

Article

Impact of double deflation on labour productivity: 1997 to 2018

Indicative estimates of the impact of Blue Book 2021 changes on our labour productivity measures for the whole economy and by industry, from 1997 to 2018.

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1 . Main points

- The implementation of double deflation does not materially affect the growth or level of labour productivity for the whole economy, although other changes introduced in Blue Book 2021 will have small impacts.
- Changes to the growth of whole economy gross value added (GVA) before and after the 2008 to 2009 economic downturn mean that the size of the “productivity puzzle” (the slowdown in growth) is a little smaller than previously estimated.
- Double deflation will have an impact on the estimates of GVA at the industry level, which will lead to large revisions to labour productivity growth rates in many industries.
- Productivity growth between 1997 and 2018 is revised up in around a quarter of industries, predominantly manufacturing, while around a third of industries remain unchanged.
- Productivity growth between 1997 and 2018 is revised down in many services industries, with some notable exceptions such as the telecommunications industry.
- The industries demonstrating large productivity slowdowns, which contribute to the slowdown in productivity growth since the 2008 to 2009 economic downturn known as the “productivity puzzle”, are largely unchanged.

2 . Overview of double deflation and productivity

Productivity is calculated by dividing a measure of output (what is produced) by a measure of input (what is used to produce the output). Our productivity statistics use gross value added (GVA) as the output measure in this calculation – see [Chapter 6 \(Productivity\) in Measuring the Economy](#). GVA is the value of output (total output) minus the value of the intermediate inputs (intermediate consumption) used up in the production process, such as raw materials and business services. When examining changes in productivity over time, GVA estimates must be adjusted for price changes (inflation) such that they become real or volume measures.

Our current estimates of real GVA are calculated using single deflation, which means that a single price index (deflator) is applied to the estimated value of GVA. Blue Book 2021, to be published later in 2021, introduces a new framework to estimate GVA, including the implementation of double deflation. Double deflation applies different price indices (deflators) to total output and intermediate consumption separately. [More information on the methodology is available](#). This approach is considered international best practice for estimating the volume of GVA under the [System of National Accounts \(SNA\) 2008 \(PDF, 9MB\)](#).

Double deflation is important for gross domestic product (GDP) and industry GVA measures, and by extension for productivity measures. Accompanying articles set out Impact of Blue Book 2021 on headline GDP, and Impact of double deflation on industry GVA. This article examines the impacts on our productivity estimates. Double deflation has long been known to be especially important for understanding productivity at the industry level, as noted in [Oulton \(2004\)](#) and [Stoneman and Francis \(1994\)](#).

Blue Book 2021 will also introduce a number of other improvements to data sources, methods, and to the deflators that are used (irrespective of whether single or double deflation is used). Among these changes include the incorporation of data from the Financial Services Survey and a new deflator for telecommunications services. These, and other changes, are detailed in the accompanying article, Impact of Blue Book 2021 on headline GDP.

3 . Impact on whole economy productivity

Changes in Blue Book 2021 have some impact on the growth of labour productivity for the whole economy between 1997 and 2018, although these are mostly not caused by the implementation of double deflation. There are small downward revisions to productivity growth in the years before the economic downturn in 2008, and small upward revisions in more recent years. Over the period as a whole, however, productivity growth is little changed.

An accompanying article, Impact of double deflation on industry chain volume measure annual estimates 1997 to 2017, concludes that the effects of Blue Book 2021 on the level and growth rate of whole economy gross domestic product (GDP) are relatively small and are mostly not caused by double deflation. Double deflation results in shifts in value added between industries, rather than changes to the overall level or growth rate.

The so-called “productivity puzzle” (the slowdown in aggregate productivity growth since the economic downturn in 2008 to 2009) will still be present in the statistics once double deflation (and the other changes in Blue Book 2021) is implemented. However, these new data improve our understanding of productivity growth and the productivity puzzle, and we will continue to explore these topics in future releases.

Figure 1: Blue Book 2021 revisions to whole economy output per hour annual growth are relatively small

Revisions to whole economy year-on-year output per hour growth, current and Blue Book 2021 data, UK, 1998 to 2018

[Download the data](#)

4 . Impact on industry productivity

Distribution of impact

Revisions to growth rates of productivity at the industry level appear far more pronounced than revisions to gross value added (GVA), given the nature of the productivity calculation. For example, if an industry’s growth in GVA over a given period is revised up from 3% to 5% on average per year, that may appear to be a relatively small revision as both growth rates are moderately positive. However, if hours worked (one measure of labour inputs, hence the denominator in the productivity equation) grows on average 4% per year, then the revision to GVA implies very different stories for productivity: previously productivity would fall at 1% per year on average, and after the revision it would rise at 1% per year.

Revisions to growth rates of productivity at the industry level as a result of implementing double deflation (and other changes in Blue Book 2021) are much larger than those seen at a whole economy level. Of the 66 industries examined (mostly “divisions” (two-digit industries) in the Standard Industrial Classification 2007), the average annual growth rate of productivity (measured by output per hour worked) over the past two decades was revised up considerably in 19, broadly unchanged in 16, and revised down considerably for the remaining 31.

