Capital services growth has slowed over each of the last seven quarters**

Quarterly changes in capital services, Quarter 1 (Jan to Mar) 2016 to Quarter 4 (Oct to Dec) 2018, UK, market sector, current and previous estimates

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Quarterly changes in capital services, Quarter 1 (Jan to Mar) 2016 to Quarter 4 (Oct to Dec) 2018, UK, market sector, current and previous estimates



**Source: Office for National Statistics**

**Notes:**

1. Previous is version published on 9 January 2019.

We have revised growth of capital services upwards since the last multi-factor productivity (MFP) release in January 2019, reflecting revised gross fixed capital formation (GFCF) estimates. GFCF estimates used in capital services are based on the same source data used in national accounts estimates of business investment, although the breakdown by asset and industry anticipates improvements scheduled to be introduced into the national accounts in Blue Book 2019.

[Business investment](#) fell for four successive quarters up to Quarter 4 (Oct to Dec) 2018, when it was 2.5% lower than in Quarter 4 2017. Our estimates show capital services continuing to grow over these quarters, albeit at a decelerating rate. This suggests that lower levels of new investment were still sufficient to more than offset declines in the stock of productive capital due to wear and tear, and retirements.

Further information including industry components is available in the MFP01 [dataset](#) published alongside this release.

We no longer publish standalone articles on [volume indices of capital services \(VICS\)](#) but we are publishing all the estimates previously included in VICS articles alongside this article (in the VICS01 [dataset](#)). These include VICS estimates at the A64 industry breakdown (with some very small industries suppressed) and VICS estimates by asset. Users should note that VICS estimates used in MFP are seasonally adjusted while those in the standalone VICS dataset are not seasonally adjusted.

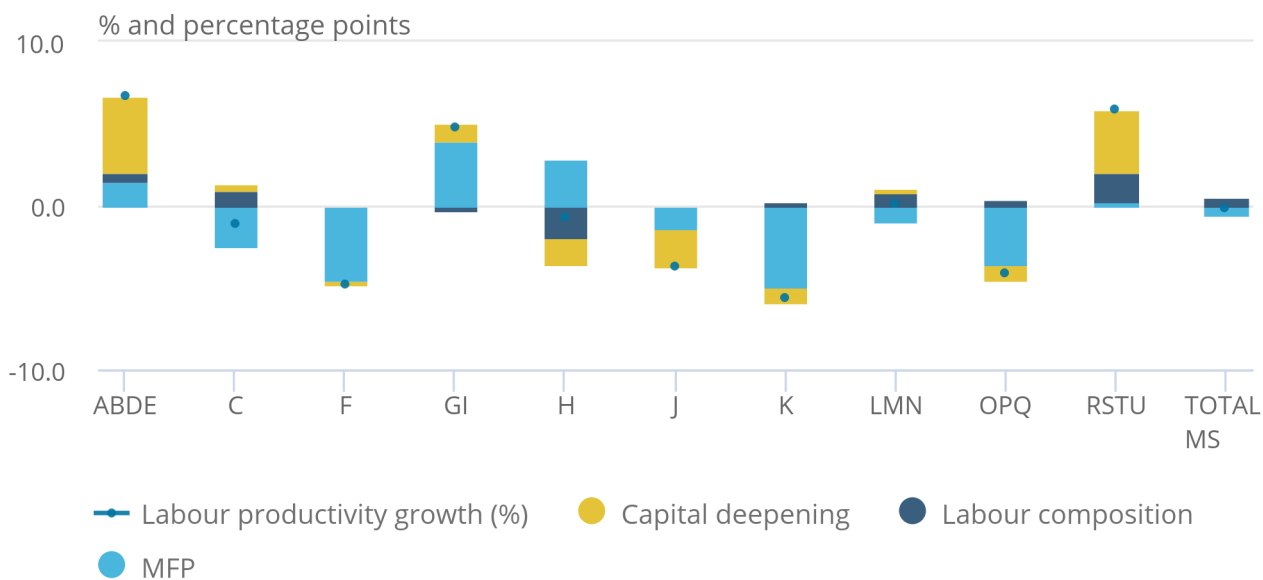
## 6 . Industry breakdown

**Figure 6: Multi-factor productivity fell in most industries in the year to Quarter 4 2018**

Decomposition of year-on-year growth of output per hour worked to Quarter 4 (Oct to Dec) 2018, UK, market sector and component industries

