Office for National Statistics

Article

Multi-factor productivity estimates, UK: July to September 2019

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

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Discontinued

Notice

23 May 2025

From 23 May 2025, this article has been replaced by our new bulletin series Annual multi-factor productivity, market sector, UK. This decision has been made to improve the user experience. Please contact productivity@ons.gov.uk with any questions.

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1 . Main points

- Multi-factor productivity (MFP) in Quarter 3 (July to Sept) 2019 is estimated to have decreased by 0.6% compared with the same quarter a year ago; this contrasts with trend growth in MFP of around 1.5% per year prior to the 2008 economic downturn.

- Capital services per hour worked (capital deepening) has also been exceptionally weak by historic standards, reflecting sluggish growth in investment and buoyant growth in hours worked, delivering a negative contribution to labour productivity growth since 2012.

- The largest positive contributor to growth in market sector hours worked has been workers with degrees, as opposed to workers with lower qualifications; in Quarter 3 2019 workers with degrees accounted for 32% of total hours worked in the market sector, compared with 21% in 2008.

- Over the last decade, since the 2008 downturn, non-financial services have made a positive contribution to MFP, while all other industries have made negative contributions.

- We estimate that multi-factor productivity has been the largest contributor to the productivity puzzle while labour composition has made a mild contribution to productivity growth.

2 . Contributions to growth in output and labour productivity

The components of UK productivity growth can be deconstructed into changes in output and the various inputs used to create that output. These inputs include capital (including buildings, machines, software and so on), labour composition (which measures the quality of labour by taking into account the different characteristics of workers such as education) and labour input in terms of hours. The difference between changes in these inputs and changes in output in a given period is multi-factor productivity (MFP), which reflects how the inputs are organised and used in order to generate output.

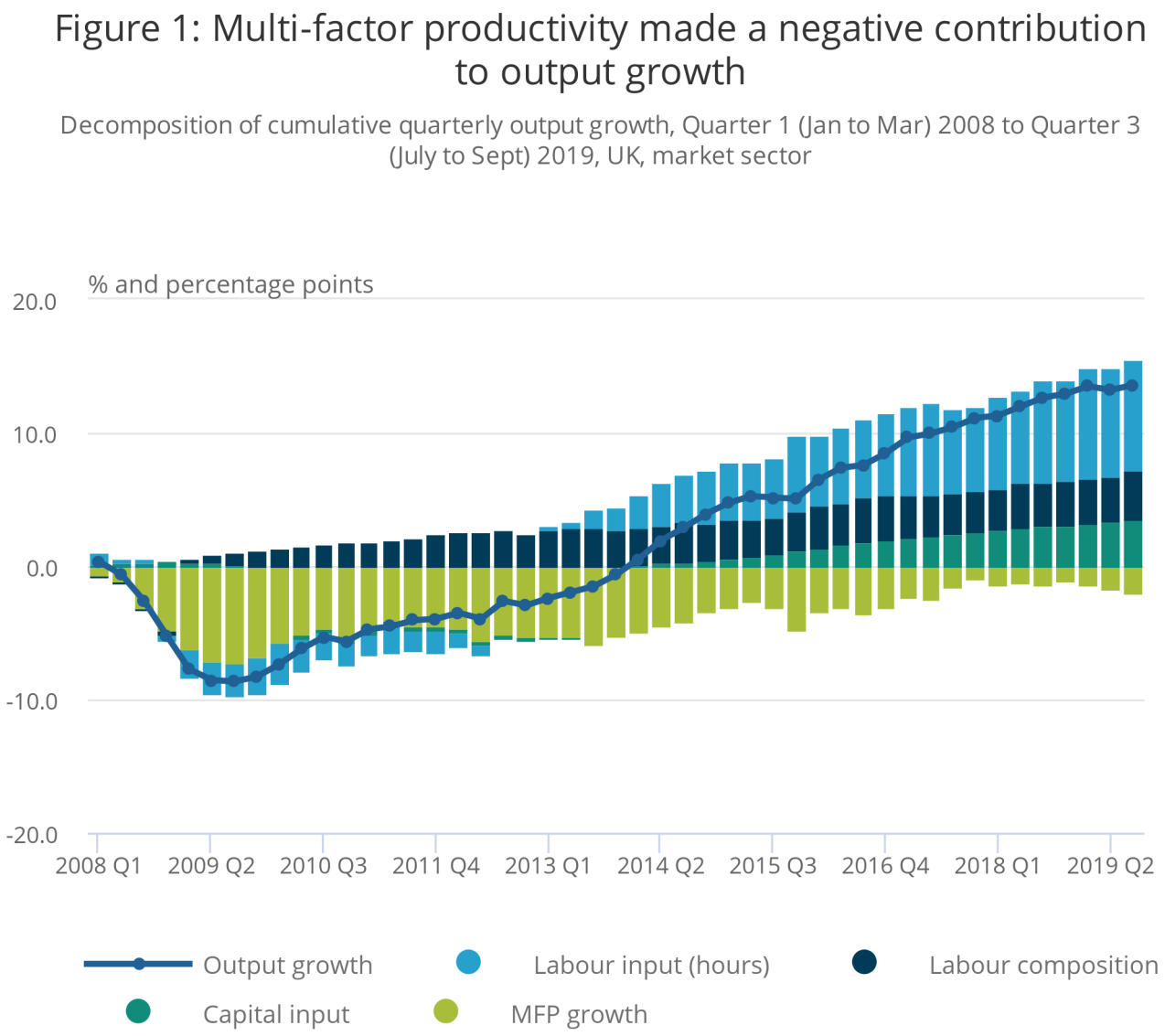
Growth of 0.4 percentage points in market sector gross value added (GVA) in Quarter 3 (July to Sept) 2019 was mainly driven by labour input, while multi-factor productivity made a negative contribution to GVA growth, shown in Figure 1. The upward trend in market sector GVA seen in earlier quarters has been roughly matched by increases in hours worked.

