Article

Multi-factor productivity estimates: Experimental estimates to Quarter 2 (April to June) 2017

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

Table of contents

1 . Main points

- This is the first release of [experimental](#) estimates of quarterly multi-factor productivity (MFP) for the UK market sector and 10 component industries.

- In Quarter 2 (Apr to June) 2017, MFP in the UK market sector is estimated to have fallen by 0.3% compared with the previous quarter.

- The difference between this and the smaller negative growth of the equivalent measure of labour productivity (negative 0.1% across the market sector on an output per hour basis) reflects growth in labour composition and capital services per hour worked, which, other things equal, would have increased output and labour productivity in the second quarter.

- Compared with the same quarter in 2016, MFP is estimated to have grown by 0.8%, compared with growth of 0.5% for output per hour over this period.

- We welcome your feedback on the content of this new release, which is intended to replace annual releases on quality-adjusted labour inputs, volume indices of capital services and MFP; feedback can be sent to productivity@ons.gov.uk.

2 . Things you need to know about this release

This release presents new experimental quarterly multi-factor productivity (MFP) estimates for the UK market sector. MFP estimates are compiled within a growth accounting framework, which decomposes changes in economic output (in this case, of the UK market sector) into contributions that can be attributed to changes in measured factor inputs to production (labour and capital) and a residual element known as MFP.

In the growth accounting framework, the contribution of labour to changes in economic output takes account of changes in labour composition, often referred to as the "quality" of the employed labour force as well as changes in the "volume" of labour measured simply by the number of hours worked.

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

This is the first of what is intended to be a regular quarterly series of MFP publications. Given the considerable data requirements for MFP and the experimental nature of the statistics and methods that underpin this release, these data have been compiled consistent with the Quarterly national accounts (QNA) published in December 2017 and with the Labour productivity release in January 2018. This release contains estimates up to Quarter 2 (Apr to June) 2017, which is two quarters behind our QNA and quarterly Labour productivity releases. As a consequence, these data are currently not fully consistent with more recent national accounts data, nor with the labour productivity estimates published alongside this release.

We aim to align the MFP publication schedule with the QNA and Labour productivity publication timetable over the next two or three quarters. At that point we will be publishing quarterly MFP estimates about one week after the publication of the QNA and around 14 weeks after the reference quarter.

In the first instance, these quarterly estimates are restricted to the 10 broad industries that comprise the UK market sector. We will investigate the feasibility of publishing a more granular quarterly breakdown by industry in future releases, taking account of the availability and reliability of the source data, as well as the time available for compilation and quality assurance, and user feedback. One possibility is that we follow the US Bureau of Labor Statistics practice of publishing more granular MFP estimates some time after publication of high-level preliminary estimates.

Subject to user feedback, this quarterly MFP publication will replace our previous pattern of publishing separate annual releases on quality-adjusted labour input, volume indices of capital services and MFP.

3 . Summary of estimates published in this release

The dataset published alongside this release contains annual and quarterly estimates for multi-factor productivity (MFP) and a range of supporting statistics. Annual series from 1970 to 2016 are provided for the UK market sector and 18 component letter-level industries. Quarterly series are provided from Quarter 1 (Jan to Mar) 1994 to Quarter 2 (Apr to June) 2017 for the UK market sector and 10 industry groupings. Estimates are provided for the following variables.

Real GVA

Gross value added (GVA) data in this release are Blue Book 2017 estimates consistent with the Quarterly national accounts (QNA) published in December 2017. As a consequence, for the first (Jan to Mar) and second (Apr to June) quarters of 2017, these estimates may differ slightly from the QNA estimates published on 31 March 2018.

Contributions to GVA growth from hours worked

These are estimated as changes in hours worked weighted by labour factor income weights. Hours worked for wholly market sector industries are consistent with estimates published in our Labour productivity release on 5 January 2018, but do not include revisions to the estimates in the accompanying Labour productivity Quarter 4 (October to December) 2017 release. All such revisions are small.