Figure 6: Multi-factor productivity fell in most industries in the year to Quarter 4 2018

Decomposition of year-on-year growth of output per hour worked to Quarter 4 (Oct to Dec) 2018, UK, market sector and component industries



Source: Office for National Statistics

Notes:

1. ABDE is Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply and water supply; and Sewerage, waste management and remediation activities.
2. C is Manufacturing.
3. F is Construction.
4. GI is Wholesale and retail trade, Repair of motor vehicles and motorcycles, and Accommodation and food service activities.
5. H is Transportation and storage.
6. J is Information and communication.
7. K is Financial and insurance activities.
8. LMN is Real estate activities, Professional, scientific and technical activities, and Administrative and support service activities.
9. OPQ is Public administration and defence, Compulsory social security, Education and Human health and social work activities.
10. RSTU is Arts, entertainment and recreation, and Other services.
11. TOTAL MS is the whole market sector.

Multi-factor productivity (MFP) decompositions by industry can be volatile, particularly over short time periods. Figure 6 shows considerable variation in all components: labour composition is positive in six industries, negative in two (distribution and transportation and storage) and negligible in the remaining two industries. Capital deepening is positive in five industries, negative in five industries and negligible overall. Movements in MFP are positive in four industries but negative in the other six industries.

Further information including industry components is available in the MFP01 [dataset](#) published alongside this release.

## **7 . Non-financial services have made a positive contribution to changes in multi-factor productivity since 2007**

The MFP01 [dataset](#) published alongside this release includes breakdowns of aggregate market sector multi-factor productivity (MFP) into contributions due to individual industries, following the methodology set out by Diewert (2015) in [Decompositions of productivity growth into sectoral effects](#). This is an extension and generalisation of the Tang and Wang (2004) methodology used in our labour productivity release.

Figure 7 shows some illustrative results from the Diewert (2015) methodology, breaking down the cumulative movement in MFP since 2007 into five broad industry groups. According to this analysis, only non-financial services has made a positive contribution to MFP over this period.

