Office for National Statistics

Statistical bulletin

Annual multi-factor productivity, market sector, UK: October to December 2024

Annual estimates of multi-factor productivity up to 2024 and quarterly estimates up to Quarter 4 (Oct to Dec) 2024. These are official statistics in development.

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Notice

23 May 2025

From 23 May 2025, this bulletin replaces our Multi-factor productivity estimates, UK article series last published on 8 January 2020. 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 2024 is estimated to have decreased by 0.6% compared with a year ago and by 0.7% compared with 2019; this contrasts with trend growth in MFP of around 1.8% per year in the decade before the 2008 economic downturn.
- Capital services per hour worked (capital deepening) after 2008 remains weak by historical standards, reflecting subdued growth in investment and sustained growth in both hours worked and labour composition.
- The largest positive contributor to growth in market sector hours worked has been workers with degrees, as opposed to workers with lower qualifications; in 2024 workers with degrees or higher qualifications accounted for 39% of total hours worked in the market sector, compared with 21% in 2008 and 12% in 1994.
- The coronavirus (COVID-19) pandemic had a significant negative impact upon non-financial services' contribution to total market sector MFP.

2 . Introduction to multi-factor productivity

Multi-factor productivity (MFP) is a measure of economic efficiency that captures how effectively labour and capital inputs are combined to create output. Derived from the Cobb-Douglas production function, as shown in the following equation, it accounts for changes in output in a given period that cannot be explained by changes in inputs of compositionally adjusted labour and capital:

Cobb-Douglas Production Function:
$Y = AL^{\alpha}K^{1-\alpha}$

Take logs to bring powers down:
$ln(Y) = ln(A) + \alpha ln(L) + (1-\alpha)\, ln(k)$

Rearrange to make A the subject:
$ln\,(A) = ln(Y) - \alpha ln(L) - (1-\alpha)\, ln(k)$

Differentiate to obtain rate of change:
$\partial A = \partial Y - a\partial L - (1-a)\partial K$

Substitute in ONS variables:

$$\partial MFP = \partial GVA - a\partial CALI - (1-a)\partial VICS$$

(Where: Y is Output; A is Productivity; L is Labour; K is Capital; is Labour share of income; MFP is Multi-factor productivity; GVA is Gross value added; CALI is Compositionally adjusted labour input; VICS is Volume index of capital services.)

If output is held steady (for simplicity’s sake), it follows that increases in MFP mean lesser amounts of labour and capital are required to achieve the same level of output and thus productive efficiency, the rate at which inputs are turned into outputs, has increased.

3 . 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 (such as buildings, machines, software and so on)
- labour composition (which measures the quality of labour by considering the different characteristics of workers such as education and age)
- labour input, in terms of hours worked

The difference, or residual, between changes in output and changes in its capital and labour inputs from period to period is multi-factor productivity (MFP), also known as the Solow Residual. This residual reflects how effectively these inputs are organised and used to generate output.

Table 1 shows changes in main variables compared with 2023 (year-on-year) and 2019. Labour inputs have driven output in 2024 compared with both 2023 and 2019, while multi-factor productivity growth remains weak compared with both years.

Table 1: Headline statistics, UK market sector, 2024

	Year-on-year change, %	Year-on-2019 change, %
Gross Value Added (GVA)	1.3%	3.4%
Hours worked	1.8%	-0.5%
Multi-factor productivity (MFP)	-0.6%	-0.7%
Labour productivity (output per hour worked)	-0.5%	4.0%
Labour composition	0.7%	4.6%
Capital deepening	-0.9%	4.8%
Compositionally adjusted labour input (CALI)	2.5%	4.1%
Volume index of capital services (VICS)	0.9%	4.4%

Source: Multi-factor productivity estimates from the Office for National Statistics

After a strong recovery following the coronavirus (COVID-19) pandemic, market sector gross value added (GVA) year-on-year growth plateaued in 2023 (0.1%), before increasing by 1.3% in 2024. This market sector growth in output, which may differ to whole economy estimates used in other publications, was mainly driven by labour input. MFP, whose contribution to output growth has been steadily diminishing since 2020, made a negative contribution to output growth in both 2023 and 2024, as shown in Figure 1.