Labour composition growth has continued its pre-downturn trend of a sustained, mild increase since 2008. It contributed 0.4 percentage points to labour productivity growth in Quarter 3 (July to Sept) 2019, its strongest contribution since Quarter 2 (Apr to June) 2009.

Capital input (as measured by the capital services) has also increased, albeit at a slower pace by historic standards. Further information is available in the dataset published alongside this release.

Figure 1: Multi-factor productivity made a negative contribution to output growth

Decomposition of cumulative quarterly output growth, Quarter 1 (Jan to Mar) 2008 to Quarter 3 (July to Sept) 2019, 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).

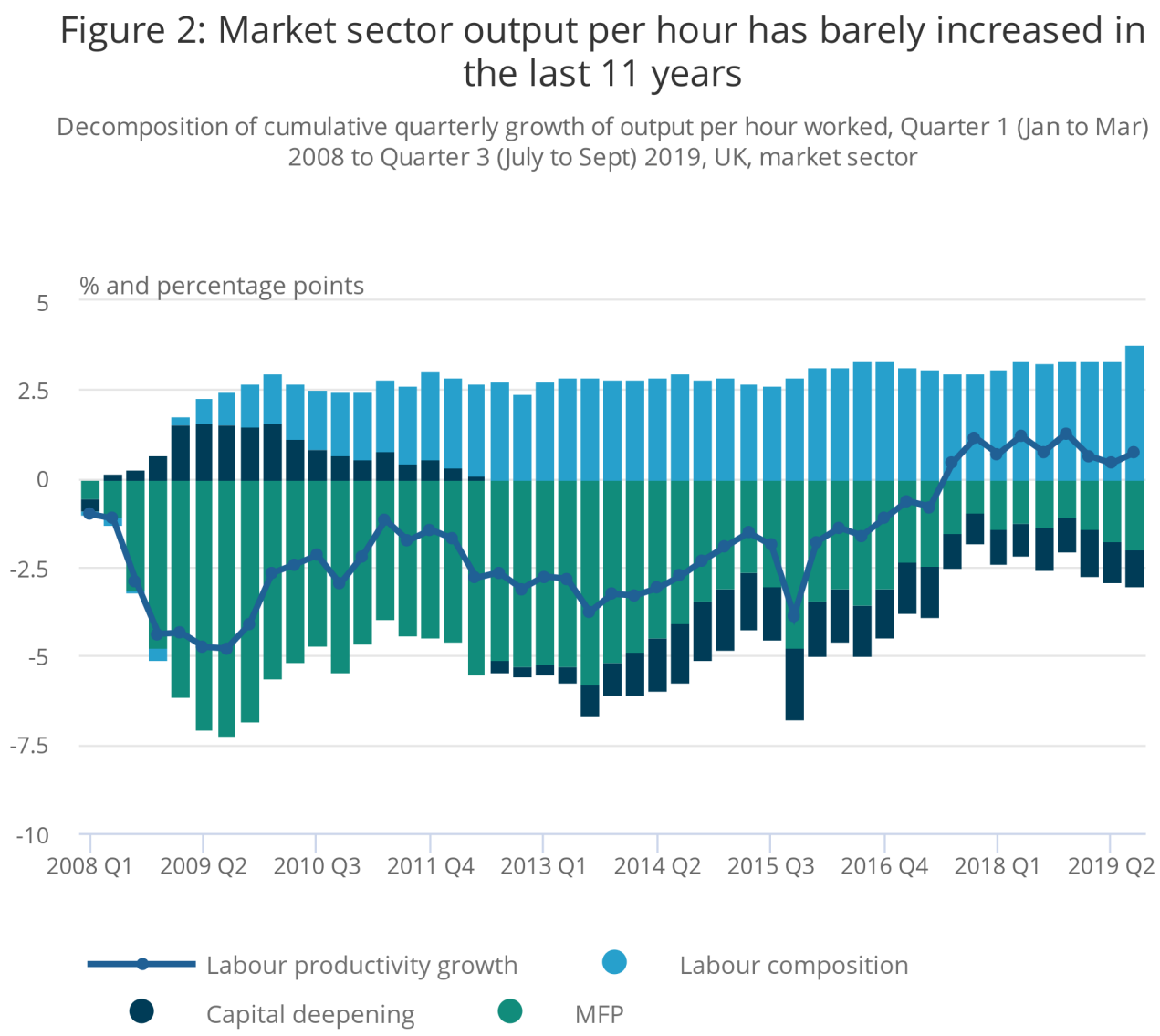
2. Columns show contributions of components, calculated by weighting log changes in each component by its factor income share.