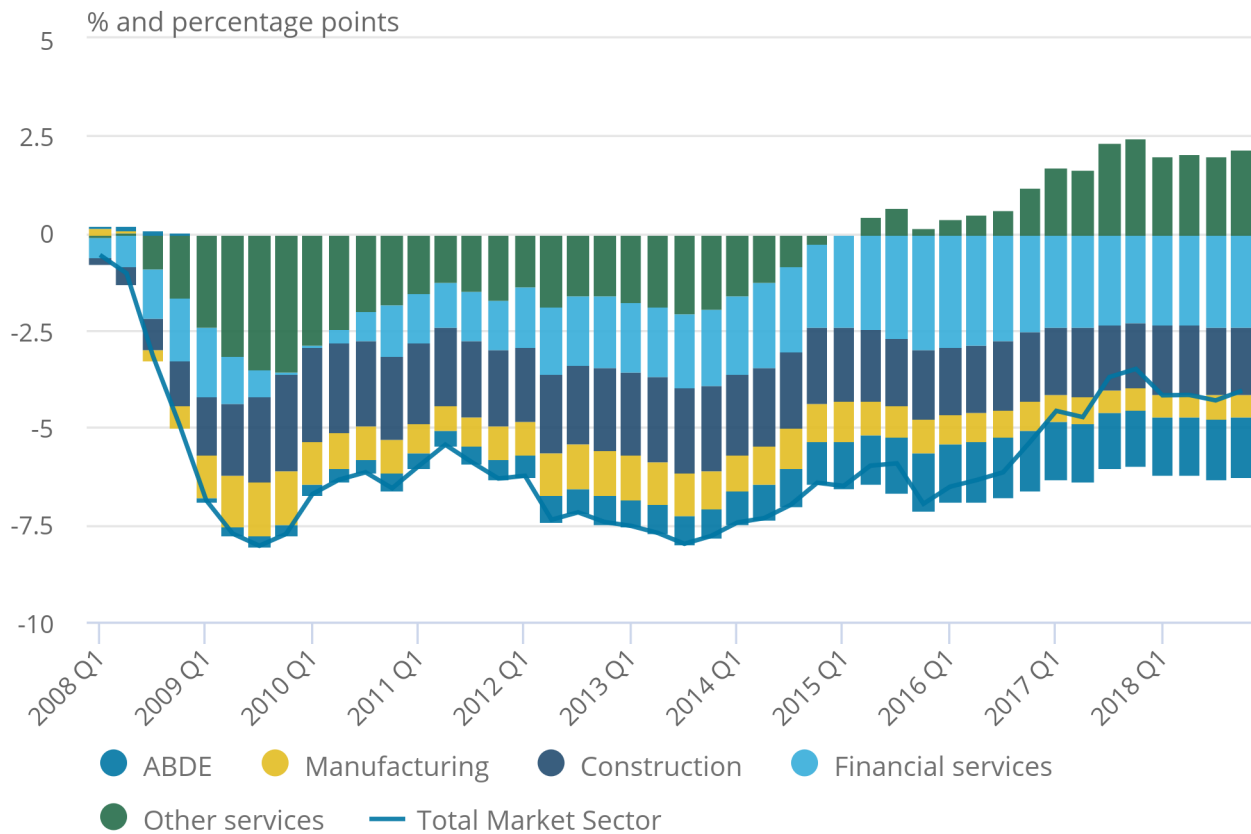
The Diewert (2015) methodology can also be used to decompose movements in MFP into “within” industry and “between” industry elements. We welcome views from users on whether this would be helpful.

**Figure 7: Multi-factor productivity lower in all industries since before downturn except non-financial services**

Industry contributions to cumulative multi-factor productivity growth, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector

Figure 7: Multi-factor productivity lower in all industries since before downturn except non-financial services

Industry contributions to cumulative multi-factor productivity growth, Quarter 1 (Jan to Mar) 2008 to Quarter 4 (Oct to Dec) 2018, UK, market sector



Source: Office for National Statistics

Notes:

1. ABDE is: Agriculture, forestry and fishing; Mining and quarrying; Electricity, gas, steam and air conditioning supply and water supply; and Sewerage, waste management and remediation activities.
2. Total MS is the whole market sector.

## 8 . What's changed in this release?

This release introduces the first provisional results from a more granular growth accounting framework. This is identical to the existing framework in terms of gross value added (GVA), capital services, hours worked and factor income weights (that is, aggregated estimates published in previous editions are simple aggregations of the bottom-level industry components). But the new framework utilises a new model of labour composition that is not strictly additive, that is, labour composition aggregated across the bottom-level industries is not consistent with labour composition derived in the existing, more aggregated framework.

The new framework identifies 19 two-digit (and some clustered two-digit) sub-sections of manufacturing and in this case the more granular estimates are almost consistent between the two frameworks. More work is planned to explore the remaining inconsistencies, but in the meantime we are sharing annual multi-factor productivity (MFP) results for 13 two-letter manufacturing sub-sectors such as CA (food products, beverages and tobacco) and CH (basic metals and metal products), consistent with aggregations of industry divisions in the Standard Industrial Classification (SIC) 2007.