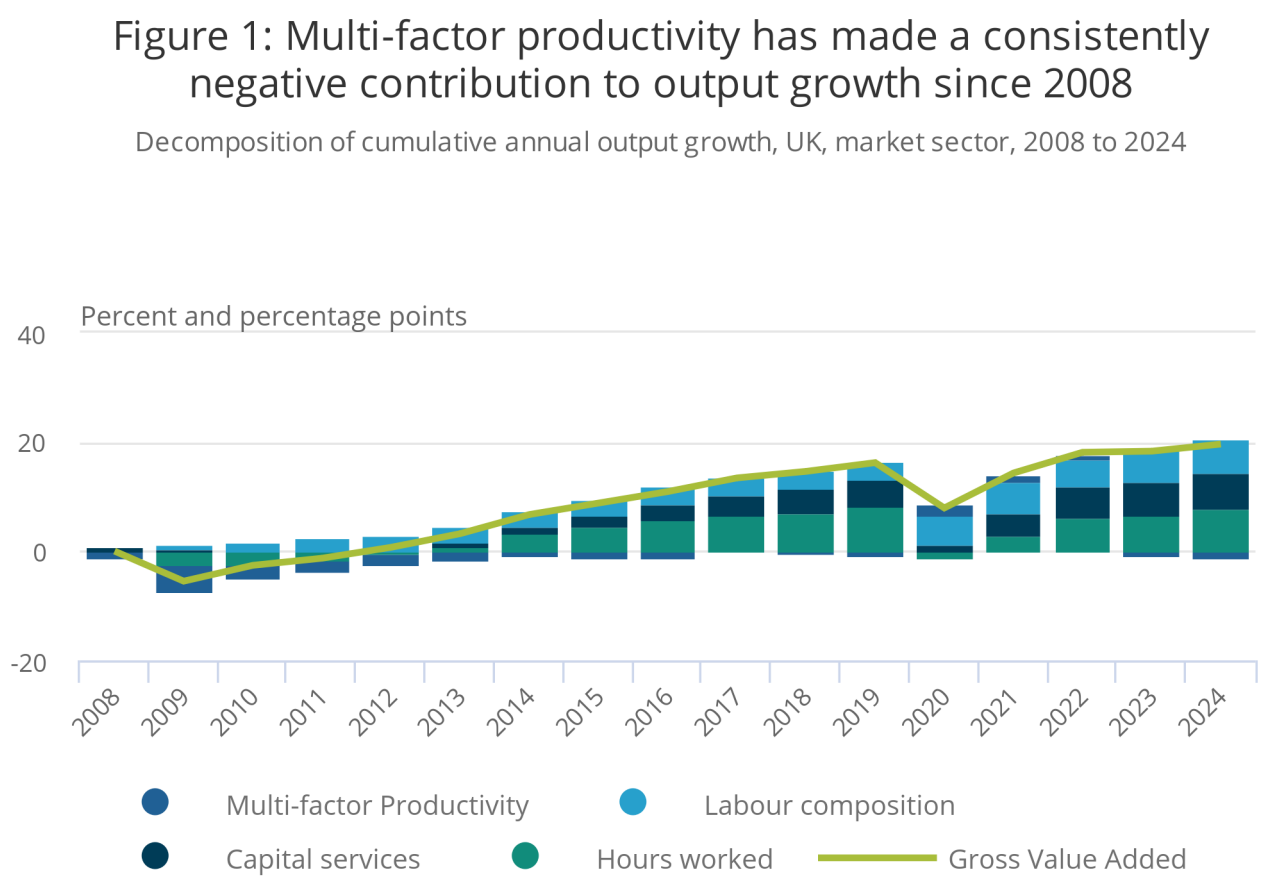
The productivity puzzle, a global phenomenon experienced following the 2008 financial downturn, which saw productivity levels drop across the world, has affected the UK to a greater extent than other advanced economies. UK market sector output growth was sluggish after 2008, with average annual growth for the period 2009 to 2024 (1.3%) only a third of that seen in the decade preceding the downturn, 1998 to 2007 (3.2%).

The compositionally adjusted labour input (CALI) accounts for both the quantity of labour (hours worked) and the quality of labour (composition adjustments for skill level, experience, and education). Labour composition growth has continued its trend of a sustained, mild increase since 2008. It contributed 0.4 percentage points to labour productivity growth in 2024, marginally higher than its average annual contribution from 2008 to 2024 (0.38 percentage points).

Capital input (as measured by capital services) also increased in 2024, however, average growth since 2008 remains well below historical, pre-2008 downturn levels. Further information is available in the datasets published alongside this release.

Figure 1: Multi-factor productivity has made a consistently negative contribution to output growth since 2008

Decomposition of cumulative annual output growth, UK, market sector, 2008 to 2024



Source: Multi-factor productivity estimates from the Office for National Statistics