Figure 2: Revisions to average annual productivity growth rates vary widely by industry

Percentage point difference, UK, 1997 to 2018

Notes:

1. Industries are divisions (two-digit industries) and groups of divisions in the [Standard Industrial Classification \(SIC\) 2007](#). See here for more details.
2. Dotted lines at -0.5 percentage points and 0.5 percentage points represent the band of 'little change' to productivity growth rates.
3. Manufacturing industries coloured green.

[Download the data](#)

One reason for the wide variety of results is that the difference between double deflation and single deflation (the current approach) depends on the relative price changes of inputs and output in each industry. Where input and output prices move relatively similarly, the impact will be small. Where input prices rise faster than output prices, double deflation will estimate a smaller increase in the volume of inputs, and hence a greater increase in GVA and, by extension, faster growth in productivity. The reverse is true when input prices rise more slowly than output prices. This was noted in the [Independent review of UK economic statistics by Professor Sir Charles Bean in 2016 \(PDF, 5.1MB\)](#).

Another important factor is the share of intermediate inputs in "total output", as noted in the [OECD Measuring Productivity Manual, 2001 \(PDF, 993KB\)](#). Across the economy as a whole, around half of the value of "total output" is the result of intermediate consumption (put another way, GVA is about half of "total output"). At the industry level, these ratios can vary substantially: intermediate inputs make up around 60 to 70% of "total output" in many manufacturing industries, but only around 30 to 40% in many business services industries. Where intermediate inputs are large relative to "total output", industry GVA is more sensitive to double deflation impacts.

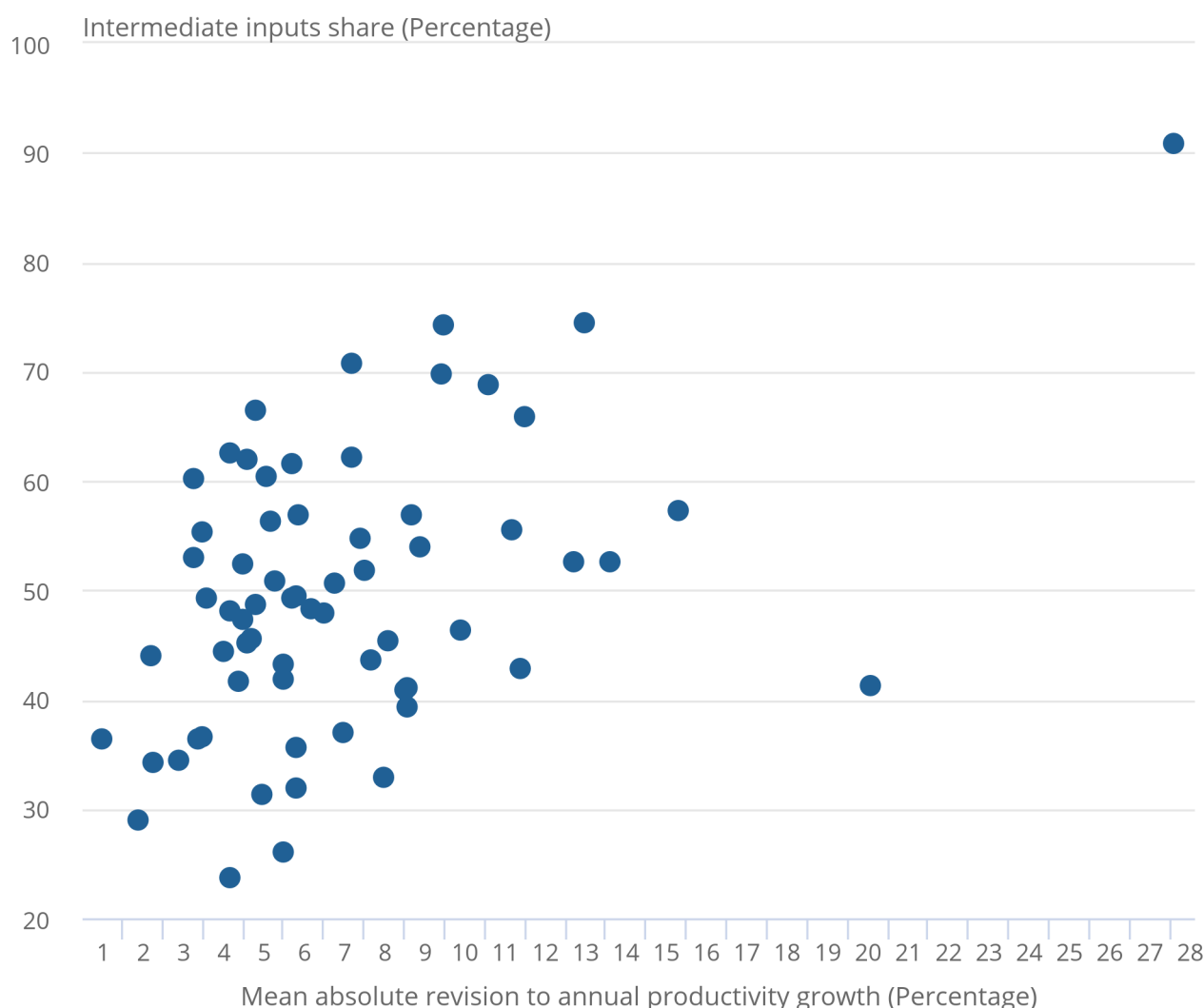
As a result, revisions to productivity growth of different industries from implementing double deflation will depend on the relative price changes of inputs and outputs in that industry, and the share of intermediate inputs in "total output". Figure 3 shows a weak but positive relationship between the share of intermediate inputs in total output, and the average revision to annual productivity growth (in absolute terms) of each industry.

