

Article

# Public service productivity, UK: 1997 to 2022

An overview of UK annual public service productivity between 1997 and 2020, and a new experimental measure for the path of annual UK public service productivity in 2021 and 2022.

Contact:  
Ed Bailey, A Blunden, Nick  
Chapman, Rebecca McAlpine  
psp.review@ons.gov.uk  
+44 1633 580075

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# 1 . Main points

- Based on new experimental methods, total public service productivity grew by an average of 0.2% per year between 1997 and 2019, with variation by service area, and periods of faster and slower growth over the period.
- Service area productivity growth rates ranged from negative 1.4% (public order and safety) to 0.9% (healthcare) per annum over the same period.
- Based on new experimental modelled nowcasts, total public service productivity is estimated to have been around 0.3% lower than pre-coronavirus (COVID-19) pandemic levels in 2022, although this varies by service area.
- An Office for National Statistics (ONS) work programme will update and monitor how best to improve estimates of timelier measures of annual public service productivity.

These are Experimental Statistics. These nowcast estimates will be subject to revision as modelling methods are refined and more up-to-date data becomes available. We advise caution when using the data.

## 2 . Overview of productivity review

In June 2023, the Chancellor of the Exchequer asked Professor Sir Ian Diamond, the National Statistician, to undertake a [Review of the measurement of public service productivity](#) in England. To improve measures, the Office for National Statistics (ONS) is now partnering with government departments, academics, and expert users to help develop and further improve methodology and data sources.

This is the first publication from the Public Services Productivity Review (PSPR), focussed on improving short-term estimates. This utilises two experimental components. The first is an analysis of the baseline trend taken from existing annual total public service quality-adjusted productivity data, which is currently available for the period 1997 to 2020, to understand the long-term potential of productivity growth. This aims to provide insight into current underlying trends in public service productivity to improve policymakers' ability to measure future performance.

Given the lag in official statistics, the second component is a nowcast estimate for public service productivity in 2021 and 2022, based on existing annual data and the path of quarterly public service productivity data. Quarterly data are currently available for the period Quarter 1 (Jan to Mar) 1997 to Quarter 2 (Apr to June) 2023 and are without quality adjustment. This nowcast estimate brings quality into the short-term measures to make them more comparable with the annual data, which is fully quality adjusted. Nevertheless, they should be considered experimental and subject to updating and revision. Our work on the Public Services Productivity Review will continue to evaluate other nowcasting methods and identify new data sources.

Further details on the concepts and methods used in our public service productivity statistics can be found in our [Sources and methods for public service productivity estimates article](#). Further details on the annual data series can be found in our [Public service productivity: total, UK, 2020 article](#), and on the quarterly series in our [Public service productivity, quarterly, UK: April to June 2023 bulletin](#).

### **3 . Trends in public service productivity**

As part of the Public Services Productivity Review (PSPR), we have developed an experimental data-driven long-term baseline against which to measure future performance. This provides an extended annual time series, during which government expenditure plans and wider economic conditions have varied.

As this is a purely empirical study, which does not make any strong assumptions about changes in public sector finances, innovation in service design, or external factors on the productivity of the public sector, actual outturns can be expected to vary from the baseline growth rate in any particular year.

This method uses Compound Annual Growth Rates (CAGR), which smooths out the volatile nature of annual growth rates by taking an average over several years. Our chosen approach uses a period from 1997 to 2019, wherever possible, for two reasons:

- The impact of the coronavirus (COVID-19) pandemic on the data is notable, severely affecting long-run growth across several service areas, with growth rates for 1997 to 2019 turning negative with the inclusion of 2020. Therefore, 2020 is treated as an outlier and has been excluded when calculating the baseline
- using the period from 1997 to 2019 better captures more than one business cycle, rather than only measuring growth since the previous recession, and therefore includes a range of wider economic conditions

There are some exceptions to the position. For adult social care and children's social care, we have only used data points from the most recent method change (in 2011 and 2010, respectively) to ensure a consistent dataset. We do not calculate a baseline for defence, social security administration, police, and other service areas which currently use the "output-equals-inputs" approach. More details on the "output-equals-inputs" method can be found in Section 6 of our [Public service productivity: total, UK Quality and Methodology Information \(QMI\)](#). The review will prioritise sourcing new data and methods to address this gap before calculating a baseline or nowcasting in these areas.