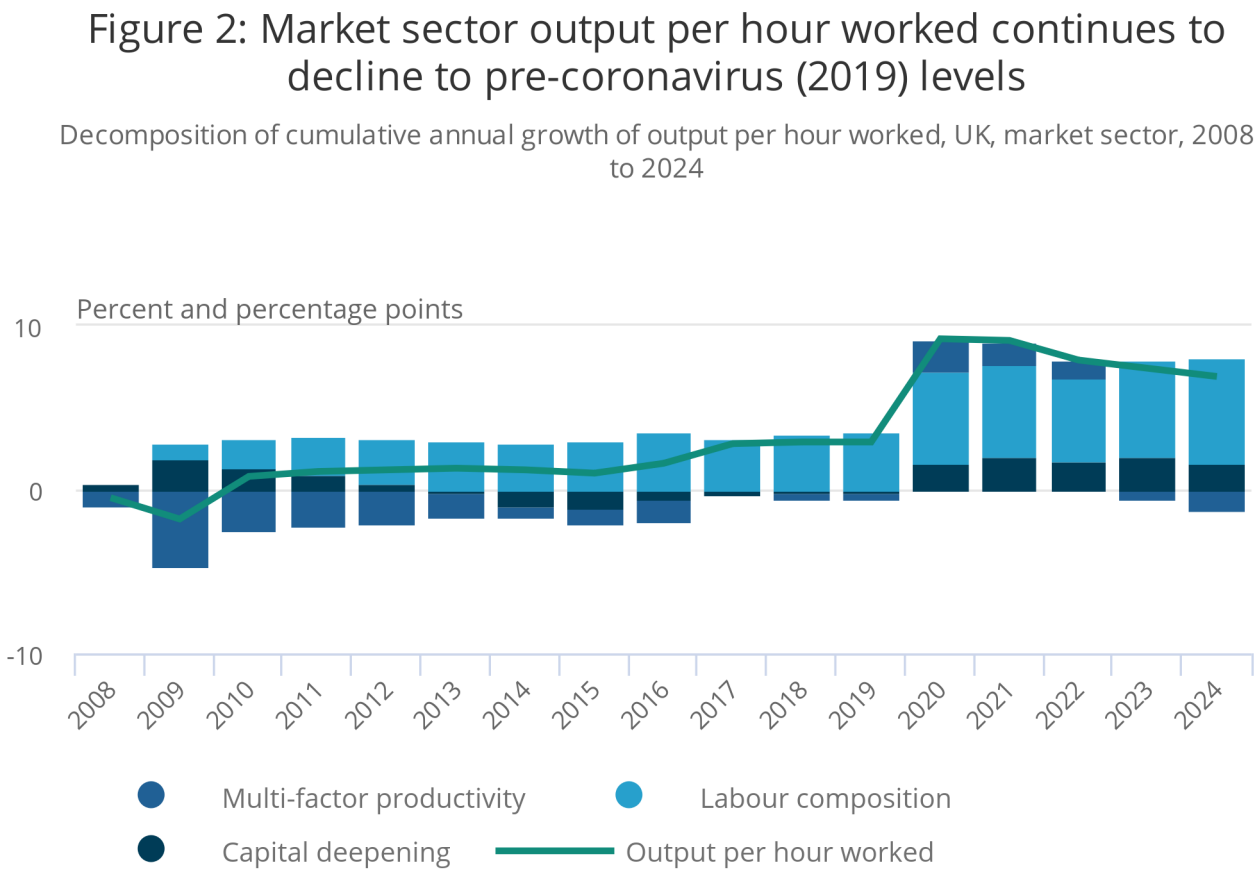
Notes:

1. Output growth is the cumulative year-on-year 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 rearranged 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 worked continues to decline to pre-coronavirus (2019) levels

Decomposition of cumulative annual growth of output per hour worked, UK, market sector, 2008 to 2024



Source: Multi-factor productivity estimates from the 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. During the coronavirus (COVID-19) pandemic, the furlough scheme caused a positive spike in output per hour in 2020 and 2021 as hours worked (the denominator in output per hour calculations) fell substantially more than output (the numerator). Labour productivity has since decreased for the third consecutive year in 2024. MFP followed a similar trajectory, falling by 0.6% in 2024 and by 1.7% in 2023.

Since the downturn, firms in the UK have expanded their production capacity mainly by increasing the labour input while investment in capital has been weak.