For the manufacturing sector as a whole, MFP in 2018 was just 0.3% higher than 2007. But this masks large positive and negative movements in MFP across different sub-sectors.

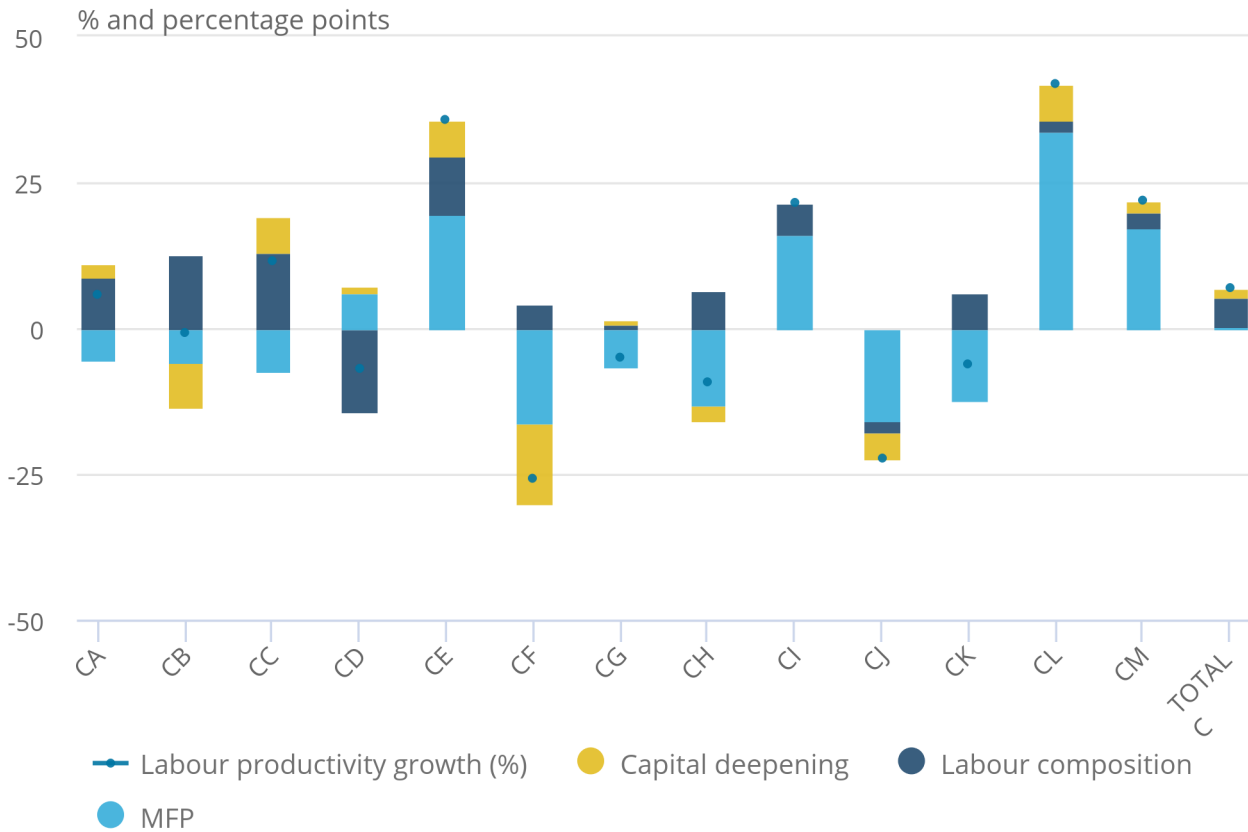
As shown in Figure 8, the best performing sub-sector in terms of MFP since the economic downturn is CL (transport equipment), while other sub-components with strong positive MFP growth include CE (chemicals and chemical products), CM (other manufacturing) and CI (computer, electronic and optical products). The worst performer in terms of MFP is CF (basic pharmaceutical products and preparations), with CJ (electrical equipment), CH (basic metals and metal products) and CK (machinery and equipment not elsewhere classified) not far behind.