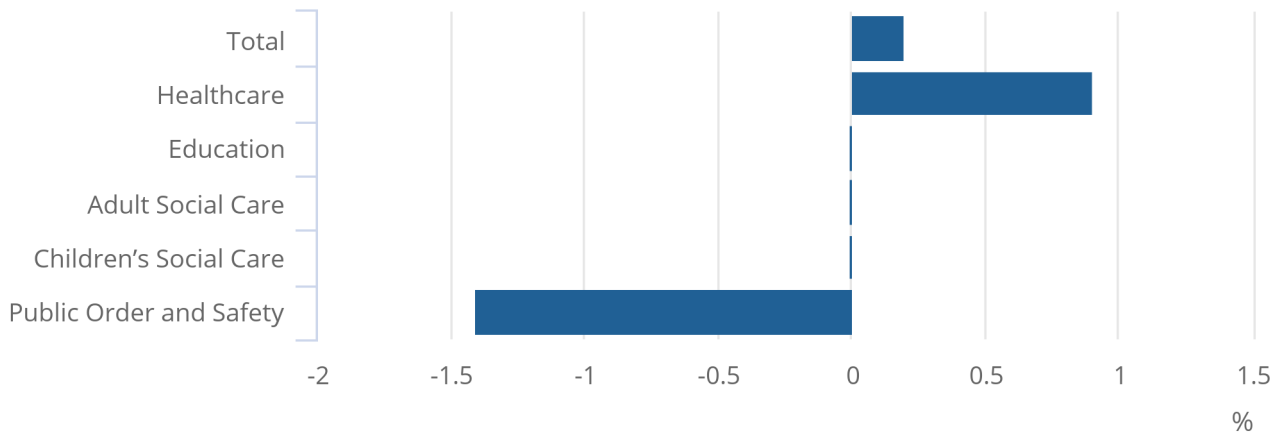
The baseline growth rates for public service productivity (PSP) are shown in Figure 1. Total PSP grew by an average of 0.2% per year from 1997 to 2019, with individual service area growth rates ranging from negative 1.4% per year for public order and safety to 0.9% for healthcare. The growth rates for education, adult social care and children's social care are all close to zero.

**Figure 1: Average productivity growth rates range from negative 1.4% (public order and safety) to 0.9% (healthcare) per year between 1997 and 2019**

Compound Annual Growth Rates for total public service productivity, quality adjusted, by service area, 1997 to 2019 unless stated, UK

Figure 1: Average productivity growth rates range from negative 1.4% (public order and safety) to 0.9% (healthcare) per year between 1997 and 2019

Compound Annual Growth Rates for total public service productivity, quality adjusted, by service area, 1997 to 2019 unless stated, UK



Source: Public Service Productivity from the Office for National Statistics

**Notes:**

1. Baseline productivity growth rates are only produced for service areas that include quality adjustment: defence, police, social security administration, and other are currently excluded, but do form part of the total.
2. Adult social care and children's social care use new methods from 2011 and 2010 onwards respectively, so data are only used from that period.

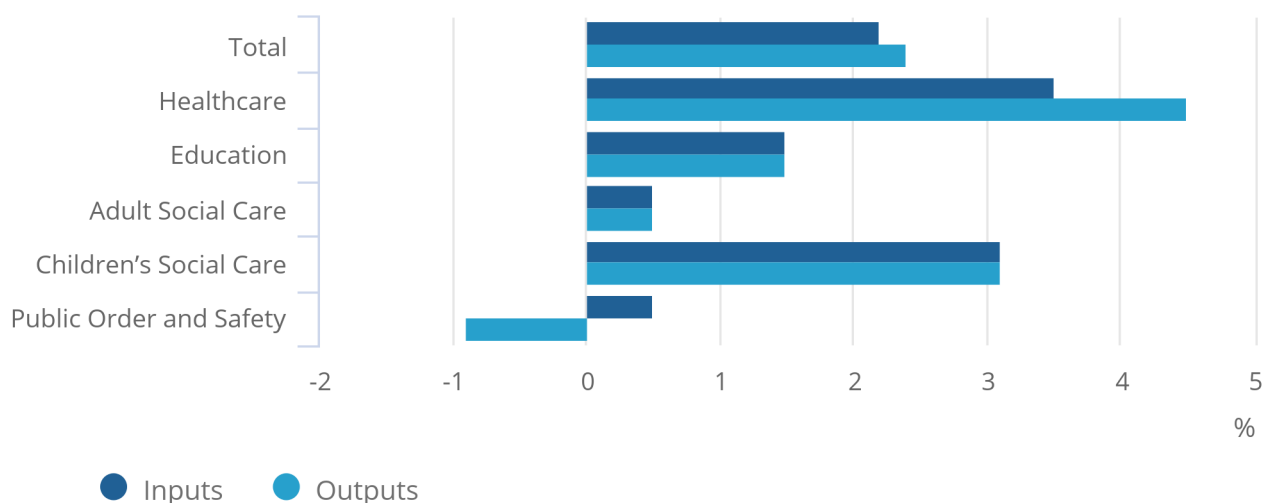
Analysing the movement in both output and inputs allows a deeper understanding of the causes of growth in productivity. Figure 2 shows a breakdown of inputs and outputs CAGRs over the same period.

