Multi-factor productivity (MFP) QMI

Quality and methodology information for multi-factor productivity estimates, detailing strengths and limitations of the data, and data uses and users.

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Release date:
27 May 2025

Next release:
To be announced

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1 . Output information

- Statistical designation: official statistics in development
- Frequency: annual
- How compiled: modelled using data from the national accounts, and survey data from the Labour Force Survey (LFS) and Annual Survey of Hours and earnings (ASHE)
- Geographic coverage: UK
- Related publications: Multi-factor productivity estimates, UK article

2 . About this Quality and Methodology and Information report

This Quality and Methodology Information (QMI) report contains information on the quality characteristics of the data (including the European Statistical System's 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

- Multi-factor productivity (MFP) estimates are constructed using inputs from the Volume Index of Capital Services (VICS) compositionally adjusted labour input (CALI), and output data from the quarterly national accounts.
- MFP covers only the UK market sector, excluding imputed rental, which means that general government and non-profit institutions serving households are excluded from these estimates.
- MFP estimates are presented in an index form, so it is not possible to make assumptions about the underlying level of the measure.

4 . Quality summary

Overview

Multi-factor productivity (MFP), which is also known as the Solow Residual, accounts for changes to the various inputs that go into creating the level of economic output for any given period.

These inputs include labour and capital, and MFP is the term given to changes in economic output that are not explained by these factors. There could be several reasons for the change in this element of productivity, making it difficult to explain. The process of measuring MFP growth is known as growth accounting, as output growth is segmented into various growth elements. For more information on the concepts measured by MFP and how it is calculated please see our Simple guide to multi-factor productivity.

To estimate MFP growth over time, we must account for changes to both the quantity and quality of labour input in the economy. The former is measured by the number of hours people work in the period, which is the same measure used for our Labour productivity estimates. More information is available in our Labour productivity quality and methodology information (QMI). The latter is calculated by accounting for changes to the quality and composition of that labour over time, estimated in compositionally adjusted labour input (CALI) figures.

Capital inputs are estimated by calculating the volume of capital services that are employed by the economy in a given period, from the existing capital stock. These estimates form the Volume Index of Capital Services (VICS) figures, which are published in our annual VICS dataset.

Annual MFP growth estimates cover 19 industries of the UK market sector. We also publish market sector volume and growth estimates for:

- hours worked labour
- composition capital
- services combined
- inputs annual labour
- weights implied factor
- prices

There is a separate quality and methodology information (QMI) report available in:

- our Labour productivity QMI
- our CALI QMI
- our VICS QMI

Uses and users of multi-factor productivity

Users interested in MFP growth estimates are predominantly external experts and academics. MFP estimates are used by other government departments and agencies, including the Bank of England, to assess the economic conditions in the UK. MFP can inform estimates of the productive capacity of the UK economy and highlight areas policymakers may want to focus on to improve economic growth.

5 . Quality characteristics of multi-factor productivity data

Relevance

Relevance measures the degree to which the statistical outputs meet users' needs.

Multi-factor productivity (MFP) data are required by analysts working in academia and in different government departments to fully analyse changes to the UK economy.

For any given change in output, MFP measures the amount that cannot be accounted for by growth in inputs of quality-adjusted labour and capital. These changes provide insights for policymakers into the contributors to productivity, and can also show areas that require a greater focus. The estimates can also be used to inform policymakers of changes in the capacity of the UK economy, which can be helpful for setting specific policy, such as interest rates.

Previously our MFP publication timetable was in line with our Gross domestic product (GDP) quarterly national accounts bulletin, which ensured users had access to the most timely data. The MFP dataset contains estimates for compositionally adjusted labour input (CALI) and the Volume Index of Capital Services (VICS), which gives a more comprehensive breakdown of productivity growth. Since the coronavirus (COVID-19) pandemic, the Office for National Statistics (ONS) has published MFP annually, as currently this ensures reliable and accurate MFP estimates. As MFP is a long-term measure of the trend in growth we do not feel the relevance has been compromised by moving from a quarterly to an annual publication schedule. However, we welcome stakeholder feedback.

We review user feedback frequently and take any suggestions into account when reviewing our development goals for MFP statistics to ensure their coverage meets user needs. We also work with the Economic Statistics Centre of Excellence (ESCoE) and other academics to improve our MFP estimates.

Accuracy and reliability

Accuracy is the degree of closeness between an estimate and the true value. Reliability is the closeness of the initial element value to the subsequent estimated measure.