**Figure 8: Multi-factor productivity across manufacturing has varied**

Decomposition of cumulative growth of output per hour worked, 2007 to 2018, UK, manufacturing sub-sectors and total manufacturing

Figure 8: Multi-factor productivity across manufacturing has varied

Decomposition of cumulative growth of output per hour worked, 2007 to 2018, UK, manufacturing sub-sectors and total manufacturing



Source: Office for National Statistics

Notes:

1. CA is Food products, beverages and tobacco.
2. CB is Textiles, wearing apparel and leather products.
3. CC is Wood and paper products and printing.
4. CD is Coke and refined petroleum products.
5. CE is Chemicals and chemical products.
6. CF is Basic pharmaceutical products and preparations.
7. CG is Rubber and plastic products and non-metallic mineral products.
8. CH is Basic metals and metal products.
9. CI is Computer, electronic and optical products.
10. CJ is Electrical equipment.
11. CK is Machinery and equipment not elsewhere classified.
12. CL is Transport equipment.
13. CM is Other manufacturing.
14. TOTAL C is all manufacturing.

## Revisions

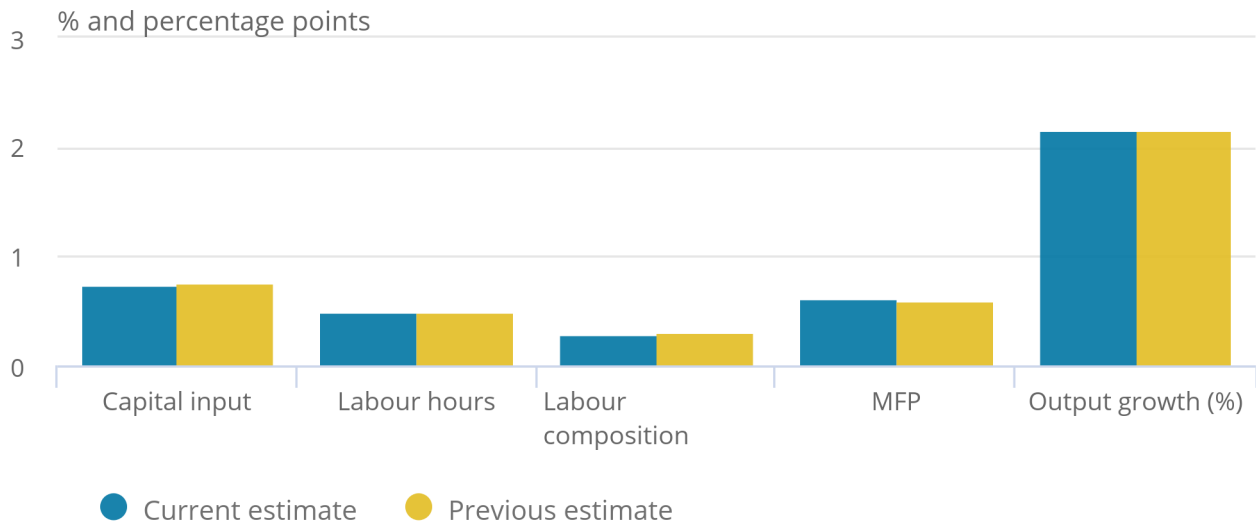
For the market sector as a whole, revisions to our MFP estimates since our last [MFP release in January 2019](#) are very small, as shown in Figure 9. Average annual contributions for capital inputs and labour composition have been revised downwards slightly, with corresponding upwards revisions to MFP.

## Figure 9: Minimal revisions to sources of growth since January

Contributions to annual average output growth, 1998 to 2017, UK, market sector, current and previous estimates

### Figure 9: Minimal revisions to sources of growth since January

Contributions to annual average output growth, 1998 to 2017, UK, market sector, current and previous estimates



Source: Office for National Statistics

Revisions at component industry level, contained in the MFP01 [dataset](#) published alongside this release, additionally reflect revised estimates of hours worked (and, to a lesser extent, of labour composition) and, from Quarter 1 (Jan to Mar) 2018 onwards, revisions to gross value added (GVA) and factor income weights.