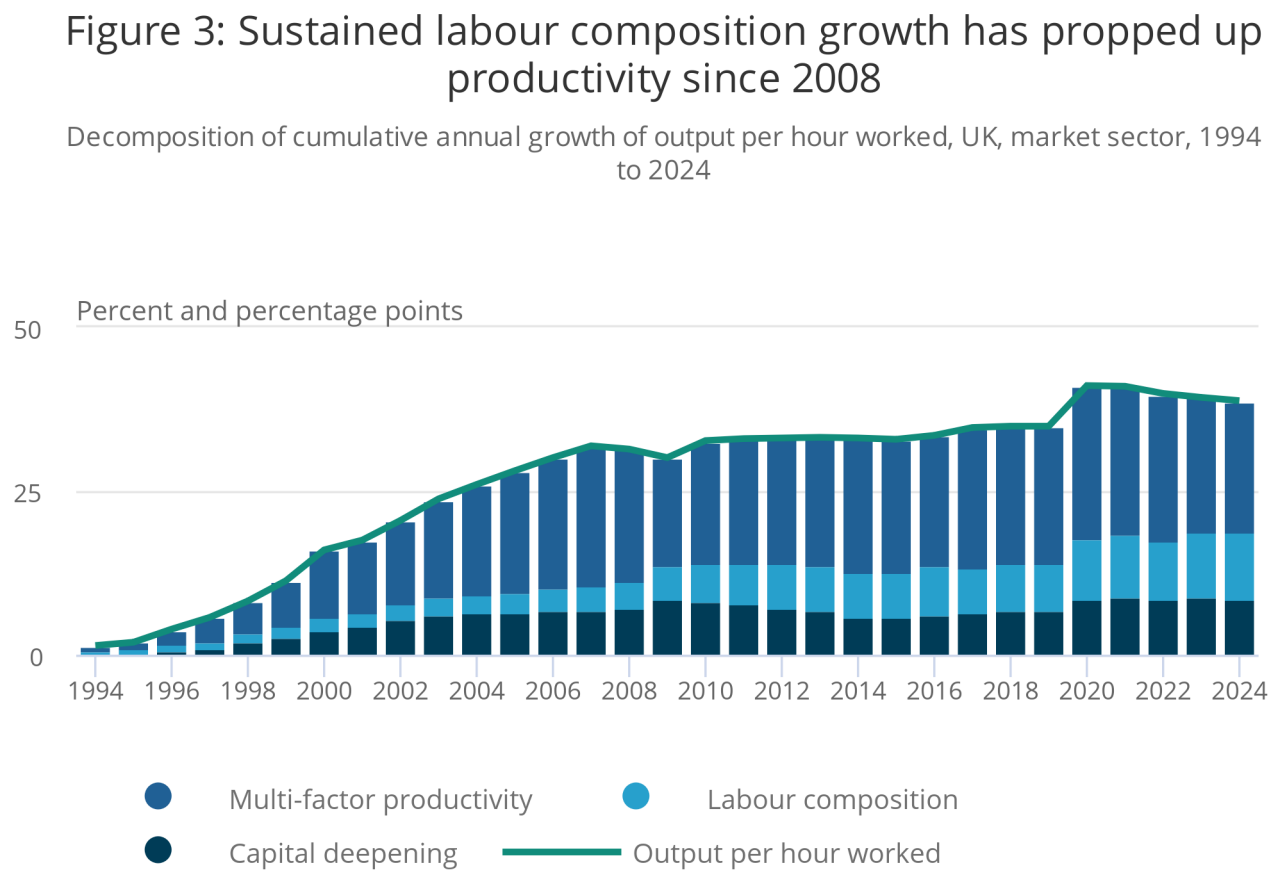
Capital deepening refers to increases in the intensity of capital per worker – consider a construction worker digging foundations using a spade being given a mechanical digger. Here defined as capital services per hour worked, capital deepening has been weak by historical standards, and since 2010, the UK market sector has experienced "capital shallowing", a reduction in capital intensity normally caused by insufficient investment in, or renewal of, capital assets (for example, our construction worker's digger breaking down and not being replaced), wherein the growth of capital services has been slower than the growth in hours worked.

While the average annual growth rate of capital services across the pre-downturn period 1998 to 2007 was 1.6%, the annual average for 2008 to 2024 was just 0.3%. Removing outlier years, specifically the downturn and the pandemic in 2009 and 2020, respectively, causes this average to drop to negative 0.2%.

This reduction in capital intensity might be partly explained by the uncertainty in the economy where, after two relatively close-together global economic shocks together with a period of historically high inflation, firms may have been holding back from costly long-term investments such as new machinery and equipment, and instead employing labour, which can be seen as the more flexible input of production.

Figure 3: Sustained labour composition growth has propped up productivity since 2008

Decomposition of cumulative annual growth of output per hour worked, UK, market sector, 1994 to 2024



Source: Multi-factor productivity estimates from the 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 both capital deepening and MFP growth plateaued. While labour composition continued to increase steadily across the period 2009 to 2024, albeit at a modest rate, average annual MFP growth across the same period was negative 0.01%, contrasting sharply with an average of 1.8% per year in the decade before the downturn (1998 to 2007). There are several possible reasons for this weak post-downturn MFP growth, and it is an area that we continue to investigate.