3. MFP is calculated by residual.

The 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, which differs from the broader concept of capital input used in Figure 1). 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 3 (July to Sept) 2019, 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.

4. Negative capital deepening is also known as capital shallowing. It represents workers having less access to capital per hour worked.

Figure 2 highlights the prolonged weakness of market sector labour productivity since the 2008 economic downturn. More than 10 years on, labour productivity per hour worked is only just ahead of its level at the end of 2007. In Quarter 3 2019, MFP growth fell by 0.6 percentage points compared with the same quarter a year ago. This contrasts with trend growth in MFP of around 1.5% per year prior to the downturn.

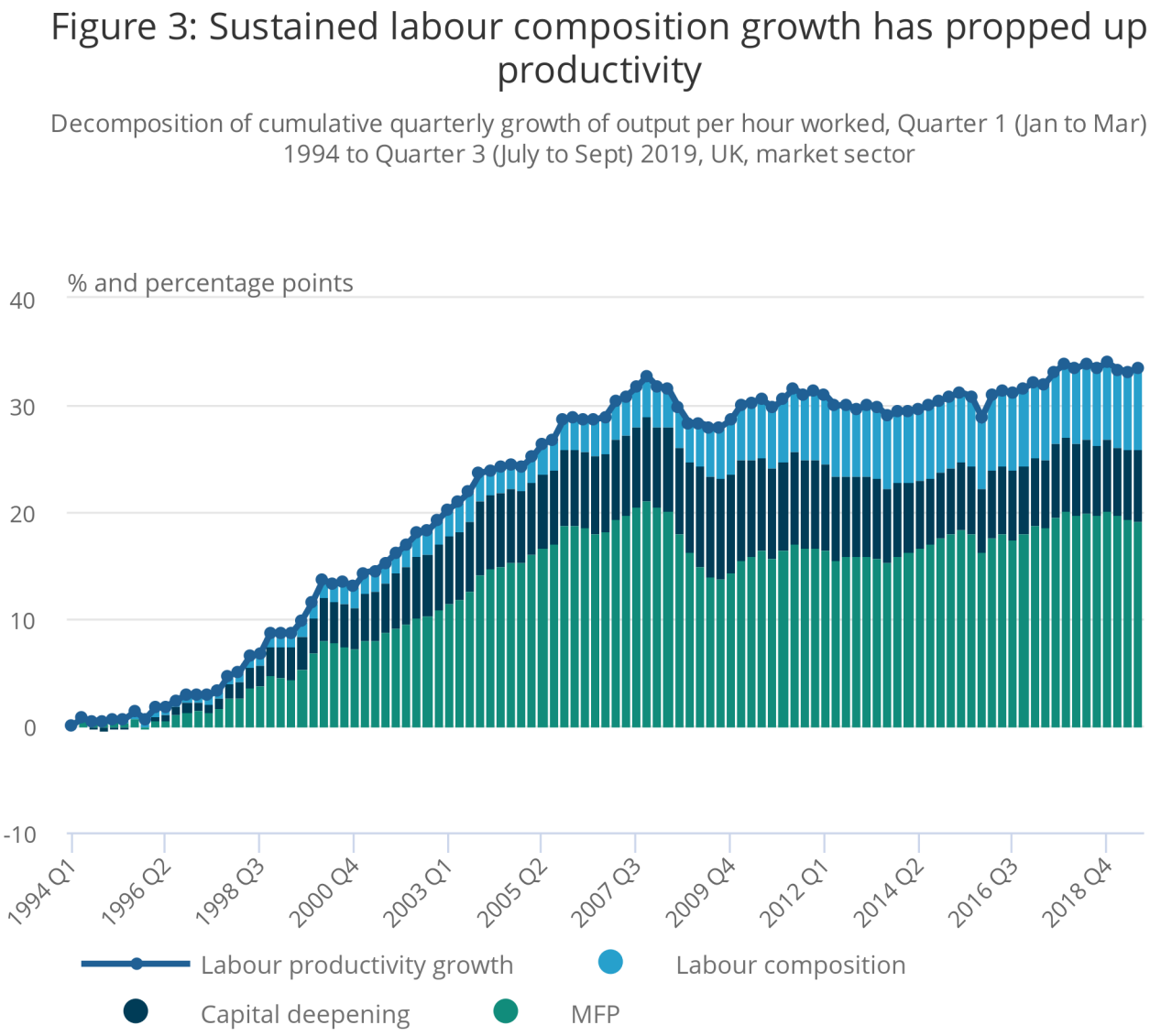
Since the downturn, firms in the UK have expanded their production capacity by mainly increasing the labour input while investment in capital has been weak. Capital deepening (capital services per hour worked) has been weak by historic standards, and since 2012, the UK market sector has actually been faced with “capital shallowing”: the growth of capital services has been slower than the growth in hours worked. The average growth rate for capital deepening for the 2009 to 2018 period has been negative 0.3% while the average growth rate for the pre-downturn period 1998 to 2008 was 1.8%.