Figure 3: Revisions to average annual productivity growth are generally higher in industries with higher intermediate inputs shares

Scatter plot of the share of intermediate consumption in gross output (1997 to 2018 average), and the mean absolute revision to annual productivity

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Scatter plot of the share of intermediate consumption in gross output (1997 to 2018 average), and the mean absolute revision to annual productivity



Source: Office For National Statistics

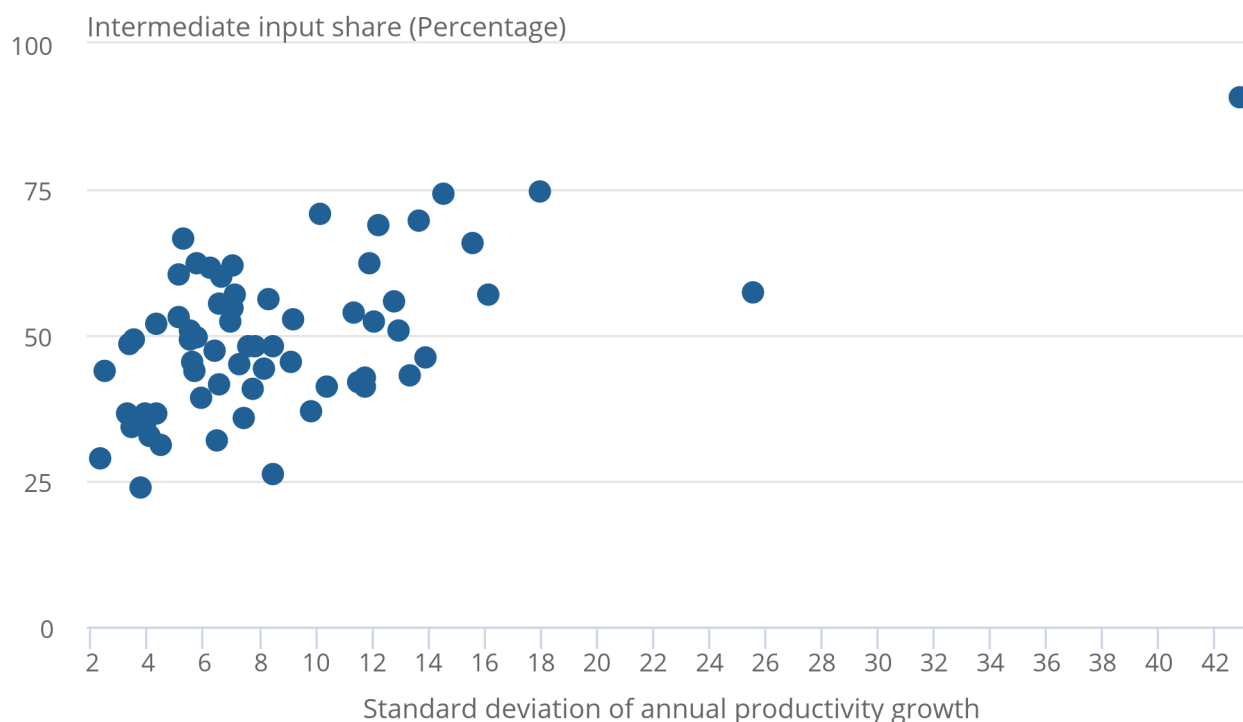
For the same reasons, double deflation leads to more volatile productivity growth rates, especially in industries with higher intermediate input shares. This is a feature noted in the OECD Measuring Productivity Manual, and found in practice in UK data by [Franklin and Murphy, 2016 \(PDF, 208.2KB\)](#). Revisions in Blue Book 2021, including double deflation, have led to more volatile industry productivity growth rates on average, especially in industries with higher shares of intermediate inputs in total output; this is shown in Figure 4.