4 . Compositionally adjusted labour input

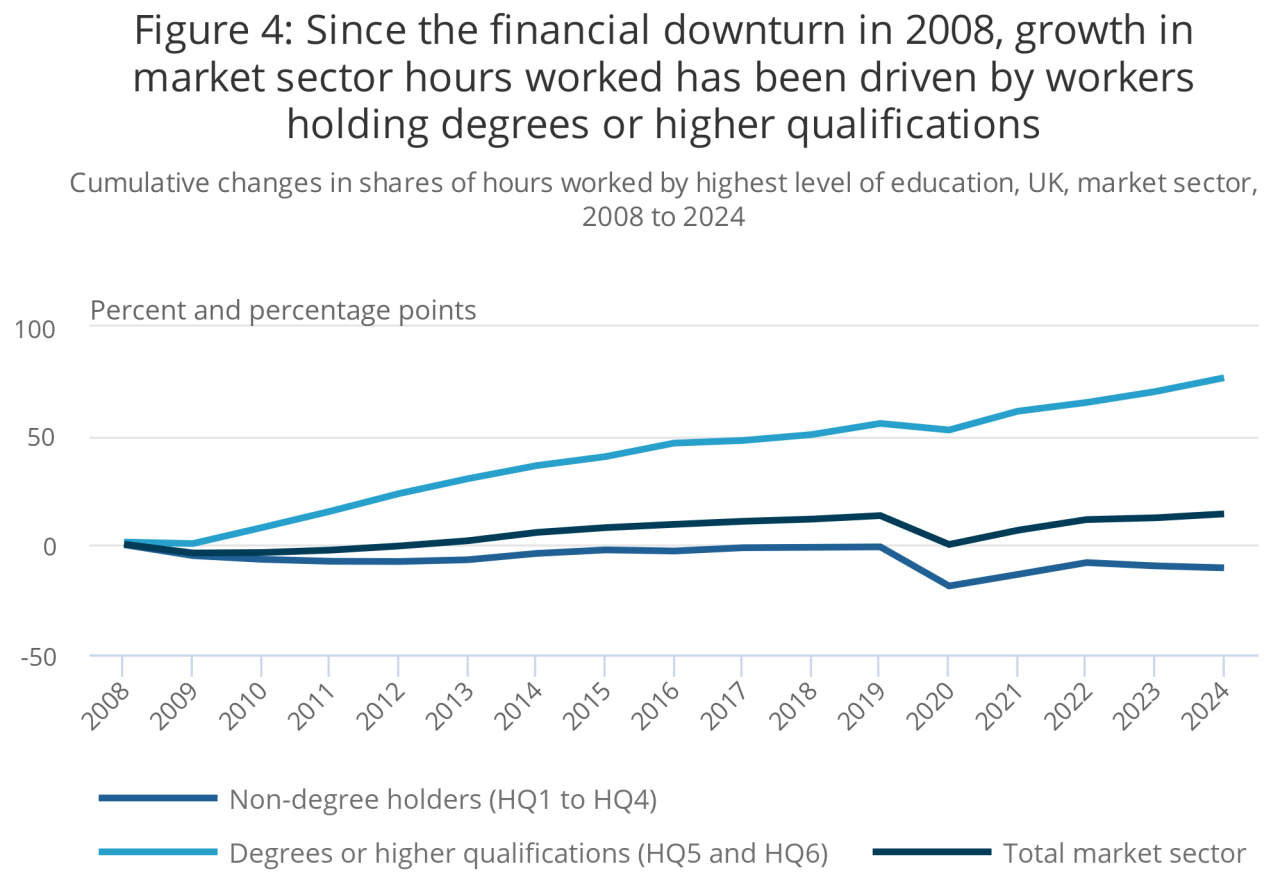
Compositionally adjusted labour input (CALI) (previously referred to as Quality adjusted labour input (QALI)) increased in 2024 by 2.5% and 4.1% when compared with 2023 and 2019, respectively.

The share of hours worked by workers with degrees or postgraduate degrees has increased steadily since the 2008 economic downturn. In 2024, workers with degrees or higher qualifications accounted for 39% 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 increasing across the post-downturn period and therein is estimated to have positively contributed to decreasing 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 article.

Figure 4: Since the financial downturn in 2008, growth in market sector hours worked has been driven by workers holding degrees or higher qualifications

Cumulative changes in shares of hours worked by highest level of education, UK, market sector, 2008 to 2024



Source: Multi-factor productivity estimates from the Office for National Statistics

Notes:

1. 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 or equivalent) and HQ4 (Higher Education). Degree or higher = HQ5 (Undergraduate and other degrees or equivalent) together with HQ6 (Higher degrees level 7 and 8 qualifications or equivalents).

Figure 4 shows cumulative annual changes in hours worked, broken down by degree and higher-degree holders (HQ5 and HQ6) and workers with a highest qualification beneath degree level (HQ1 to HQ4). 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 CALI datasets published alongside this release.

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

5 . 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 additional investment, depreciation and retirement before a further adjustment to take into account changes in their age-efficiency.

Using age-efficiency rather than an age-price measure – think here of a car's performance (that is, its productive capacity) versus its [second-hand] value over time – provides an estimate of the amount of productive capital stock available, which is subsequently weighted by a set of user cost weights. These weights reflect how intensively different types of assets are used in the production process.

Capital services relate to the value users receive from using a capital asset, however, different asset types deliver their capital services over different lifespans and to different intensities. This can be explained by taking two assets of the same value, delivering essentially the same total capital services, but with different asset lives. For example, short-lived assets such as software are viewed as delivering their capital services in bigger blocks over a shorter time period, compared with long-lived assets such as buildings, which deliver a smaller fraction of their capital services each year for a long time period. This differs from the weights these assets have in capital stocks to reflect that short-lived assets are used more intensively in the production process, and hence are "used up" faster.