This means that the amount of capital services available for each hour worked has been declining in the UK since the financial downturn. This might be partly explained by the uncertainty in the economy where firms may have been holding back from costly long-term investments such as new machinery and equipment, and instead employed labour, which can be seen as the more flexible input of production.

Further information is available in the MFP01 dataset published alongside this release.

Figure 3: Sustained labour composition growth has propped up productivity

Decomposition of cumulative quarterly growth of output per hour worked, Quarter 1 (Jan to Mar) 1994 to Quarter 3 (July to Sept) 2019, 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 economic downturn, where capital deepening ceased growing and MFP demonstrated a level-shift downwards. The MFP growth has so far failed to exceed the pre-downturn growth rate. Labour composition, however, initially grew slightly faster post-downturn before resuming its pre-downturn trend of mild growth. There are several possible reasons for the weak post-downturn MFP growth, and it is an area that we continue to investigate. For more information, see Section 6.

3 . Quality-adjusted labour input

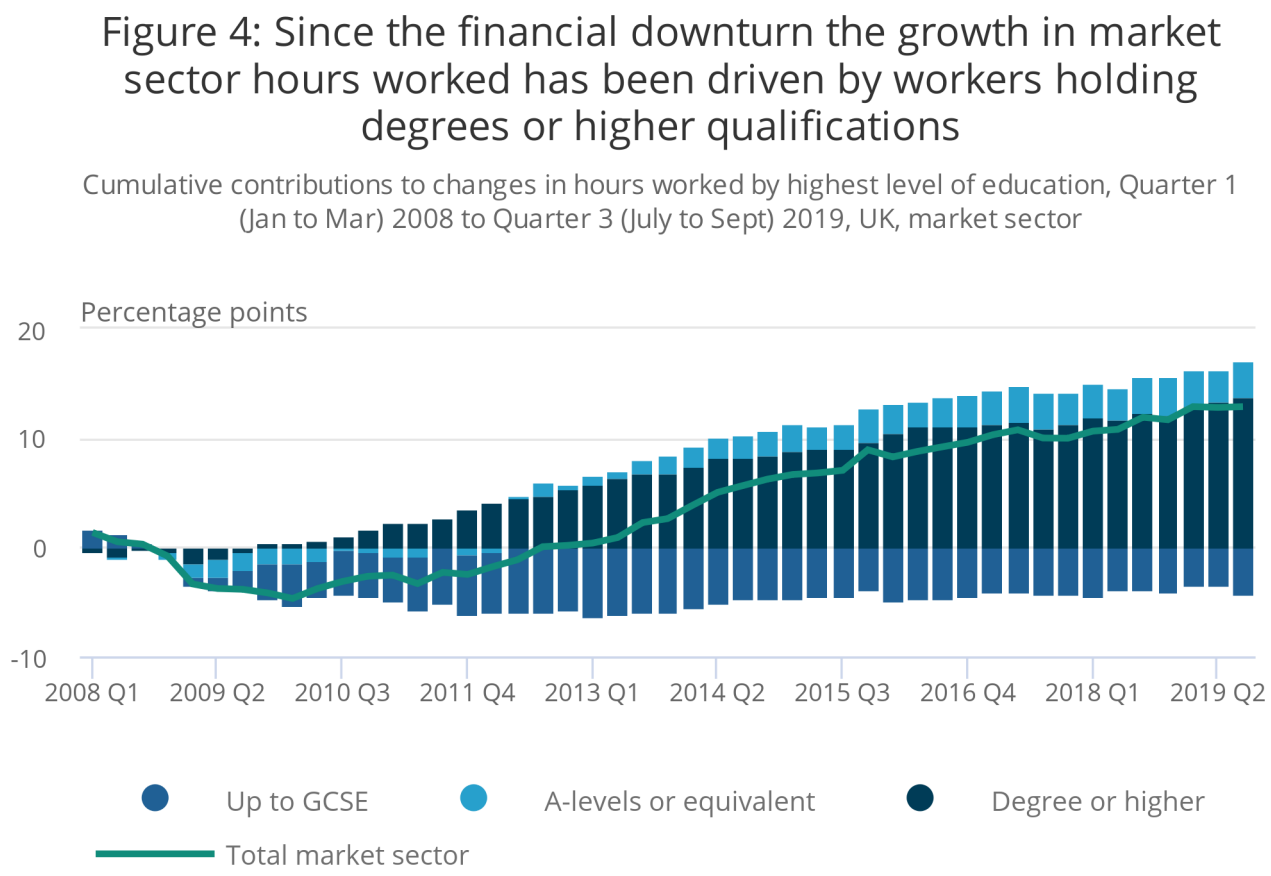
There was an increase in labour composition during Quarter 3 (July to Sept) 2019 compared with the same quarter the previous year.