Labour factor income weights are consistent with underlying data from the Blue Book 2017 supply and use tables, which contain estimates of compensation of employees and mixed income by industry. Labour and capital factor income weights are included separately in the dataset.

Contributions to GVA growth from labour composition

Changes in labour composition are estimated in our quality-adjusted labour input (QALI) system and are similarly weighted by labour factor income weights. Further information is available in the October 2017 QALI release and in the methodological article published alongside this article.

Contributions to GVA growth from capital services

These are estimated as changes in capital services weighted by capital factor income weights. Capital services are consistent with those published in our February 2018 Volume Index of Capital Services article. Capital factor income weights are estimated as one minus labour weights.

Multi-factor productivity

Changes in MFP can be computed by residual as changes in GVA minus the contributions due to hours worked, labour composition and capital services. Alternatively, MFP can be computed by dividing an index of GVA by an index of "combined inputs", that is, an index of labour and capital weighted by their respective weights. Indices and growth rates of combined inputs are shown separately in the dataset.

Other variables

The dataset also includes capital deepening (capital services divided by hours worked, sometimes also called capital intensity), capital productivity (GVA divided by capital services), the ratio of labour to capital inputs (that is, QALI divided by capital services) and, for the first time, implicit price indices for labour, capital and combined inputs. These are estimated by dividing current price factor incomes used in constructing our factor income weights by the relevant volume input series.

Sources and methods

Brief notes on sources and methods are provided in an appendix to this release. Further information is available in an accompanying [methodology article](#).

4 . Multi-factor productivity estimated to have fallen by 0.3% in the second quarter of 2017
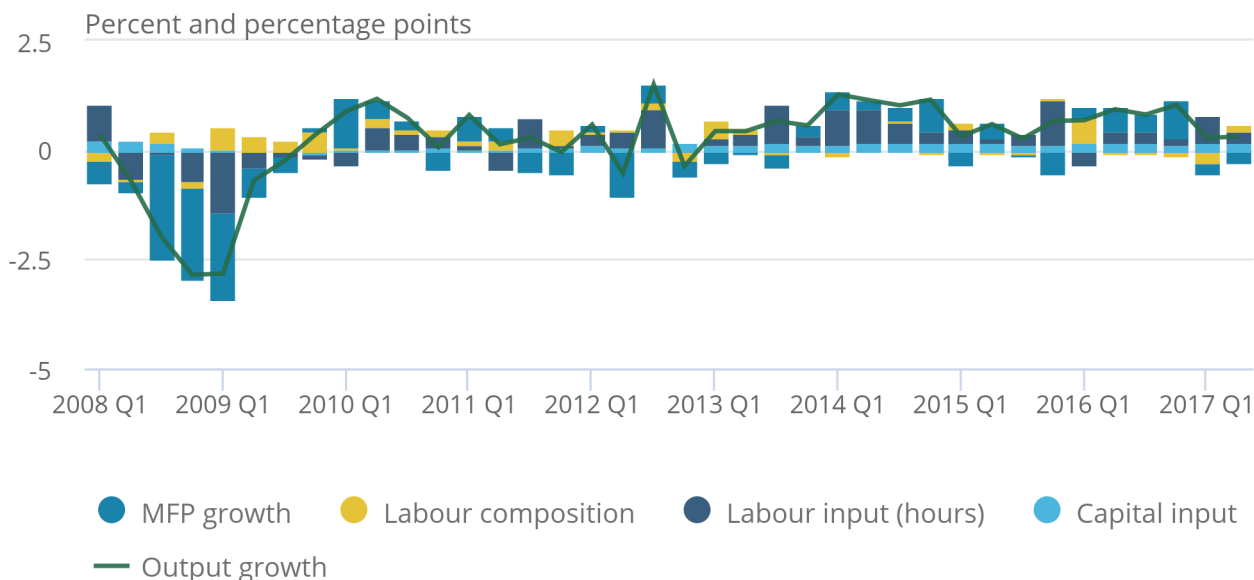
Figure 1 decomposes quarterly market sector output growth into contributions from capital and labour input growth (the latter separated into contributions from hours and labour composition) and the residual multi-factor productivity (MFP) contribution. This presentation shows the importance of MFP in explaining the fall in output growth during the economic downturn, as well as the large and consistent contribution of hours worked to overall output growth during the recovery. Labour composition – which initially supported output growth during the downturn – has made a more marginal contribution during the recovery, while capital input growth has been similarly subdued at the market sector level.