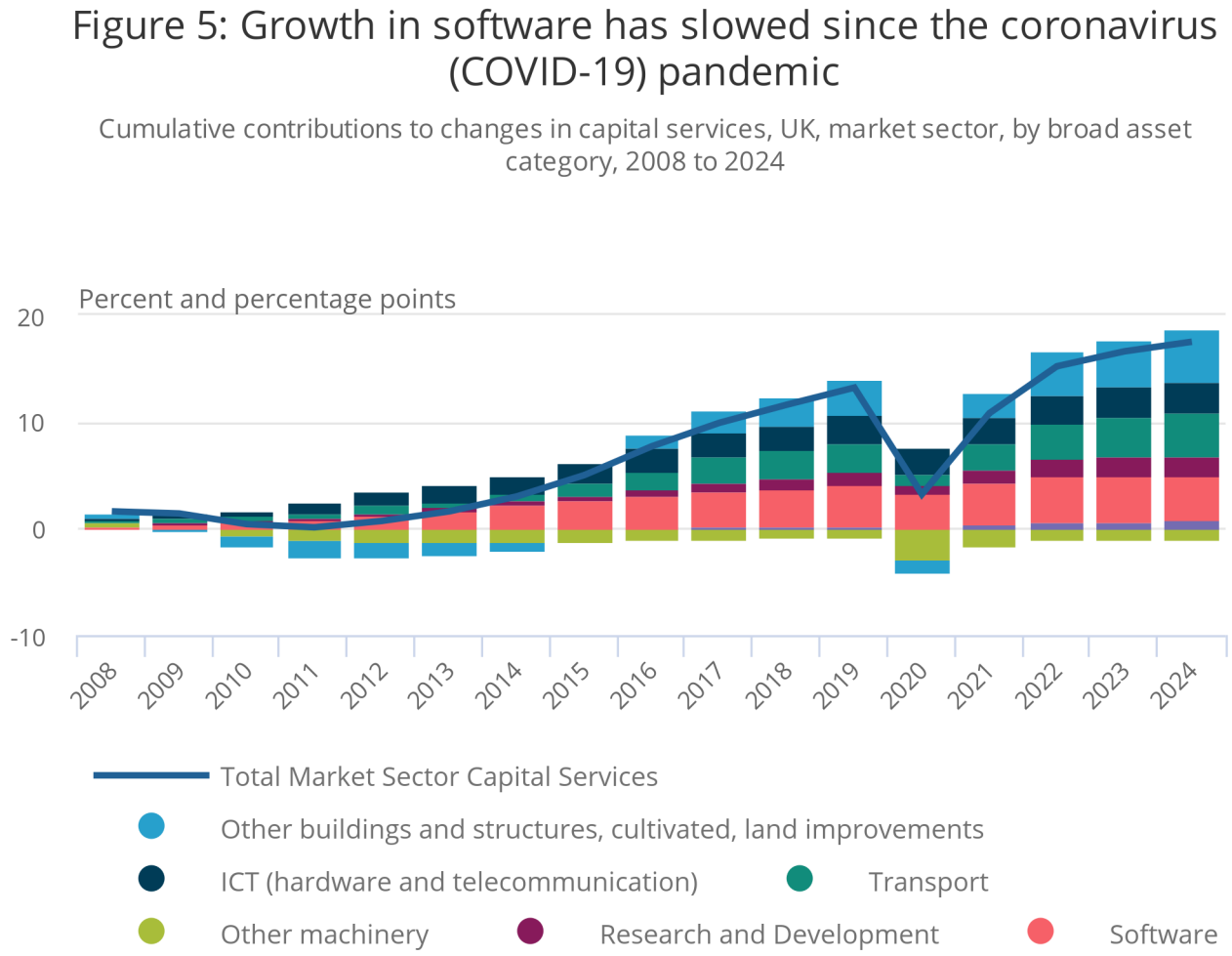
The coverage of capital in the multi-factor productivity (MFP) system is similar to that of business investment. Annual business investment growth increased by 2.0% in 2024. In contrast, capital services are estimated to have increased by only 0.9%.

While it is not unusual for business investment growth to exceed that of capital services, growth in capital services was weak by historical standards, with an average annual growth of 2.1% between 1998 and 2007.

Capital services growth can be decomposed by asset type. Figure 5 shows cumulative annual contributions to total market sector capital services growth by broader asset groups. Software was an important driver in capital services growth before the coronavirus (COVID-19) pandemic, however, in recent years its growth has slowed. Both transport and "buildings other than dwellings, other structures, cultivated biological resources, and land improvements", offered greater cumulative contributions across the period 2021 to 2024.