Figure 4: Annual productivity growth rates are more volatile in industries with higher intermediate input shares

Share of intermediate consumption in gross output (1997 to 2018 average), and the standard deviation of annual productivity (output per hour worked) growth, UK, 1997 to 2018

Figure 4: Annual productivity growth rates are more volatile in industries with higher intermediate input shares

Share of intermediate consumption in gross output (1997 to 2018 average), and the standard deviation of annual productivity (output per hour worked) growth, UK, 1997 to 2018



Source: Office For National Statistics

Manufacturing industries

Most manufacturing industries saw an upward revision to GVA growth, and hence productivity growth, as a result of changes in Blue Book 2021. Manufacturing industries are coloured green in Figure 2, which shows that most are revised notably up, and some are little changed. Only one manufacturing industry (measured at the sub-section level) is revised notably down – manufacture of coke and refined petroleum products (industry sub-section CD). This industry is part of a chain of industries producing and refining oil, and movements in deflators have shifted value added up and down this supply chain.

The largest upward revision is the manufacturing of textiles, wearing apparel and leather products industry (industry sub-section CB), which now has an average annual growth rate in labour productivity of 11.3% between 1997 and 2018 compared with 2.5% previously. This is partly because of the introduction of an improved deflator for clothing in Blue Book 2021.

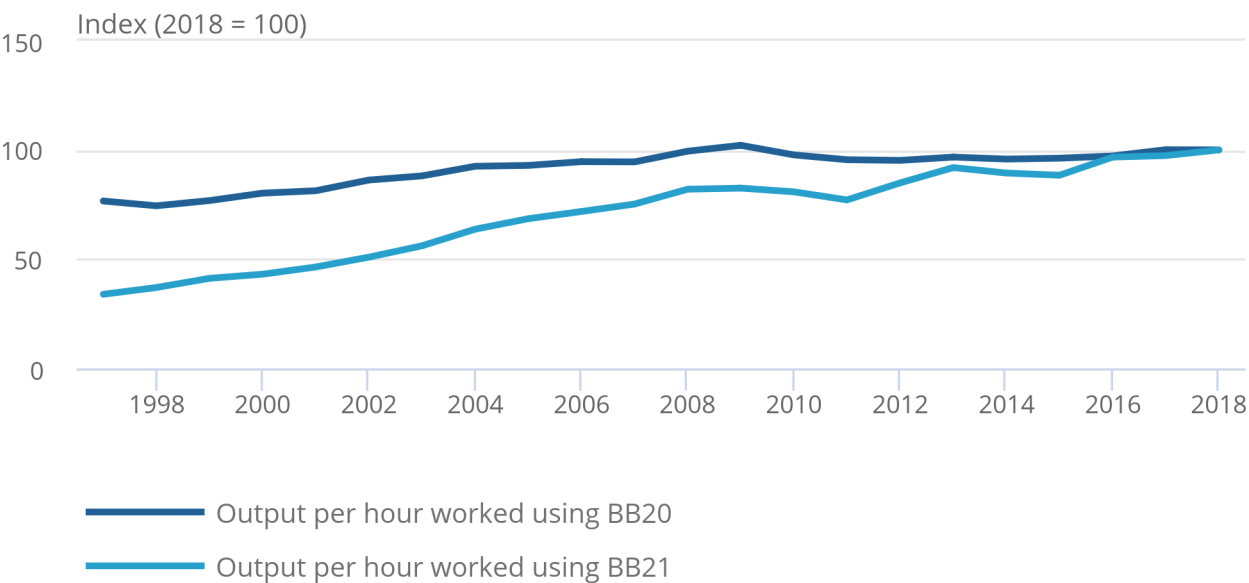
The widespread upward revisions in manufacturing are partly the result of double deflation, which better reflects the changes in prices of inputs and output. Changes to the way data are balanced have also affected estimates of the volume of manufacturing output. An example, for the manufacture of wood and paper products and printing industry (industry sub-section CC), is shown in Figure 5. Output per hour worked in this industry increases at an average rate of 5.3% per year based on Blue Book 2021 data, compared with 1.3% previously.

Figure 5: Output per hour worked in the manufacture of wood and paper products and printing industry is revised up

Output per hour worked, current and Blue Book 2021 data, UK, 1997 to 2018

Figure 5: Output per hour worked in the manufacture of wood and paper products and printing industry is revised up

Output per hour worked, current and Blue Book 2021 data, UK, 1997 to 2018



Source: Office For National Statistics

Services industries

Many services industries saw a downward revision to productivity growth as a result of changes in Blue Book 2021. Figure 2 shows some large downward revisions to productivity growth in some services industries, and many with moderate downward revisions. There are some notable exceptions, which generally have unique explanations.