The share of hours worked by workers with degrees or postgraduate degrees has been increasing since the 2008 economic downturn. In Quarter 3 2019, workers with degrees accounted for 32% of the total hours worked in the market sector, compared with 21% in 2008.

This means that the labour composition or “labour quality” in the UK has been slightly higher for the post-downturn period, and therefore labour composition is estimated to have decreased the productivity gap. More information on the UK labour composition post-downturn can be found in our analysis of compositional changes in hours worked in the UK.

Figure 4: Since the financial downturn the growth in market sector hours worked has been driven by workers holding degrees or higher qualifications

Cumulative contributions to changes in hours worked by highest level of education, Quarter 1 (Jan to Mar) 2008 to Quarter 3 (July to Sept) 2019, UK, market sector



Source: Office for National Statistics

Notes:

1. Please note that education labels correspond to those used in the Labour Force Survey (LFS); Up to GCSE = HQ1 (no qualifications) plus HQ2 (GCSE or equivalent) A-levels = HQ3 (A-levels or trade apprenticeships) and HQ4 (certificates of education or equivalent) Degree or higher = HQ5 (first and other degrees) together with HQ6 (masters and doctorates).

Figure 4 shows quarterly changes in hours worked broken down by highest educational 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.

This article uses the latest data from the Annual Survey of Hours and Earnings (ASHE). The ASHE provides detailed estimates of UK employees' hourly earnings and it is used to augment the compilation of all quality-adjusted labour input (QALI) indices that would otherwise exclusively rely upon data from the Labour Force Survey (LFS).

4 . Volume index of capital services

Capital services measure the flow of services that different types of assets provide to the production process. These different types of assets are adjusted for deterioration and weighted by a set of user cost weights. These weights reflect how intensively different types of assets are used in the production process.

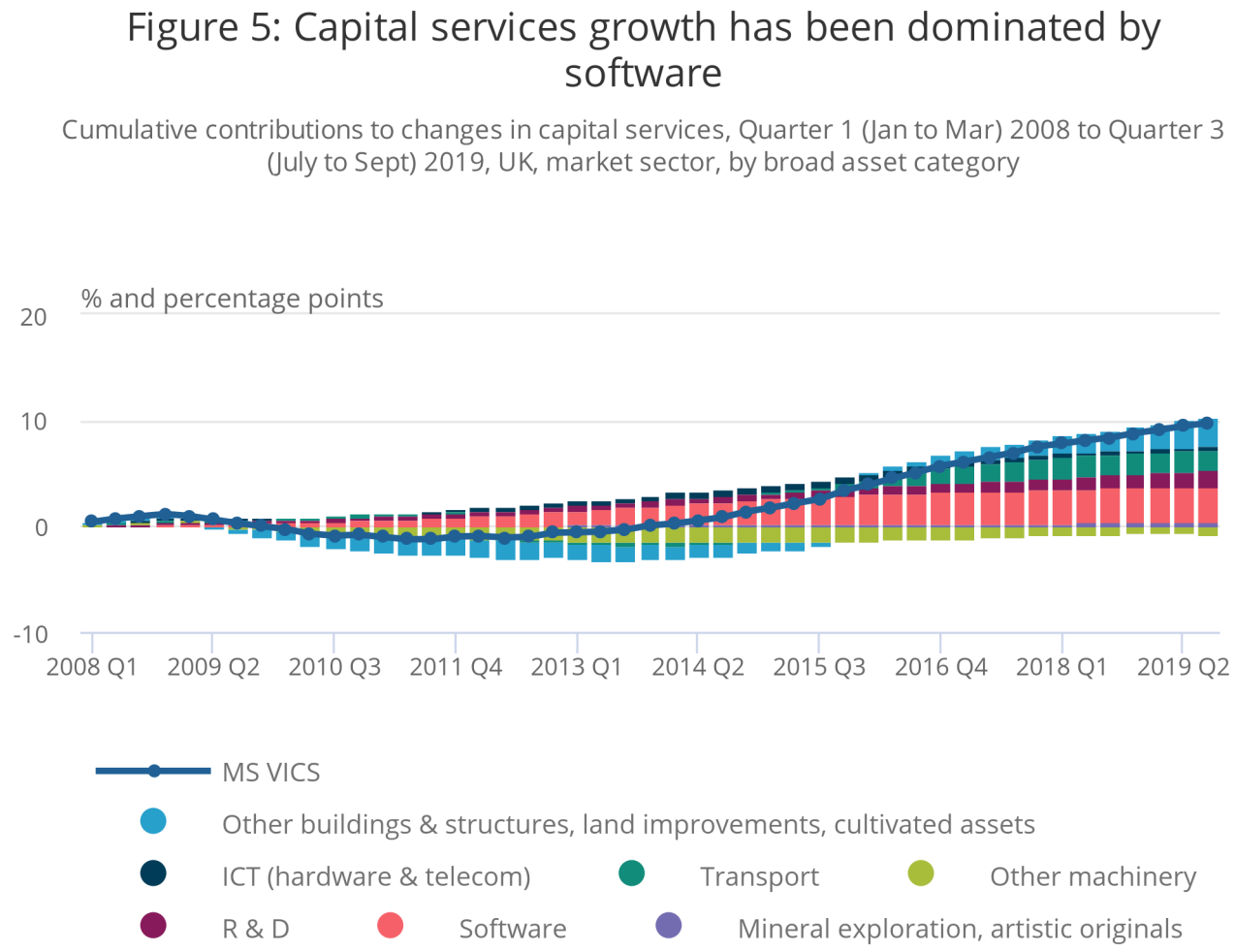
In capital services, short-lived assets such as software are given a proportionately higher weight than long-lived assets such as buildings. This differs from the weights these assets have in capital stocks as these short-lived assets are used more intensively in the production process.