Figure 5: Growth in software has slowed since the coronavirus (COVID-19) pandemic

Cumulative contributions to changes in capital services, UK, market sector, by broad asset category, 2008 to 2024



Source: Multi-factor productivity estimates from the Office for National Statistics

6 . Contributions to growth in multi-factor productivity

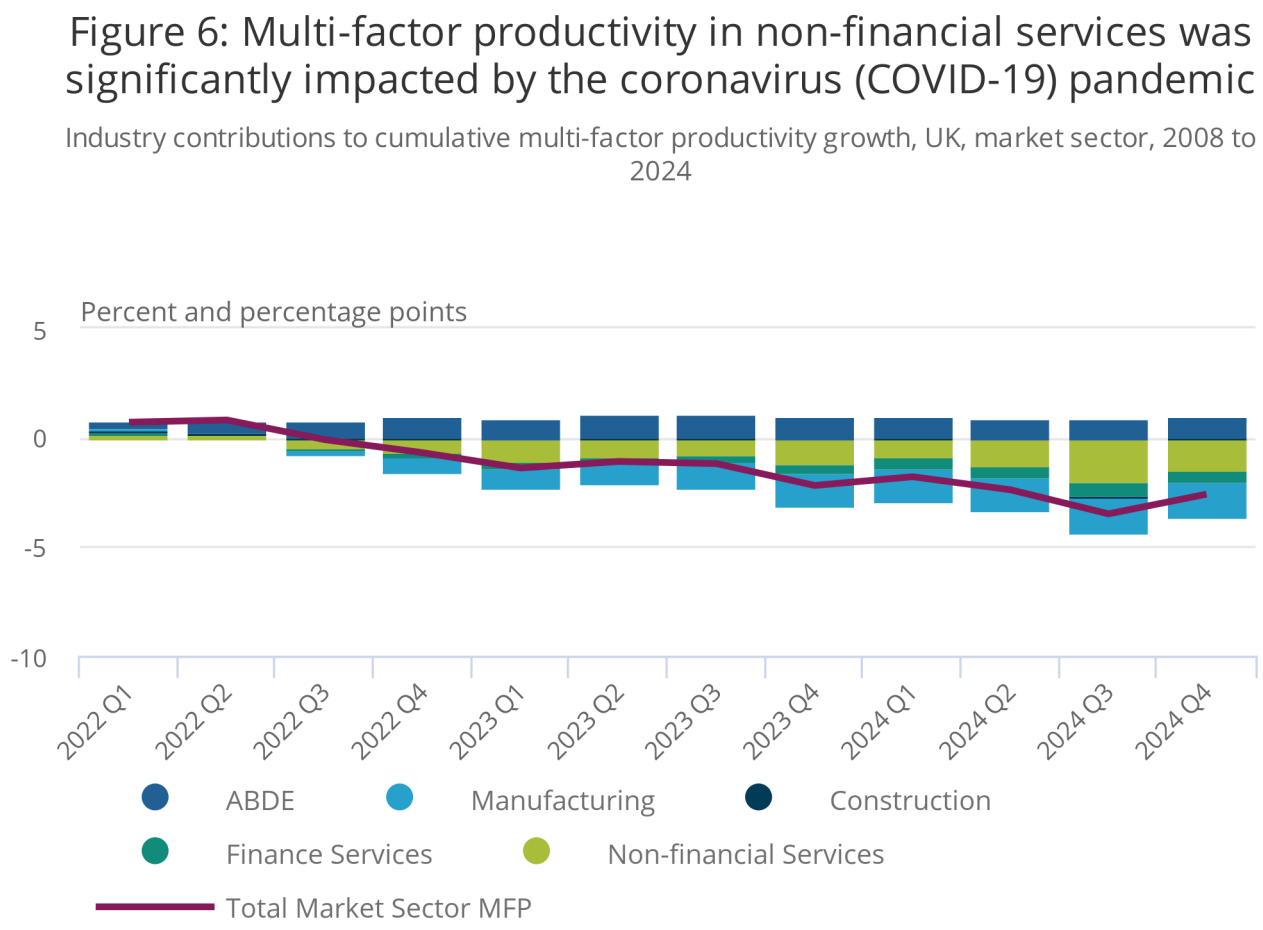
Contributions to multi-factor productivity (MFP) growth reflect the ability of industries to harness new technologies or use their inputs in a more efficient way in the production process. Figure 6 shows cumulative annual contributions to growth in MFP across five broad industry groups.

Non-financial services was the only industry group that had made a positive cumulative contribution to post-downturn growth in MFP; however, the coronavirus (COVID-19) pandemic has greatly affected this group. Food and accommodation made the largest negative contribution to this group since 2020.

There is a notable variation in MFP growth within the five industrial groups and their constituent industries. For example, within the non-financial services group, while food and accommodation has contributed negatively since the pandemic, professional, scientific and technical activities has made a consistent positive contribution, as has administrative and support service activities. Likewise, there are also instances of industries contributing negatively at the sector level but with several or more of their subsectors making positive contributions.