Figure 1: Decomposition of quarterly output growth, Quarter 1 (Jan to Mar) 2008 to Quarter 2 (Apr to June) 2017

UK, market sector

Figure 1: Decomposition of quarterly output growth, Quarter 1 (Jan to Mar) 2008 to Quarter 2 (Apr to June) 2017

UK, market sector

Percent and percentage points

● MFP growth   ● Labour composition   ● Labour input (hours)   ● Capital input
— Output growth

Source: Office for National Statistics

Notes:

Output growth is the quarter-on-quarter growth in market sector GVA expressed as changes in natural logarithms. Columns show contributions of components, calculated by weighting changes in each component by its factor income share. 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). Figure 2 presents the breakdown in terms of year-on-year changes, although the underlying changes in labour composition and MFP are identical between Figures 1 and 2.

Although these experimental statistics should not be over-interpreted, Figure 2 suggests that the slowdown in market sector labour productivity in the first two quarters of 2017 may be attributable to a slowing in MFP and negative contributions from labour composition. This pattern, as well as the comparative weakness of capital intensity, is reflected across a number of component industries, as shown in the dataset published alongside this release.

Figure 2: Decomposition of year-on-year growth of output per hour worked, Quarter 1 (Jan to Mar) 2008 to Quarter 2 (Apr to June) 2017

UK, market sector

Figure 2: Decomposition of year-on-year growth of output per hour worked, Quarter 1 (Jan to Mar) 2008 to Quarter 2 (Apr to June) 2017

UK, market sector

Percent and percentage points

- MFP growth
- Capital deepening
- Labour composition
- Labour Productivity Growth
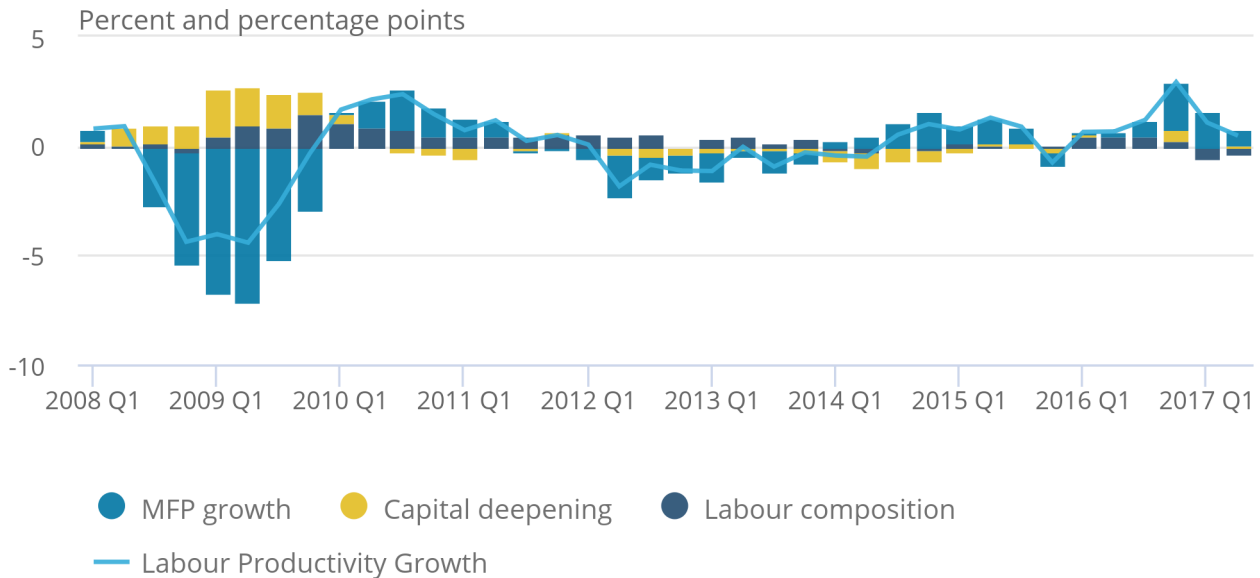
Source: Office for National Statistics

