

# Multi-factor productivity 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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# 1 . Output information

<b>National Statistic</b>	No
<b>Frequency</b>	Quarterly
<b>How compiled</b>	Modelled using data for multiple sample-based surveys from both National Accounts and labour markets
<b>Geographic coverage</b>	UK
<b>Related publications</b>	Labour productivity
<b>Last revised</b>	

## 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
- 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), quality-adjusted labour input (QALI) and output data from quarterly national accounts.
- MFP covers only the UK market sector, which means that general government and non-profit institutions serving households are excluded from these estimates.
- MFP estimates are presented in an index form and 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 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 elements of its growth.

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 labour productivity estimates. The latter is calculated by accounting for changes to the quality and composition of that labour over time, estimated in quality-adjusted labour input (QALI) 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.

Quarterly MFP growth estimates cover 10 industries of the UK market sector with annual estimates more disaggregated to 19 industries. 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 are separate QMIs for Labour productivity, QALI and VICS. We are exploring bringing together the QALI, VICS and MFP QMIs in the future.

## Uses and users of multi-factor productivity

Parties interested in MFP growth estimates are predominantly external expert and academic users. MFP estimates are used by other government departments and agencies, including the Bank of England, and academics to assess the economic conditions in the UK. In particular, MFP can inform estimates of the productive capacity of the UK economy and highlight areas where 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. This, along with other changes highlighted through growth accounting, provides insights for policymakers into the drivers of productivity and can highlight areas that require a greater focus. The estimates can also be used to inform policymakers of the changes in the capacity of the UK economy, which can be helpful for setting specific policy, such as interest rates.

The publication timetable is in line with the [Quarterly national accounts](#), which gives users access to timely data. The MFP dataset contains estimates for quality-adjusted labour input (QALI) and Volume Index of Capital Services (VICS), which give a more complete picture of the breakdown of productivity growth and which currently have separate QMI reports.

We review user feedback frequently and take any suggestions into account when reviewing development goals for MFP statistics to make sure their coverage meets user needs. We hold an annual user forum to discuss recent development work and gather feedback. We also work with the [Economic Statistics Centre of Excellence](#) (ESCoE) and other leading 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.

MFP estimates are compiled using the latest data available in each quarter. MFP growth is calculated using the latest published data on output, labour markets and business investment. These data, where appropriate, are deflated using deflators that are derived from various different sources such as Producer Price Indices (PPIs).

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. Yet some elements of productivity can 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 and 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.

Additionally, there are some kinds of capital that are not captured by current estimates. For example, MFP calculations do not include estimates of the extent to which productivity is driven by natural capital, social capital or those intangible assets that fall outside the national accounts asset boundary drive productivity (see the [European System of Accounts 2010](#) for more details). Human capital is implicitly addressed through the quality-adjusted labour input (QALI).

Despite these drawbacks, the process for calculating productivity does draw on a rich literature to inform these estimates. The Office for National Statistics (ONS) also has various procedures in place to ensure that errors are minimised. The data are checked in various stages of the 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 will also take on revisions to other outputs, which increase 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.

MFP uses other published data sources and so the quality of MFP estimates depends on the quality of other published statistics. Changes to MFP estimates that can be traced back to changes in the input data are covered in the revisions section of the quarterly MFP release. This section also links to the relevant articles published by the providers of the input data.

To maintain the reliability of quarterly MFP growth, we currently aggregate MFP data to 10 industries, with additional breakdowns for particular industries in the annual dataset. This level of data provides higher-quality estimates, although the lack of granularity makes it more difficult to determine which sub-industry is driving changes to the higher-level industry.

## 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 that the ONS publishes. The publication that is most relevant to MFP is the Labour productivity bulletin.

Labour productivity forms the basis for productivity measures. MFP uses the same data for its output and labour market inputs as the market sector labour productivity estimates, making the two measures coherent with one another.

MFP can be compared with both datasets and doing so provides a richer understanding of productivity movements in the UK. However, caution should be taken when comparing datasets as labour productivity is published both at the whole economy and the market sector level.

MFP also uses data for capital services from its Volume Index of Capital Services (VICS) series. This is a distinct concept from [capital stocks](#). The main difference between these two estimates is that capital stocks is a stock measure at a point in time and it measures the value or "wealth" of capital. Capital services in turn is an estimate of 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-price profile and further modelling in the case of capital services. More information is available in the [VICS QMI](#).

The data MFP uses from VICS and quality-adjusted labour input (QALI) is seasonally adjusted. This differs from the QALI- and VICS-specific estimates that we publish. As such, there may be quarterly differences between the two measures when comparing their respective datasets.

## 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 experimental or national statistics, the difference being national statistics are fully compliant with the [Code of Practice](#). MFP is an [Experimental Statistic](#), which means that the estimates are still being developed to achieve complete compliance with the Code.

Experimental statistics are valid estimates, but 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](#) and the asset breakdown is consistent with the [System of National Accounts 2008: SNA 2008](#) and [European System of Accounts 2010 \(ESA 2010\)](#). Our methodology for measuring MFP draws from the methodology set out in the [OECD measuring productivity](#) manual.

## 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 quarterly and are available free of charge on the ONS website. Datasets have contents and metadata tabs that provide information that is important to understanding the statistics. The quarterly MFP article also has a section providing a brief explanation of the statistics and longer sections covering the latest trends of the factors feeding into MFP growth. We also published [A 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 quarterly. This timetable is usually one week after the publication of the [Quarterly national accounts](#) (QNA) and around 14 weeks after the reference quarter.

For more details on related releases, the [official statistics 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

## How we collect, process and analyse the data

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

The labour measure used for MFP is quality-adjusted labour input (QALI), and the capital measure is the Volume Index of Capital Services (VICS). 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 ( $\alpha$  and  $1-\alpha$ ), which reflect the shares of labour and capital that contribute to generating output. This is calculated as:

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

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 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 analogous to the treatment of labour input insofar as 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.

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, while previously, quarterly capital services could only be derived by 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 [A 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 the processing. The input data used to calculate multi-factor productivity (MFP) data are first quality assured by the internal data provider. Then more checks are used throughout data processing to further quality assure our estimates before final 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 the quarterly 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) estimates to our team mailbox [productivity@ons.gov.uk](mailto: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) manual [Measuring productivity](#) provides guidance on producing productivity statistics, including MFP, to international standards. Several countries produce estimates for MFP, or for 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) concept(s), they might differ in terms of the methodology used. This also implies that international comparisons of quality-adjusted labour inputs and capital services are limited because of these differences in methodology.