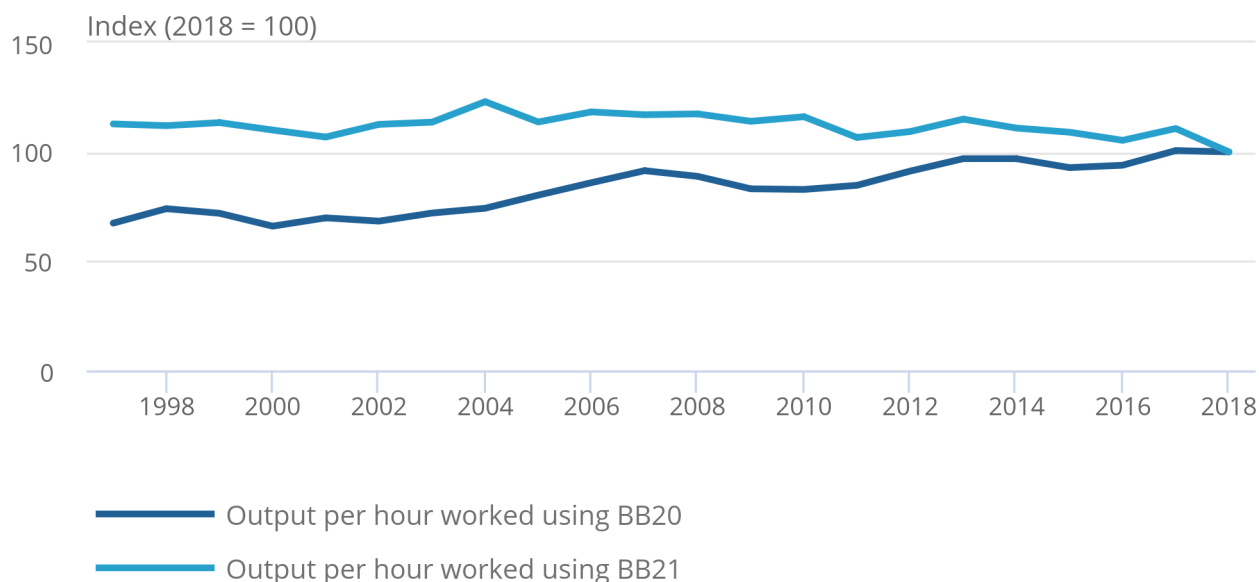
Figure 6 illustrates the downward revision to productivity growth in the architectural and engineering activities industry (Division 71), which is illustrative of many services industries. Productivity growth in this industry is now estimated to have remained relatively flat between 1997 and 2018, whereas previously it was estimated to have risen at 1.9% per year on average.

Figure 6: Output per hour worked in the architectural and engineering services industry is revised down

Output per hour worked, current and Blue Book 2021 data, UK, 1997 to 2018

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Output per hour worked, current and Blue Book 2021 data, UK, 1997 to 2018



Source: Office For National Statistic

5 . New deflator for telecommunications services

As well as double deflation, Blue Book 2021 introduces a new deflator for telecommunications services. The new deflator better reflects the rapid change in quality improvements in the industry, and hence the rapid increase in the quantity of data that can be transferred despite relatively little price change. The deflator for telecommunications services now falls rapidly, implying much faster increase in the volume of services produced and consumed than previously estimated. This leads to slower GVA growth, and hence slower productivity growth, in industries that use a lot of telecommunications services as an intermediate input.

Telecommunications services are consumed across the whole economy, especially in services industries. They account for around 2% of intermediate consumption in the economy as a whole, but this figure is higher in many business services industries and is closer to 5% in the financial and insurance services industry. This is one reason for downward revisions in productivity growth in many services industries.

By contrast, the growth in the volume of output of the telecommunications industry is revised up dramatically. In effect, the value added has been “shifted” from the industries that use telecommunications services to the industry that produces the telecommunications services. Figure 7 shows the upward revision to productivity in the telecommunications industry – output per hour worked is now estimated to grow at an average rate of over 25% per year compared with 5.7% previously.

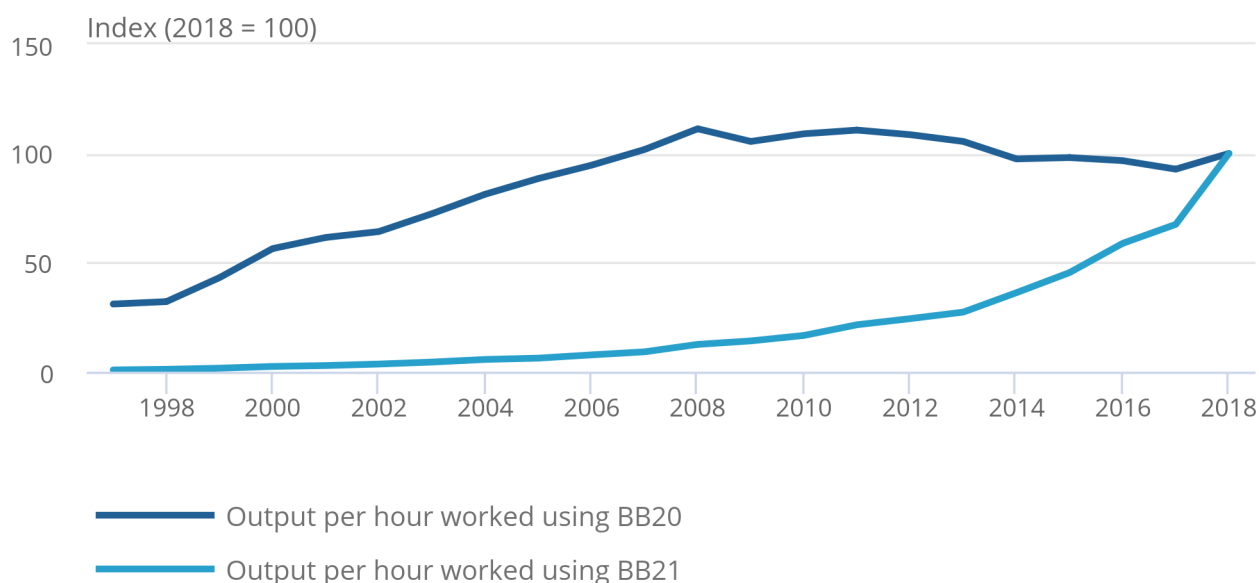
While this leads to very low estimates of the productivity of the telecommunications industry in 1997, this reflects the rapid technological progress in this industry over the past two decades. This development is set out in detail in [earlier methodological publications](#).