## Figure 2: Growth in inputs and outputs has been broadly similar over the entire period

Compound Annual Growth Rates for total public service inputs and outputs, quality adjusted, by service area, 1997 to 2019, unless stated, UK

### Figure 2: Growth in inputs and outputs has been broadly similar over the entire period

Compound Annual Growth Rates for total public service inputs and outputs, quality adjusted, by service area, 1997 to 2019, unless stated, UK



Source: Public service productivity from the Office for National Statistics

#### Notes:

1. Baseline productivity growth rates are only shown for service areas that include quality adjustment: defence, police, social security administration, and other are currently excluded, but do form part of the total.
2. Adult social care and children's social care use new methods from 2011 and 2010 onwards respectively.

From 1997 to 2019, healthcare inputs grew by an average of 3.5% per year, while outputs grew by 4.5% per year. Conversely, for public order and safety, outputs fell by 0.9% per year while inputs grew by 0.5% per year. More detail on trends in annual public service productivity can be found in our [Public service productivity: total, UK, 2020 article](#).

The difference between the CAGR of inputs and outputs may not equal the CAGR of productivity because of the growth rates for the inputs, outputs and productivity series being averages of their individual series. Nonetheless, the inputs and outputs CAGRs highlight the potential causes of long-term productivity trends.

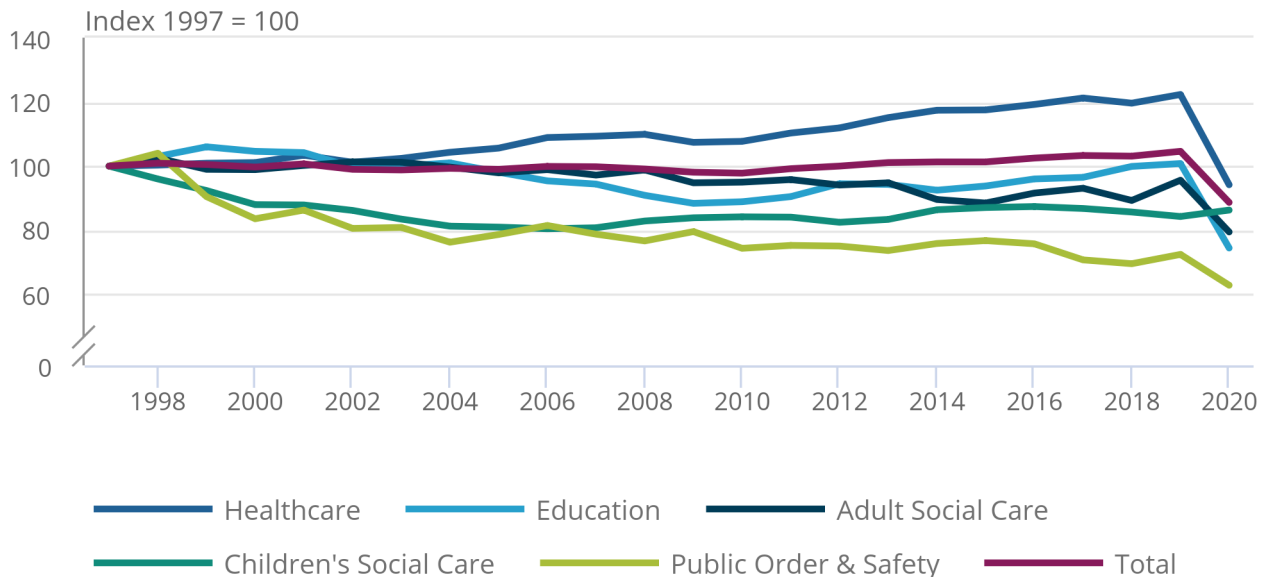
It can be helpful to consider the context of these growth rates. Figure 3 shows the path of annual total public service productivity from 1997 to 2020 for each service area.