The coverage of capital in the multi-factor productivity (MFP) system is similar to that of business investment. Business investment growth was flat in Quarter 3 (July to Sept) 2019. On a year-on-year basis, business investment was 0.5% higher than in Quarter 3 2018. In contrast, capital services are estimated to have increased by 1.4% in Quarter 3 2019 compared with the same quarter a year ago (Figure 5).

This suggests that the lower levels of new investment were still sufficient enough to offset declines in the stock of productive capital because of wear and tear, and retirements. This growth is weak by historical standards, with capital services growing by 2.3% a year on average between 1998 and 2008.

Figure 5: Capital services growth has been dominated by software

Cumulative contributions to changes in capital services, Quarter 1 (Jan to Mar) 2008 to Quarter 3 (July to Sept) 2019, UK, market sector, by broad asset category



Source: Office for National Statistics

5 . Contributions to growth in multi-factor productivity

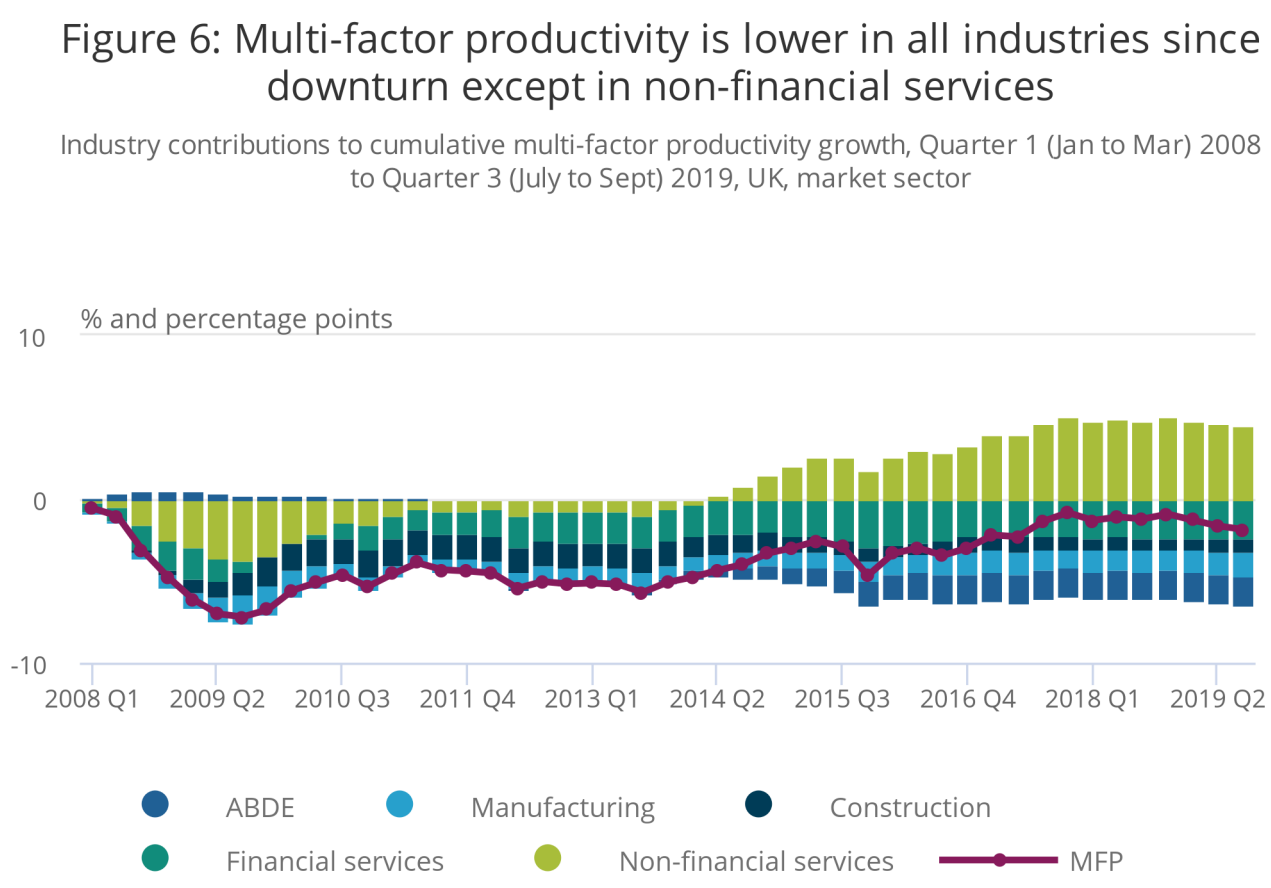
Figure 6 shows the cumulative contributions to growth in multi-factor productivity (MFP) by five broad industry groups. Non-financial services is the only industry group that has made a positive contribution to post-downturn growth in MFP. The positive contributions to MFP growth reflect the ability of these industries to harness new technologies or use their inputs in a more efficient way in the production process.