Figure 7: Output per hour worked in the telecommunications industry is revised up sharply

Output per hour worked, current and BB21 data, UK, 1997 to 2018

Figure 7: Output per hour worked in the telecommunications industry is revised up sharply

Output per hour worked, current and BB21 data, UK, 1997 to 2018



Source: Office For National Statistics

6 . Contributions to the productivity puzzle

Despite notable revisions to productivity growth in many industries, the drivers of productivity growth before and after the economic downturn in 2008 (and the slowdown in productivity growth after 2008) are not radically different. Figure 8 shows the relationship between productivity growth in each industry before and after the 2008 downturn, in Blue Book 2021 data and the current data. In both cases there is a strong positive correlation, albeit with some variation and a few outliers. Therefore, industries that have faster productivity growth in the current data also tend to in the revised data.

Figure 8: Industries with faster growth in output per hour in the current data tend to also have faster growth in the revised data

Compound annual average growth rates, current and Blue Book 2021 data, UK, 1997 to 2007 and 2010 to 2018

[Download the data](#)

Decomposing changes in aggregate productivity growth into industries also shows that the same broad sectors of the economy are driving productivity growth in each period, and the slowdown in productivity after 2008 (the so-called “productivity puzzle”). Revised data suggest a stronger contribution from manufacturing before and during the 2008 economic downturn than in the current data, but a weaker contribution from consumer-facing services (see notes to Figure 9 for details) over the same periods. Public services industries play a slightly larger role in Blue Book 2021 data than previously: negative before and during the 2008 downturn, and positive afterwards.

The finance and insurance services industry contributed less to productivity growth prior to the economic downturn in the Blue Book 2021 data than before. Blue Book 2021 incorporates data from the new Financial Services Survey for the first time to provide better estimates for this important sector of the economy; these changes are described in an accompanying article [The new data also show their contribution to be close to zero through the downturn period and between 2009 and 2018. Therefore, the slowdown in contribution from the financial services industry is still a feature of the new data.](#)

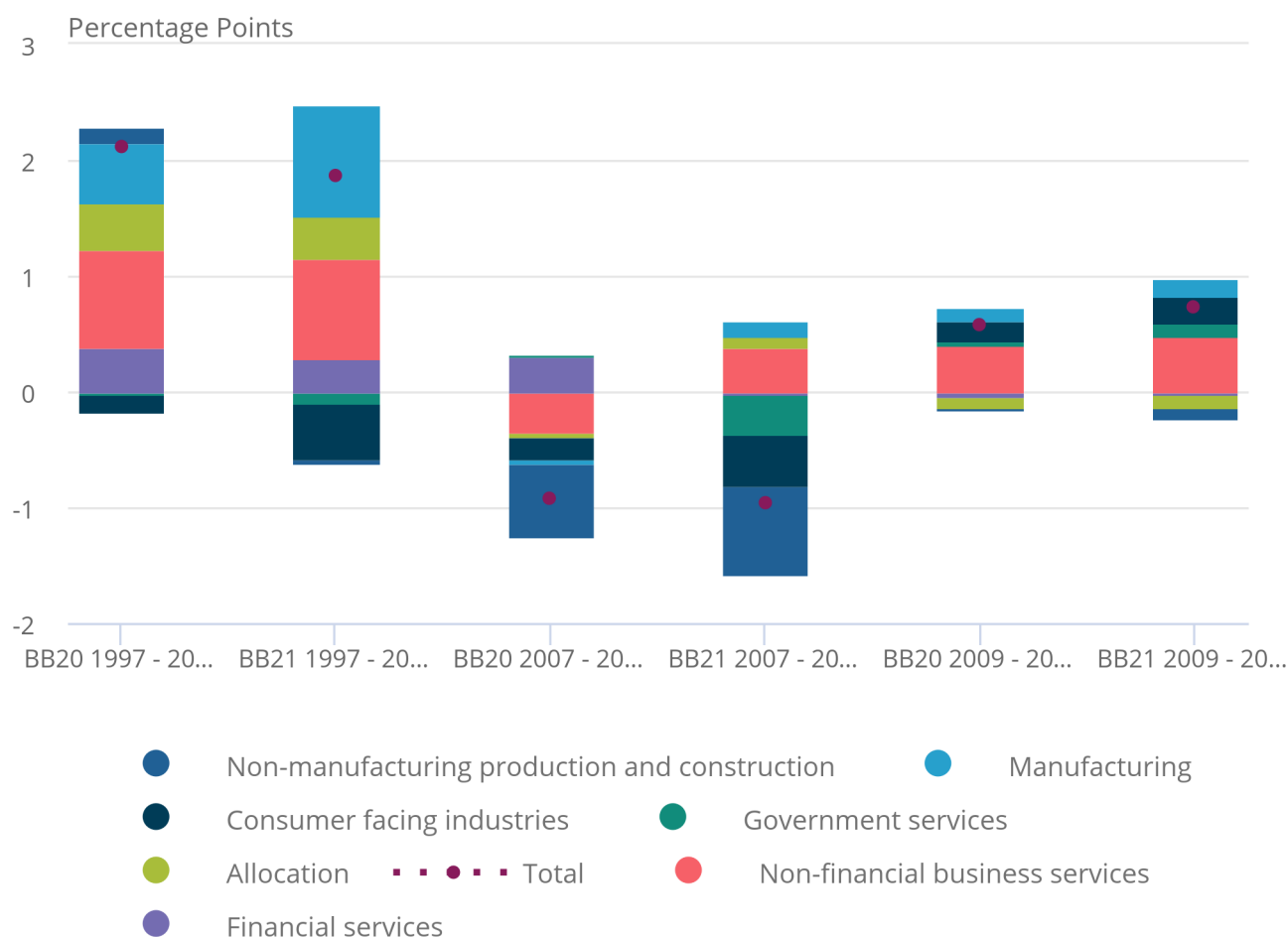
The drivers of growth since 2009 are little changed in the new data, although most industry groupings in Figure 9 make a slightly large contribution than before. The movements during the downturn period of 2007 to 2009 have changed to a greater degree, although this is a short and unusual period.