Figure 6: Multi-factor productivity in non-financial services was significantly impacted by the coronavirus (COVID-19) pandemic

Industry contributions to cumulative multi-factor productivity growth, UK, market sector, 2008 to 2024



Source: Multi-factor productivity estimates from the 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. Non-financial services is comprised of the remaining industries not included in the other four groups.

7 . Data on multi-factor productivity

Multi-factor productivity, annual, UK
Dataset | Released 23 May 2025
Annual multi-factor productivity data for the UK market sector and component industries. These are official statistics in development.

Multi-factor productivity, quarterly, UK
Dataset | Released 23 May 2025
Quarterly multi-factor productivity data for the UK market sector and component industries. These are official statistics in development.

Volume Index Capital Services (VICS), annual, UK
Dataset | Released 23 May 2025
Annual Volume Index of Capital Services estimates for the UK market sector. These are official statistics in development.

Volume Index Capital Services (VICS), quarterly, UK
Dataset | Released 23 May 2025
Quarterly Volume Index of Capital Services estimates for the UK market sector. These are official statistics in development.

Compositionally adjusted labour input (CALI), market sector, annual, UK
Dataset | Released 23 May 2025
Compositionally adjusted labour input (CALI) aggregates and underlying data for the market sector by industry, education, age and sex categories. These are official statistics in development.

Compositionally adjusted labour input (CALI), market sector, quarterly, UK
Dataset | Released 23 May 2025
Compositionally adjusted labour input (CALI) aggregates and underlying data for the market sector by industry, education, age and sex categories. These are official statistics in development.

Compositionally adjusted labour input (CALI), whole economy, annual, UK
Dataset | Released 23 May 2025
Compositionally adjusted labour input (CALI) aggregates and underlying data for the whole economy by industry, education, age and sex categories. These are official statistics in development.

Compositionally adjusted labour input (CALI), whole economy, quarterly, UK
Dataset | Released 23 May 2025
Compositionally adjusted labour input (CALI) aggregates and underlying data for the whole economy by industry, education, age and sex categories. These are official statistics in development.

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, adjusted for intermediate consumption.

Labour composition

Labour composition measures the characteristics of the labour used in the production process. The labour measure used in multi-factor productivity is compositionally adjusted labour input (CALI), 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 . Data sources and quality

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 compositionally adjusted labour input (CALI), 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.

In the growth accounting framework, the contribution of labour (CALI) 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 CALI 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 CALI 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 comparable with the treatment of labour input to the extent that user 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. Please refer to our Volume index of capital services (VICS) Quality and Methodology Information for a more detailed analysis of VICS.

To account for the impact of the coronavirus (COVID-19) pandemic, capital utilisation factors are used for the period of Quarter 1 (Jan to Mar) 2020 to Quarter 3 (July to Sept) 2021.

Percentage changes in Figures 1, 2, 3, 5 and 6 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 multi-factor productivity.

This release contains data that are consistent with the UK National Accounts, The Blue Book: 2024. Data for all periods in this release are subject to revision in line with the National Accounts Revisions Policy and our Revisions policies for labour market statistics.

More quality and methodology information on strengths, limitations, appropriate uses, and how the data were created is available in our Multi-factor productivity (MFP) Quality and Methodology Information.

Official statistics in development

These statistics are labelled as "official statistics in development". Until September 2023, these were called "experimental statistics". Read more about the change in the Guide to official statistics in development.

We are developing how we collect and produce the data to improve the quality of these statistics. Once the developments are complete, we will review the statistics with the Statistics Head of Profession. We will decide whether the statistics are of sufficient quality and value to be published as official statistics, or whether further development is needed. Production may be stopped if they are not of sufficient quality or value. Users will be informed of the outcome and any changes.

We value your feedback on these statistics. Contact us at productivity@ons.gov.uk.

10 . Related links

Public service productivity, quarterly, UK: October to December 2024
Statistical bulletin | Released 8 May 2025
The latest experimental estimates for quarterly UK total public service productivity, inputs and output.

Labour costs and labour income, UK
Dataset | Released 15 May 2025
Labour share of income, unit labour costs (ULCs), unit wage costs (UWCs) and average labour compensation per hour worked (ALCH) for the whole economy and a range of industries.

Productivity flash estimate and overview, UK: January to March 2025 and October to December 2024
Statistical bulletin | Released 15 May 2025
Output per hour, output per job and output per worker for the whole economy and a range of industries.

Regional and subregional labour productivity, UK: 2022
Bulletin | Released 17 June 2024
Regional and subregional output per hour and output per job performance levels.

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.

How productive is your business?
Article | Released 7 March 2022
An interactive tool that helps businesses to calculate their productivity and compare their performance with other businesses in Great Britain.

11 . Cite this statistical bulletin

Office for National Statistics (ONS), released 23 May 2025, ONS website, statistical bulletin, Annual multi-factor productivity, market sector, UK: October to December 2024