There is variation in MFP growth within the industry groups. For example, manufacturing overall has made a negative contribution to post-downturn MFP growth. However, some of the sub-sectors of manufacturing had a positive MFP growth during the same period. Manufacturing of computer, electronic and optical products has seen strong MFP growth since 2016 while the MFP growth in manufacturing of textiles, wearing apparel and leather products was mostly unaffected by the downturn but since 2010 the growth has trended downwards. See the MFP02 dataset for more granular MFP data.

The MFP01 dataset published alongside this release includes breakdowns of aggregate market sector MFP into contributions by 10 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 6: Multi-factor productivity is lower in all industries since downturn except in non-financial services

Industry contributions to cumulative multi-factor productivity growth, Quarter 1 (Jan to Mar) 2008 to Quarter 3 (July to Sept) 2019, 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.

6 . Productivity gap

Before the 2008 economic downturn, UK labour productivity growth was trending upwards, meaning that more goods and services were produced per hour worked. Since the downturn, labour productivity growth has flatlined. The productivity gap, sometimes referred to as the productivity puzzle, is the gap between actual labour productivity growth (solid line in Figure 7) and the pre-downturn trend growth (dotted line in Figure 7).

Productivity growth is one of the drivers of improved living standards, as in the long-run, wage growth is expected to track productivity growth. The wage growth in the UK over recent years has been slow by historical standards, which could be partly explained by flatlined productivity growth over the last decade. The productivity gap could be seen to present losses in potential living standards. We have estimated that average market sector wages would be just over £5,000 higher in 2018 for the average worker, had productivity growth followed the pre-downturn trend growth rate.

Figure 7 decomposes the gap between actual productivity growth and the pre-downturn trend growth into the gap' s component parts. We estimate that straight after the downturn, the productivity gap was almost wholly multi-factor productivity (MFP) driven. More recently, investment has been growing slower than it did before the downturn. Slow post-downturn growth in investment combined with growth in hours worked has meant that the capital available for every hour worked (capital deepening) has decreased.

Since around 2012, negative capital deepening has been estimated to contribute to the productivity gap, accounting for around one-third of the gap during the recent periods, whilst positive contributions from labour composition, which were noticeable up to 2017, have declined. This is through growth in labour composition keeping pace with the long-term trend in this period.

As seen in Figure 4, the post-downturn growth in market sector hours worked has been driven by highly educated workers.

Figure 7: Insufficient growth in MFP and capital deepening have contributed to the productivity gap

Growth in output per hour from 1994 and contributions to the productivity gap from 2008, UK, market sector

Data download

Notes:

1. Contributions to the productivity gap are estimated using pre-downturn growth rates of labour productivity, MFP, QALI and VICS.

2. Signs have been reversed. So a fall in MFP, for example, represents the difference between the pre- and post-downturn trend in MFP.

3. Negative capital deepening is also known as capital shallowing. It represents workers having less access to capital per hour worked.

7 . Multi-factor productivity data

Multi-factor productivity (experimental): estimates: MFP01
Dataset | Released 8 January 2020
Indices and log changes for gross value added, multi-factor productivity, implied factor prices, hours worked, labour composition, capital services and gross value added per hour worked.

Capital services estimates (experimental): VICS01
Dataset | Released 8 January 2020
Industry and asset data for volume index of capital services, user cost, gross fixed capital formation, productive capital stock, implied deflator for gross fixed capital formation and market sector rate of return.