Annual MFP estimates are more reliable and accurate than quarterly MFP estimates, as small Labour Force Survey (LFS) response rates for some CALI categories increase estimate volatility. Annual MFP estimates take a four-quarter average, which increases the accuracy and reliability of our estimates. Benchmarking LFS pay data to the Annual Survey of Hours and Earnings (ASHE) in CALI has increased the overall accuracy and reliability of our MFP estimates.

MFP is derived from other data sources, and its accuracy is dependent on the accuracy of those data. Improvements in those source data will lead directly to improvements in MFP estimates. However, some elements of productivity can also be difficult to measure. For example, it is difficult to estimate the level of capital currently employed in an economy. Business investment will provide a flow and certain assumptions are necessary to convert these flows over time into:

- a level of capital
- a flow of services from that capital

These assumptions include how long assets will last, whether they are fully employed during that period, and how productive they are during that period.

There are some forms of capital that are not captured by our current estimates. For example, MFP calculations do not include estimates of the extent to which productivity is influenced by natural capital, social capital or those intangible assets that fall outside the national accounts asset boundary (see the European System of Accounts 2010 for more details). Human capital is implicitly addressed through CALI.

Despite these drawbacks, our process for calculating productivity does draw on a range of sources to inform our estimates. We also have various procedures in place to ensure that errors are minimised. The data are checked at various stages of processing and the outputs are peer reviewed before being published. If errors are found in the data after publication, a notice will be attached to the publication to inform users, and datasets will be revised in line with the Code of Practice for Statistics.

MFP also takes on revisions to other outputs, which increases the quality of the data over time.

Output quality trade-offs

Trade-offs are the extent to which different dimensions of quality are balanced against each other.

The main trade-off with MFP is balancing timeliness and accuracy. MFP can be produced quarterly, as all the inputs are also produced quarterly. This can result in the aggregation of some MFP dimensions or the suppression of some estimates because of quality concerns. However, the annual MFP data provide a reliable estimate. As MFP is a long-term decomposition of the performance of the economy, it is better to provide accurate, comprehensive estimates that are less timely. The annual MFP estimates are dependent on LFS response rates, as these control the quality of CALI. Recent economic shocks have resulted in lower LFS response rates, which limit the accuracy and reliability of MFP estimates. Improvements to the LFS are ongoing and more information is available in our Labour Force Survey quality update article, published in May 2025.

Coherence and comparability

Coherence is the degree to which data derived from different sources or methods, but referring to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain.

MFP is a measure of productivity growth and there are several productivity measures published by the ONS. The most relevant publication to MFP is our Productivity flash estimate and overview, UK article. However, our headline productivity measures are for the whole economy, including output from imputed rental. MFP is calculated for the market sector only and we remove imputed rental from the MFP's measure of output. These differences reduce the coherence between MFP and Labour productivity. More information is available in our Labour productivity QMI. International comparisons of MFP are difficult because of countries using different data sources and methods to calculate MFP estimates.

Labour productivity forms the basis for our productivity measures. MFP uses the same data for its labour market inputs as the market sector labour productivity estimates. This means that the two measures are coherent. To improve coherence, we benchmark CALI to ASHE. This reduces bias from reliance on a household survey by incorporating pay data from a structural survey of businesses. This process is explained further in our CALI QMI and in our ASHE QMI.

MFP can be compared with labour productivity to provide a clearer understanding of productivity movements in the UK. However, caution should be taken when comparing datasets, as headline labour productivity measures are for the whole economy, not the market sector.

MFP also uses data for capital services from its VICS series. "Capital services" is a distinct measure from "capital stocks". More information is available in our Capital stocks and fixed capital consumption QMI. The main difference between these two estimates is that capital stocks is a stock measure at a point in time that measures the value or "wealth" of capital. Capital services in turn is an estimate of the flow of services that different types of asset provide to the production process.

Both estimates use largely the same data sources, but the processing is different in terms of the choice of age or price profile, and because capital services uses further modelling. More information is available in our VICS QMI.

The data from VICS and CALI used in MFP are seasonally adjusted, so different seasonal patterns in the data have been removed. This means that our estimates of labour and capital are comparable.

Concepts and definitions

Concepts and definitions describe the legislation governing these statistics, and a description of the classifications used in the data.

All the statistics produced by the ONS are official statistics. Official statistics can either be official statistics in development or accredited official statistics, accredited official statistics are fully compliant with the Code of Practice for Statistics. MFP estimates are official statistics in development, which means that they are still being developed to comply with the Code of Practice for Statistics.

Users are advised to ensure they are fully aware of published limitations, assumptions and planned improvements to methods or data sources that may affect the estimates.