Figure 9: Industry contributions to aggregate output per hour growth are largely unchanged

Contributions to aggregate annual average productivity (output per hour worked) growth, current and Blue Book 2021 data, UK, 1997 to 2007, 2007 to 2009 and 2009 to 2018

Figure 9: Industry contributions to aggregate output per hour growth are largely unchanged

Contributions to aggregate annual average productivity (output per hour worked) growth, current and Blue Book 2021 data, UK, 1997 to 2007, 2007 to 2009 and 2009 to 2018



Source: Office For National Statistics

Notes:

1. Consumer facing services are retail, wholesale and motor trades (section G), accommodation and food services (section I), real estate (section L), arts, entertainment and recreation (section R), and other services (sections S and T).
2. Non-financial business services are transportation and storage (section H), information and communication (section J), professional, scientific and technical activities (section M), and administrative and support services (section N).
3. ABDEF are the relevant sections of SIC07, representing non-manufacturing production including construction. Allocation is the indirect effect of changes in the size of different industries on aggregate productivity growth.

Previous studies have found some specific industries to be large contributors to the slowdown in aggregate productivity. Researchers at the National Institute for Economic Research (Riley, Rincon-Aznar and Samek) found in 2018 that [two industries had contributed disproportionately to the slowdown](#): the telecommunications industry (division 61) and the financial services industry (division 64). Similarly, Goodridge, Haskel and Wallis (2016) using earlier data found that [the financial and insurance services industry \(section K\) was a large driver of the slowdown \(PDF, 1.2MB\)](#). Using more recent data, Bank of England Monetary Policy Committee member Silvana Tenreyro suggested in 2018 that around [three-quarters of the slowdown could be explained by manufacturing \(section C\) and financial and insurance services \(section K\)](#).

The growth in some of these industries has changed in Blue Book 2021 data. Figure 10 shows the 10 industries that had the largest slowdown in productivity growth after the 2008 downturn in the current data, and how this slowdown has changed in the Blue Book 2021 data.

The Blue Book 2021 data has reduced the size of the slowdown in some of these industries, such that their growth trajectory after the economic downturn is more similar to before 2007. This effect is most obvious in the telecommunications industry (division 61), although it is also notable in head office activities (division 70), and warehousing and other transportation support activities (division 52). The building and landscaping activities industry (division 81) is now estimated to have faster productivity growth after the 2008 economic downturn than before, reversing the slowdown in the current data.