Quality adjusted labour input: (experimental): descriptive statistics: QALI00
Dataset | Released 8 January 2020
Annual data on relative hourly remuneration and shares of hours worked by industry, age, sex and education for market sector and whole economy.

Quality adjusted labour input (experimental), summary data: QALI01
Dataset | Released 8 January 2020
Quarterly and annual data on quality-adjusted labour input log changes by industry, age, sex and education.

Quality adjusted labour input (experimental), underlying data: QALI02
Dataset | Released 8 January 2020
Underlying quarterly quality-adjusted labour input data on hours worked, jobs and income weights.

8 . Glossary

Capital deepening and capital shallowing

Capital deepening measures the amount of capital services available per hour worked. If the amount of capital services per hour worked is increasing it is referred to as capital deepening and when the amount of capital services per hour worked is reducing it is referred to as capital shallowing.

Capital services

Measures the flows of services that different types of assets provide to the production process. The capital services measure used in multi-factor productivity is Volume index of capital services (VICS).

Gross value added

Gross value added (GVA) is an estimate of the volume of goods and services produced by an industry, and in aggregate for the UK.

Labour composition

Labour composition measures the characteristics of the labour used in the production process. The labour measure used in multi-factor productivity is quality-adjusted labour input (QALI), which splits the hours worked data using four categories: industry, age, sex and education.

Market sector

Market sector is that part of the economy where economically meaningful prices for goods and services can be measured. Market sector excludes general government and non-profit institutions serving households.

User cost

User cost, sometimes referred to as the rental price, reflects the cost of using a capital asset for the period in question. User costs are used in the Volume index of capital services to weight the contributions by different types of assets in the production process.

9 . Measuring the data

Multi-factor productivity (MFP) estimates are compiled using the growth accounting framework, which decomposes changes in economic output, in this case gross value added (GVA) of the UK market sector, into contributions from changes in measured inputs: labour, capital and a residual element known as MFP. For more information, see our simple guide to MFP.

The labour measure used for MFP is quality-adjusted labour input (QALI), and the capital measure used for MFP is volume index of capital services (VICS). The weights (and 1-) reflect the factor shares of labour and capital.

$$\Delta \ln MFP = \Delta \ln GVA - \alpha \Delta \ln VICS - (1-\alpha)\Delta \ln QALI$$

In the growth accounting framework, the contribution of labour (QALI) 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. The QALI index is calculated by multiplying log changes in hours worked by income weights. The income weights reflect the shares of different types of labour of the total wage bill. As more educated workers earn more on average, they will get a higher weight in the QALI index, and therefore on average an increase in the hours worked by highly educated workers would translate into an increase in labour composition or “labour quality”.

Movements in capital inputs (VICS) are captured through capital services, which measures the flow of services that different types of assets provide to the production process. Conceptually, this is analogous to the treatment of labour input insofar as use cost 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 quantifiable distinction between the volume and quality of capital.

$$User\ cost = Net\ capital\ stock * (Depreciation + Rate\ of\ return - Holding\ gains) * Tax\ adjustments$$

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 differ slightly from those in our Labour productivity release.

Estimates of capital services have been compiled using 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.

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. For more information, see our simple guide to MFP.

10 . Strengths and limitations

We are working on strengthening experimental quarterly multi-factor productivity (MFP) estimates for the UK market sector to obtain National Statistics badging. We invite users’ feedback on our MFP release to productivity@ons.gov.uk.

11 . Related links

Productivity economic commentary: July to September 2019
Article | Released 8 January 2020
Draws together the main findings from official statistics and analysis of UK productivity to present a summary of recent developments.

Public service productivity: quarterly, UK, July to September 2019
Article | Released 8 January 2020
The latest experimental estimates for quarterly UK total public service productivity, inputs and output.

Unit labour costs, UK: July to September 2019
Statistical bulletin | Released 8 January 2020
Unit labour costs and sectional unit labour costs estimates for the whole economy and a range of industries.

Labour productivity, UK: July to September 2019
Statistical bulletin | Released 8 January 2020
Output per hour, output per job and output per worker for the whole economy and a range of industries.

Industry by region estimates of labour productivity: 2017
Article | Released 6 February 2019
Annual productivity estimates for 16 industries in Standard Industrial Classification 2007 section groups for each of the NUTS1 regions from 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.

Regional and sub-regional productivity in the UK
Article | Released 6 February 2019
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.

Improving estimates of labour productivity and international comparisons
Article | Released 9 January 2019
Discusses recent Organisation for Economic Co-operation and Development 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 international comparisons of productivity.

A simple guide to multi-factor productivity
Article | Released 5 October 2018
Explains the concept and measurement of multi-factor productivity through simple stylised examples.

Analysis of compositional changes in hours worked in the UK
Article | Released 7 August 2019
Analysis of the changes in the UK labour composition during and after the economic downturn, and international comparison over the last five years.

How productive is your business?
Article | Released 6 July 2018
An interactive tool that helps businesses to calculate their productivity and compare their performance with other businesses in Great Britain.