The industry classification used to compile MFP estimates is the Standard Industrial Classification 2007: SIC 2007 . The asset breakdown is consistent with the System of National Accounts 2008 (SNA 2008) and the European System of Accounts 2010 (ESA 2010). Our methodology for measuring MFP draws from the methodology set out by the Organisation for Economic Co-operation and Development (OECD) Statistics and Data Directorate.

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.

MFP statistics are published every November on the ONS website. Datasets have contents and metadata tabs that provide information to help users understanding the statistics. The published MFP article also has a section providing a brief explanation of the statistics, and longer sections covering the latest trends about factors feeding into MFP growth. We also published our Simple guide to multi-factor productivity to further assist users.

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.

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.

MFP statistics are published annually, usually one week after the publication of the second quarter of our Gross domestic product (GDP) quarterly national accounts bulletin and around 14 weeks after the reference quarter.

For more details on related releases, the GOV.UK release calendar is available online and provides 12 months' advance notice of release dates. In the unlikely event of a change to the pre-announced release schedule, public attention will be drawn to the change and the reasons for the change will be explained fully at the same time, as set out in the Code of Practice for Statistics.

6 . Methods used to produce multi-factor productivity data

Multi-factor productivity (MFP) estimates are compiled using the growth accounting framework. This decomposes the growth in economic output (in this case, the gross value added (GVA) of the UK market sector) into contributions from measured inputs. These are:

- labour
- capital
- a residual element known as MFP

More information is available in our Simple guide to multi-factor productivity.

The labour measure used for MFP is compositionally adjusted labour input (CALI), and the capital measure is the Volume Index of Capital Services (VICS). More information is available in our CALI quality and methodology information (QMI) and in our VICS QMI.

The change in the volume of these inputs between two periods is then weighted by their average cost over the periods (or more precisely, by the cost that we can easily observe, which is the change in the cost of labour). This is represented by the weights (and 1-), which reflect the shares of labour and capital that contribute to generating output. This is calculated as:

$$\Delta \ln \mathrm{MFP} = \Delta \ln \mathrm{GVA} - (1-\alpha)\Delta \ln \mathrm{VICS} - \alpha \Delta \ln \mathrm{CALI}$$

In the growth accounting framework, the contribution of labour (CALI) to changes in economic output takes account of changes in labour composition or the 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 in the total wage bill. As more educated workers earn more on average, they will get a higher weight in the CALI index, and so 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 measure the flow of services that different types of assets provide to the production process. Conceptually, this is the same as the treatment of labour input, when 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 observed directly, there is no equivalent to a standard unit of capital service and so there is no quantifiable distinction between the volume and quality of capital.

Hours worked in the UK market sector are aggregated from estimates of each component industry, as set out in our Developing improved estimates of quality-adjusted labour inputs using the Annual Survey of Hours and Earnings progress report, published in July 2017. These differ slightly from those in our Labour productivity bulletin .

Estimates of capital services have been compiled using processes and source data described in our Volume index of UK capital services (experimental): estimates to Quarter 2 (Apr to June) 2017 article, published in February 2018. These changes allow estimation of capital services on a quarterly basis. Previously, quarterly capital services could only be derived by the interpolation of annual series.

Users should be aware that all percentage changes 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.

How do we quality assure and validate the data

We have quality management systems in place to quality assure the data at different stages of processing. The input data used to calculate multi-factor productivity (MFP) data are first quality assured by the internal data provider. More checks are then used throughout data processing to quality assure our estimates further before publication.

How do we disseminate the data

MFP data and analysis produced by the Office for National Statistics (ONS) are published on the ONS website as part of our annual MFP release.

Publication dates are planned in advance and pre-announced on the release calendar around 12 months before the agreed release date.

7 . Other information

Assessment of user needs and perceptions

We invite user feedback on multi-factor productivity (MFP). We can be contacted at our team mailbox: productivity@ons.gov.uk. Any proposals or comments from those who use MFP will be considered in the final proposals for future development work on MFP estimates.

International standards

The Organisation for Economic Co-operation and Development (OECD) Statistics and Data Directorate provides guidance on producing productivity statistics, including MFP, to international standards. Several countries produce estimates for MFP or related statistics, such as total factor productivity (TFP), which accounts for a wider range of capital inputs.

While these estimates measure the same (or similar) concepts, they might differ in terms of the methodology used. For this reason, international comparisons of quality-adjusted labour inputs and capital services are limited because of differences in methodology.

8 . Cite this methodology

Office for National Statistics (ONS), updated 27 May 2025, ONS website, quality and methodology information report, Multi-factor productivity (MFP) QMI