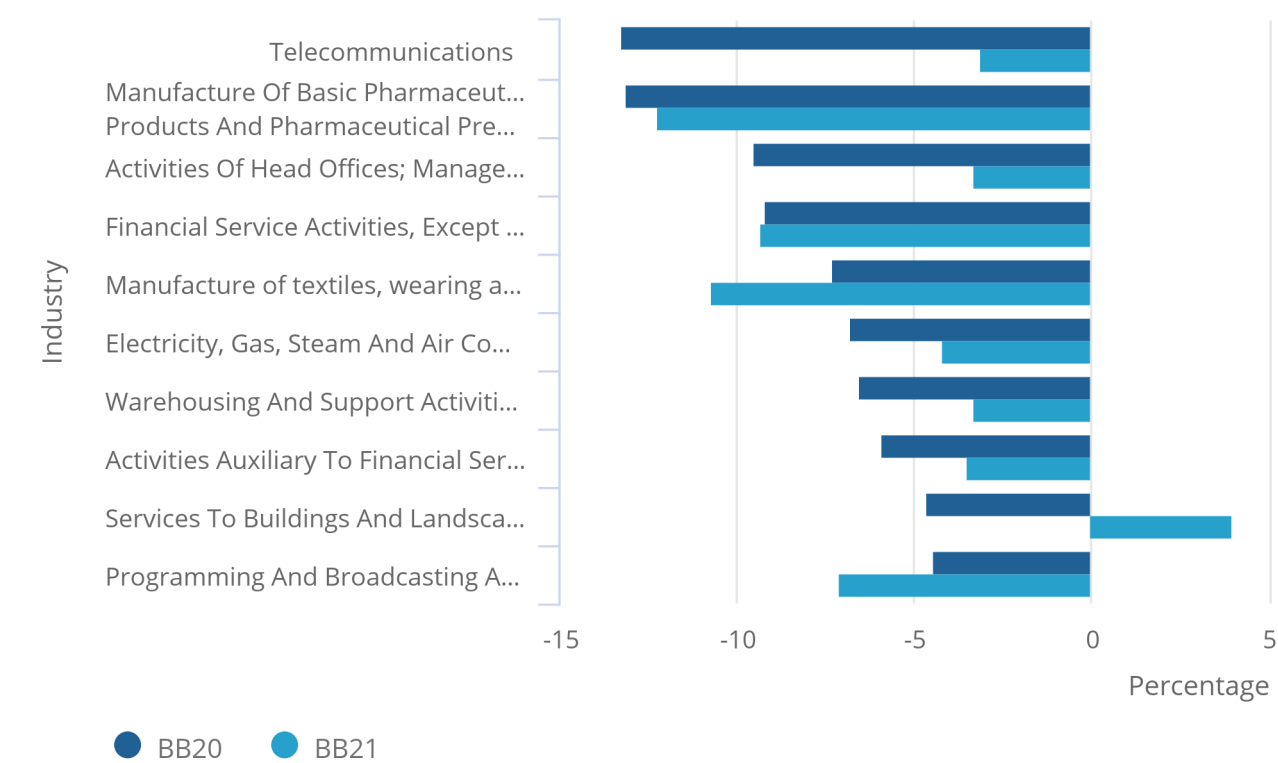
Other industries have seen more muted changes, including the manufacturing industries highlighted in Figure 10, and the financial services industry (especially division 64; see also Figure 9). This suggests that many of the conclusions reached in previous studies of productivity data are likely to hold, with the exception of the telecommunications industry. Changes to these findings demonstrate the benefits of improved measurement introduced in Blue Book 2021.

Figure 10: Most of the industries that have large slowdowns in current data continue this in new data

Slowdown in productivity growth after 2008 economic downturn, top 10 industries based on current data, current data and Blue Book 2021 data, UK

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Slowdown in productivity growth after 2008 economic downturn, top 10 industries based on current data, current data and Blue Book 2021 data, UK



Source: Office For National Statistics

Notes:

1. Data shows each industries' productivity growth prior to the economic downturn (1997 to 2007) minus its performance post economic downturn (2010 to 2018) for current and BB21 data.

7 . Future developments

[Official quarterly productivity estimates released in October 2021](#) will be the first to reflect these changes, following publication of the Blue Book 2021-consistent [quarterly national accounts in September 2021](#).

8 . Glossary

Labour productivity

Labour productivity measures how many units of labour input is needed to produce a unit of output, and is calculated by dividing output by labour input.

Labour inputs

The preferred measure of labour input is hours worked (“productivity hours”), but workers and jobs (“productivity jobs”) are also used.

Output

Output refers to gross value added (GVA), which is an estimate of the volume of goods and services produced by an industry, and in aggregate for the UK.

Deflator

A price index used to remove inflation effects from current price estimates of expenditure to provide a volume estimate.

Double deflation

Double deflation is a method for calculating value added by industry chained volume measures, which takes separate account of the differing price and volume movements of input and outputs in an industry’s production process.

9 . Related links

[Impact of double deflation on industry chain volume measure annual estimates 1997 to 2018](#)

Article | Released 28 June 2021

In Blue Book 2021, a new framework will be introduced to produce GDP in volume terms which includes double deflated industry level gross value added. This article contains estimates of the impact to the industry composition of volume gross value added from 1997 to 2017.

[Impact of Annual Blue Book 2021 changes on current price and volume estimates of gross domestic product](#)

Article | Released 28 June 2021

Methodological and data improvements that impact on current price and chain volume measure of GDP for the period 1997 to 2019

[Productivity economic commentary, UK: October to December 2020](#)

Article | Released 14 April 2021

The main findings from official statistics and analysis of UK productivity, presenting a summary of recent developments.