Notes:

Labour productivity growth is the year-on-year growth in market sector GVA per hour worked expressed as changes in natural logarithms. Columns show contributions of components, calculated by weighting changes in each component by its factor income share. MFP is calculated by residual

To give a flavour of the behaviour of MFP across industries, Figure 3 shows indices of quarterly MFP since 1994 for the UK market sector and for the manufacturing, and information and communication industries. MFP has been broadly flat since 2009 across the UK market sector and in manufacturing, having trended upwards (with some cyclical variation) prior to the economic downturn. By contrast, MFP is estimated to have fallen in the information and communication industry up to 1997 before recovering sharply up to 2000. Since 2000, this industry has followed a similar trajectory to manufacturing, albeit with more cyclical variation up to 2014, since when MFP growth has accelerated once more.

UK, market sector and selected industries

Figure 3: Quarterly multi-factor productivity, Quarter 1 (Jan to Mar) 1994 to Quarter 2 (Apr to June) 2017

UK, market sector and selected industries
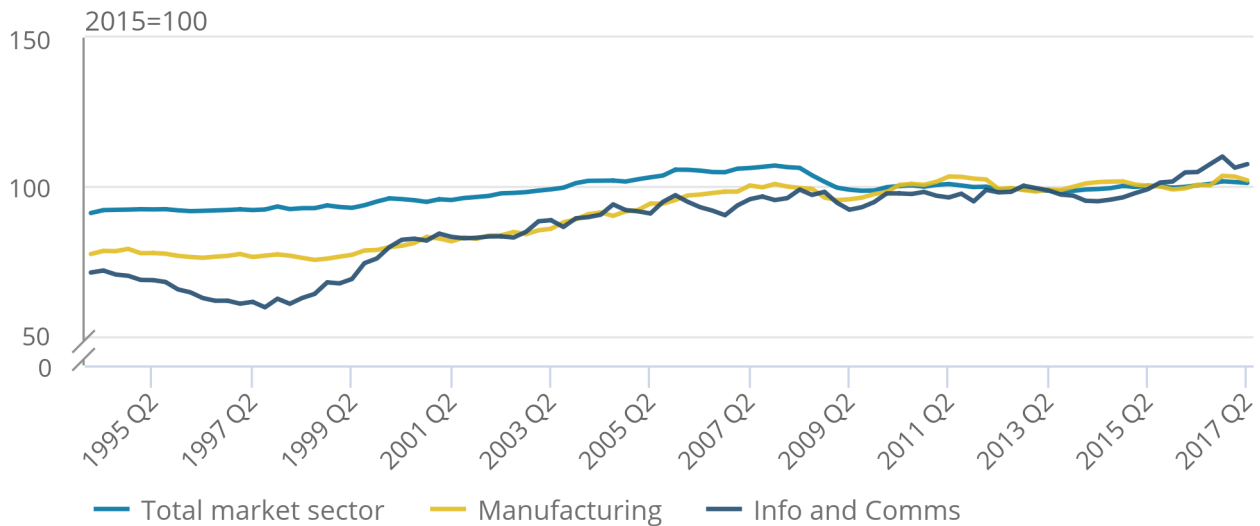
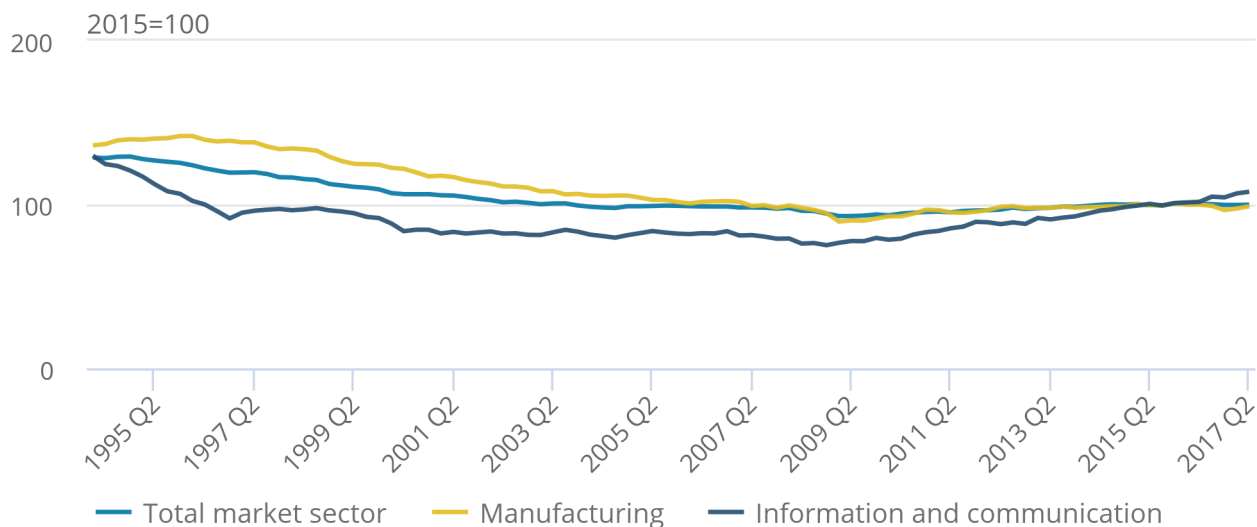