Estimates for hours worked, labour composition and factor income weights prior to 1997 have also been revised – in some cases very substantially – to take account of information from different sources. For example, combining information on output and employment for industry B (mining and quarrying) suggests a large decrease in the share of labour income in gross value added as North Sea oil and gas reserves were brought into production.

## 9 . Next steps

In addition to ongoing work to expand the level of industry detail, the development priorities of the Office for National Statistics Growth Accounting Team, as set out in our [Productivity development plan](#), published in July 2018, are further developments to capital stocks and capital services, and development of wider measures of MFP. This will build on work in our national accounts division to compile supply and use tables in constant prices as well as in current prices. This will allow industry-level decompositions of real gross output, identifying the separate contribution of real intermediate consumption.

## 10 . Links to related statistics



- [Productivity economic commentary: October to December 2018](#) draws together the main findings from official statistics and analysis of UK productivity to present a summary of recent developments (published 5 April 2019).
- [Labour productivity, UK: October to December 2018](#) contains the latest estimates of labour productivity for the whole economy, the UK regions at NUTS1 level and a range of industries, together with estimates of unit labour costs (published 5 April 2019).
- [Region by industry labour productivity](#) presents annual productivity estimates for 16 industries in Standard Industrial Classification 2007 section groups for each of the NUTS1 regions for 1997 to 2017. It compares annual productivity growth by region, as output per hour, relative to the UK and explains how manufacturing and services have grown across the regions (published 6 February 2019).
- [Regional and sub-regional productivity in the UK](#), estimates for measures of labour productivity using a balanced gross value added (GVA) approach for NUTS1, NUTS2 and NUTS3 sub-regions of the UK, selected city regions and English local enterprise partnerships (LEPs) up to 2017. Estimates are in both real and nominal terms (published 6 February 2019).
- [Multi-factor productivity estimates: Experimental estimates to October to December 2018](#) presents quarterly estimates of multi-factor productivity (MFP), capital services and quality-adjusted labour input (QALI), including a range of industry breakdowns and analysis (published 5 April 2019).
- [A simple guide to multi-factor productivity](#) explains the concept and measurement of multi-factor productivity through simple stylised examples (published 5 October 2018).
- [Quarterly UK public service productivity \(Experimental Statistics\): October to December 2018](#) contains the latest experimental estimates for quarterly UK total public service productivity, inputs and output (published 5 April 2019).
- [Public service productivity: total, UK, 2016](#) presents updated measures of output, inputs and productivity for public services in the UK between 1997 and 2015, in addition to new estimates for 2016 (published 9 January 2019).
- [Public service productivity: healthcare, UK, 2016](#) presents updated estimates of output, inputs and productivity for public service healthcare in the UK between 1995 and 2015, and new estimates for 2016 (published 9 January 2019).
- [Public service productivity: healthcare, England: financial year ending 2017](#) presents estimates of output, inputs and productivity for public service healthcare in England on a financial year basis up to FYE 2017 (published 9 January 2019).
- [Improving estimates of Labour Productivity and International Comparisons](#) discusses recent OECD findings showing that the methodologies, data sources and adjustments used to estimate the number of persons, jobs and hours worked varied significantly across countries, and explores these differences and the impact on our ICP (published 9 January 2019).
- [Productivity development plan: 2018 to 2020](#) builds on recent improvements to our productivity statistics and looks at introducing new outputs, further improving our productivity statistics and consolidating our improvements to date (published 6 July 2018).
- [How productive is your business?](#) is an interactive tool which aids businesses to calculate their productivity and compare their performance to other businesses in Great Britain (published 6 July 2018).