Source: Office for National Statistics

Figure 4 shows quarterly labour-capital ratios for these industries (that is, the ratio of indices of quality-adjusted labour to capital services). An increase (decrease) in these indices implies that labour input is growing more (less) rapidly than capital inputs, or falling more (less) slowly. These data appear to show a turning point in 2009. Up until 2009, the labour-capital ratio trended downwards, as firms substituted capital for labour (alternatively, capital intensity trended upwards), albeit with some cyclical variation. This trend has reversed since 2009, especially in information and communication.

UK, market sector and selected industries

Figure 4: Quarterly labour-capital ratios, Quarter 1 (Jan to Mar) 1994 to Quarter 2 (Apr to June) 2017

UK, market sector and selected industries

Source: Office for National Statistics

Figure 5 shows (annual) implied capital prices (that is, nominal returns to capital divided by volume indices of capital services) for the same industries as in Figures 3 and 4. Implied capital price indices are rather volatile, more so than implied prices of labour services, which are essentially indices of quality-adjusted hourly earnings and trend continuously upwards, albeit at different rates over time.

The data in Figure 5 show that implied capital services prices fell quite markedly prior to the early 2000s. This slowdown started earlier in information and communication (reflecting the importance of assets with falling prices such as computer hardware in this industry), but was also evident in manufacturing and the UK market sector as a whole.

More recently, implied prices of capital services have increased. This, combined with sluggish growth of earnings and hence of labour services, could be a factor in the turnaround in labour-capital ratios shown in Figure 4.
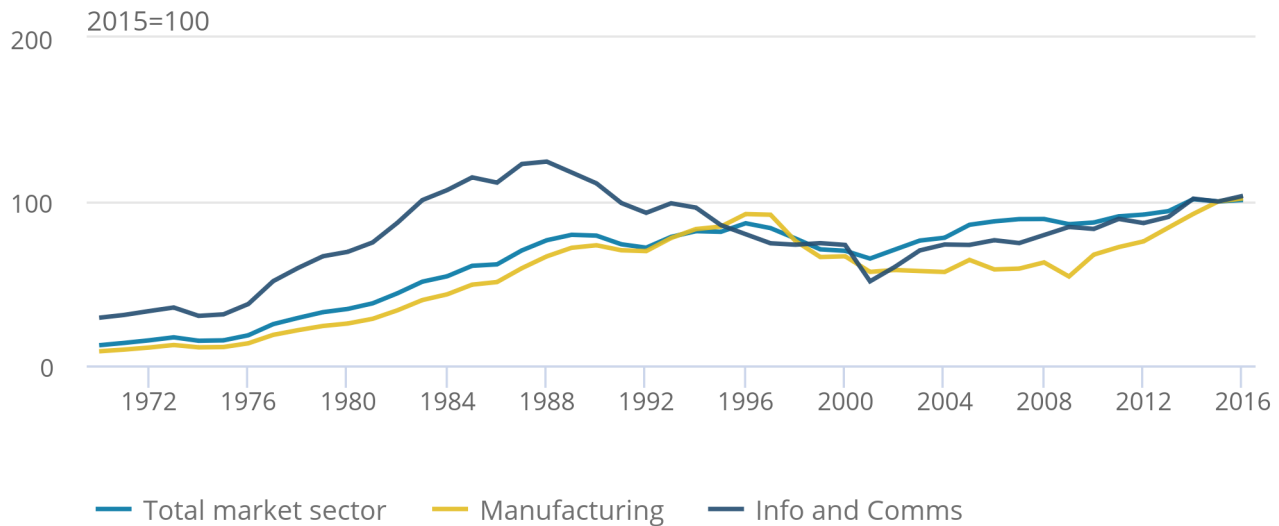
Figure 5: Annual implied prices of capital services, 1970 to 2016

UK, market sector and selected industries

Figure 5: Annual implied prices of capital services, 1970 to 2016

UK, market sector and selected industries

Source: Office for National Statistics

5 . What's changed in this release?

Despite widespread revisions to sources and methods, and the move from annual to quarterly frequency, revisions to (annual) multi-factor productivity (MFP) for the UK market sector since our last MFP release in April 2017 are comparatively modest, as shown in Figure 6. Average annual growth of capital inputs has been revised up a little, while growth of hours worked and MFP has been revised down.

Figure 6: Contributions to annual average output growth, 1998 to 2015

UK, Market sector, Current and previous estimates
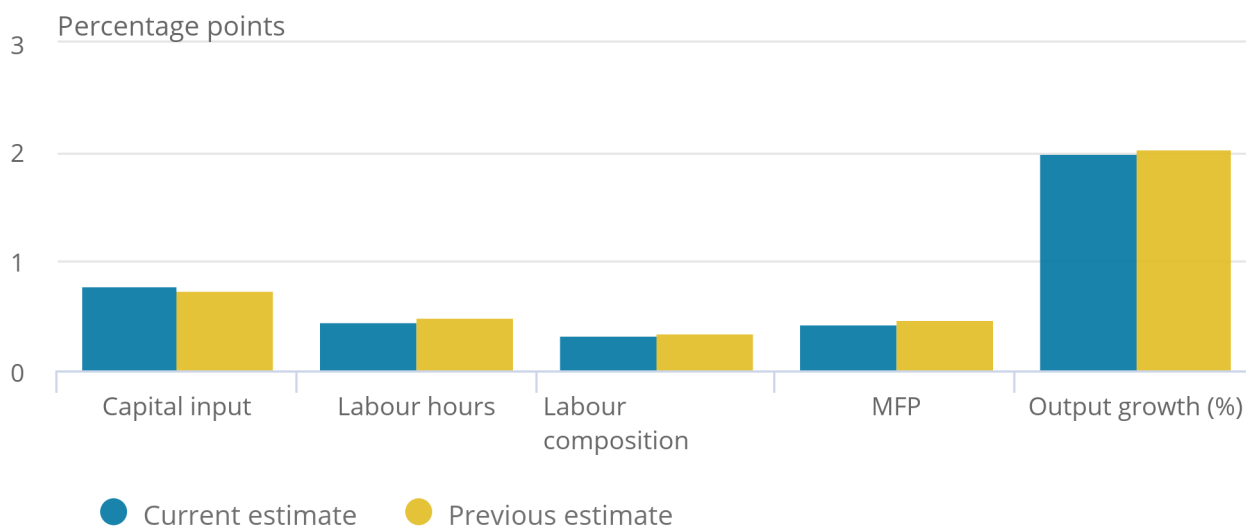
Source: Office for National Statistics

6 . Next steps

Subject to user feedback, we intend to develop our production systems with the eventual aim of compiling quarterly estimates of multi-factor productivity (MFP) on the same schedule as we currently follow for quarterly labour productivity. On this schedule, MFP estimates would be published around one week after our Quarterly national accounts (QNA) release, which in turn is typically published around 13 weeks after the end of the reference quarter.

We anticipate reaching this end point for the Productivity theme day on 5 October 2018, when subject to user feedback and progress, we will commence a quarterly series of MFP estimates. This is partly because we anticipate needing several production rounds to iron-out issues and to streamline compilation processes. It will also enable us to incorporate annual Blue Book revisions, which will affect many components of the MFP framework, published in the QNA release at the end of June 2018. For these reasons we do not plan to publish quarterly MFP estimates in July. We welcome your feedback on the uses and usefulness of these data and our proposed production timelines. Feedback should be directed to Productivity@ons.gov.uk.

Separately we are working on developing additional industry granularity. We will report on this development work in July, when we also plan to publish an accessible guide to MFP for the non-expert user.

Further information on next steps is available in an accompanying methodology article.

7 . Appendix: Notes on sources and methods

You should be aware that all growth rates in this release (annuals, quarter-on-quarter and quarter on same quarter a year ago) are expressed as changes in (natural) logarithms (multiplied by 100). These can differ slightly from the discrete percentage changes typically used in our other statistical releases. For example, the annual change in market sector gross value added (GVA) to Quarter 2 (Apr to June) 2017 is 2.41% in log change terms, but 2.44% in percentage terms.

The use of log changes is standard practice in multi-factor productivity (MFP) decompositions. One advantage is that log changes are symmetric. In the example in the previous paragraph, the log change from Quarter 2 (Apr to June) 2017 to the same quarter of 2016 is negative 2.41%, whereas in percentage change terms it is negative 2.39%, reflecting the well-known feature that the percentage change from, say, 100 to 110 (10%) differs from the change from 110 to 100 (negative 9.1%).

Hours worked in the UK market sector are aggregated across component industries as set out in Franklin, 2017. These estimates for market sector hours currently differ slightly from those in our Labour productivity release, although we plan to align the two estimates in future releases.

Quality-adjusted labour input (QALI) estimates are updated slightly from our most recent QALI publication in October 2017, principally to reflect revised industry-level benchmarks on hours worked and labour remuneration.

Estimates of capital services have been compiled using new processes and source data as described in the article we published in February 2018. These changes allow estimation of capital services on a quarterly frequency, whereas previously, quarterly capital services could only be derived by interpolation of annual series. The quarterly capital services system is still subject to development and testing. This is the main reason why the quarterly estimates in this release are limited to 10 industry groupings rather than 19 letter-level industries.

Annual factor income weights are two-period indices, while quarterly factor income weights are smoothed over calendar years. Although the annual and quarterly MFP systems are fully consistent in terms of inputs (that is, all quarterly inputs are consistent with their annual equivalents), some slight differences in outputs may arise due to the method of smoothing quarterly factor income weights. These differences could be eliminated by benchmarking the quarterly estimates to their annual equivalents, but we have not undertaken this step in this release.

8 . Links to related statistics

- UK productivity introduction: October to December 2017 draws together the headlines of the productivity releases into a single release, providing additional analysis of our productivity statistics (published 6 April 2018).

- Labour productivity: October to December 2017 contains the latest estimates of labour productivity for the whole economy and a range of industries, together with estimates of unit labour costs (published 6 April 2018).

- Quarterly UK public service productivity (experimental statistics): October to December 2017 contains the latest experimental estimates for quarterly UK total public service productivity, inputs and output (published 6 April 2018).

- International comparisons of UK productivity (ICP), final estimates: to 2016 presents an international comparison of labour productivity across the G7 nations, in terms of growth in GDP per hour and GDP per worker (published 6 April 2017).

- Introducing industry-by-region labour metrics and productivity presents new, experimental industry-by-region productivity metrics; this includes measures of hours worked, jobs, and accompanying productivity measures for the SIC letter industries in the NUTS1 regions (published 6 April 2018).

- [Quarterly multi-factor productivity: Progress to date and next steps](#) details the methodology used to compile quarterly multi-factor productivity and sets out plans to reduce the time taken in producing these estimates and increasing the industry granularity (published 6 April 2018).

- [Quarterly Multi-factor productivity (MFP), (experimental estimates): to Q2 2017](#) decomposes output growth into the contributions that can be accounted for by labour and capital inputs; the contribution of labour is further decomposed into quantity (hours worked) and quality dimensions (published 6 April 2018).

- [Management practices and productivity in British production and services industries - initial results from the Management and Expectations Survey: 2016](#) Results from the second wave of a pilot survey, the Management and Expectations Survey, which gathered information on British management practices and firms' expectations for future growth (published 6 April 2018).

- [Public service productivity estimates: total public service, UK: 2015](#) presents updated measures of output, inputs and productivity for public services in the UK between 1997 and 2014, in addition to new estimates for 2015 (published 5 January 2018).

- [Public service productivity estimates: healthcare, 2015](#) presents updated estimates of output, inputs and productivity for public service healthcare in the UK between 1995 and 2014, in addition to new estimates for 2015 (published 5 January 2018).

- [International comparisons of labour productivity by industry: 2014](#) uses new production-side PPPs to present estimates of labour productivity for 29 European countries across 10 industries on a GVA per hour worked basis (published 6 October 2017).

- [Quality adjusted labour input: UK estimates to 2016](#) presents updated estimates of quality adjusted labour input (QALI) for the whole economy and for the market sector (published 6 October 2017).

- [Foreign direct investment and labour productivity: a micro-data perspective: 2012 to 2015](#) examines the composition of firms with foreign direct investment (FDI) in Great Britain between 2012 and 2015, and their productivity outcomes compared with firms with no FDI relationships (published 6 October 2017).

- [Introducing division level labour productivity estimates](#) provides an overview of new and experimental estimates of labour productivity at the two-digit SIC industry level for the UK and provides some initial analysis demonstrating trends in the data (published 5 July 2017).

- [Understanding firms in the bottom 10% of the labour productivity distribution in Great Britain: "the laggards", 2003 to 2015](#) examines the characteristics of businesses in the bottom 10% of the labour productivity distribution in terms of their size, age, industry and location, between 2003 and 2015 (published 5 July 2017).

- [Multi-factor productivity estimates: Experimental estimates to 2015](#) decomposes output growth into the contributions that can be accounted for by labour and capital inputs; the contribution of labour is further decomposed into quantity (hours worked) and quality dimensions (published 5 April 2017).

- [Developing new measures of infrastructure investment: July 2017](#) is the first in a series of papers on infrastructure statistics, focusing on definitional and data challenges in measuring infrastructure investment (published 5 July 2017).

- [Volume index of UK capital services (experimental): estimates to Quarter 2 (Apr to Jun) 2017](#) provides estimates of the contribution of capital inputs to production in the market sector, split by asset and industry (published 7 February 2018).