### Figure 3: The rate of public service productivity growth varies by service area

Total public service productivity, quality adjusted, by service area, Index 1997=100, 1997 to 2020, UK

## Figure 3: The rate of public service productivity growth varies by service area

Total public service productivity, quality adjusted, by service area, Index 1997=100, 1997 to 2020, UK



Source: Public service productivity from the Office for National Statistics

#### Notes:

1. Defence, police, social security administration, and other are excluded, but do form part of the total.

The trajectory of total public service productivity over the period 1997 to 2020 shows a shallow decline to 2010, followed by a steady increase to 2019; 2020 saw a large decline in measured productivity during the coronavirus pandemic. The contributors to productivity differ during these periods. While both output and input growth were positive throughout the period, annual growth of both output and input in 1997 to 2010 far exceeded that of 2010 to 2019. Input growth exceeded output growth pre-2010, and output growth exceeded input growth post-2010. This trend is detailed in our [Public service productivity: total, UK, 2020 article](#).

Estimates in this publication are based on our most up-to-date methods and data available. As more up-to-date detailed data becomes available and we continue to improve our methods, we will revise our annual estimates. This means these estimates will change in the future.

## 4 . Public service productivity nowcasts for 2021 and 2022: a dynamic regression approach

Given the timeliness of our source data, which come from administrative sources, annual public service productivity estimates are currently produced at a two-year time lag. To give indicative estimates of timelier measures, we produce nowcast estimates of annual public service productivity each quarter, most recently in our [Public service productivity overview, UK: April to June 2023 article](#). This nowcasting approach uses annualised quarterly public service productivity growth rates for the most recent periods and applies them to the annual series.

This approach has limitations. Although both the annual data and annualised quarterly estimates track changes in the quantity of services delivered, only the annual series applies a quality adjustment (see our [Guide to quality adjustment in public service productivity measures article](#)). Moreover, our quarterly output indices have lower coverage and are less granular than our annual estimates.

Between 1997 and 2019, our annual productivity measures perform better on average than quarterly productivity measures because of the inclusion of quality adjustment. Therefore, basing nowcasts on just the quarterly series may result in lower productivity growth estimates in 2021 and 2022.

As an alternative nowcasting approach, we produced experimental modelled estimates using dynamic regression. Unlike forecasting, which relies heavily on projections and assumptions about the future economic situation, our alternative approach uses data on annual quality-adjusted productivity trends for previous years (before 2020), and information on current quarterly public service productivity (up to Quarter 4 (Oct to Dec) 2022), to estimate annual public service productivity in 2021 and 2022. These nowcasts are a product of the observed annualised quarterly series in 2021 and 2022 and the relationship between the observed annual series and annualised quarterly series in 1997 to 2019 (excluding 2020 because of the impact of the coronavirus (COVID-19) pandemic). More information on the regression methods used in this article can be found in [Section 8: Data sources and quality](#).

We acknowledge, as experimental statistics, that our alternative nowcasts presented for the first time in this article have limitations. As they use quarterly annualised data as part of the estimation process, the strength of the relationship between the two data series will affect the robustness of the estimates produced. To increase the reliability of our experimental nowcast method, we sought to incorporate relevant leading indicators for service area output. To reflect this, we have applied an adjustment to reduce healthcare output growth in 2021 by a quarter and then apply this to our nowcasts for healthcare and total productivity.

We will continue to evaluate other nowcasting methods and will monitor and improve experimental estimates of public service productivity where appropriate. This includes undertaking cross validation of estimates used when new data becomes available in early 2024. Changes to methods, quality adjustments and revisions to data will affect the accuracy of our current nowcast estimates and will lead to future revisions.

Our Data Science Campus has previously published [Outputs exploring economic nowcasting methods](#). Likewise, the Economic Statistics Centre of Excellence has recently published a [Discussion paper](#) on nowcasting unpaid production activity and quality adjustments in public service productivity.



## Total public service productivity

Our experimental regression-based measure of annual total public service productivity estimates growth of around 15.1% and 2.2% in 2021 and 2022, respectively. This large increase in 2021 reflects a post-coronavirus (COVID-19) pandemic rebound, as services recovered from the decrease seen during the pandemic. The level of total public service productivity is estimated to be around 0.3% lower by 2022 than their pre-pandemic peak.

We have included confidence intervals at the 95% level around our central modelled estimate. These provide an indication of the degree of uncertainty for total public service productivity estimates for 2021 and 2022. The width of the confidence intervals are determined by the uncertainty there is in the estimate produced (for instance, wider confidence intervals reflect greater uncertainty).

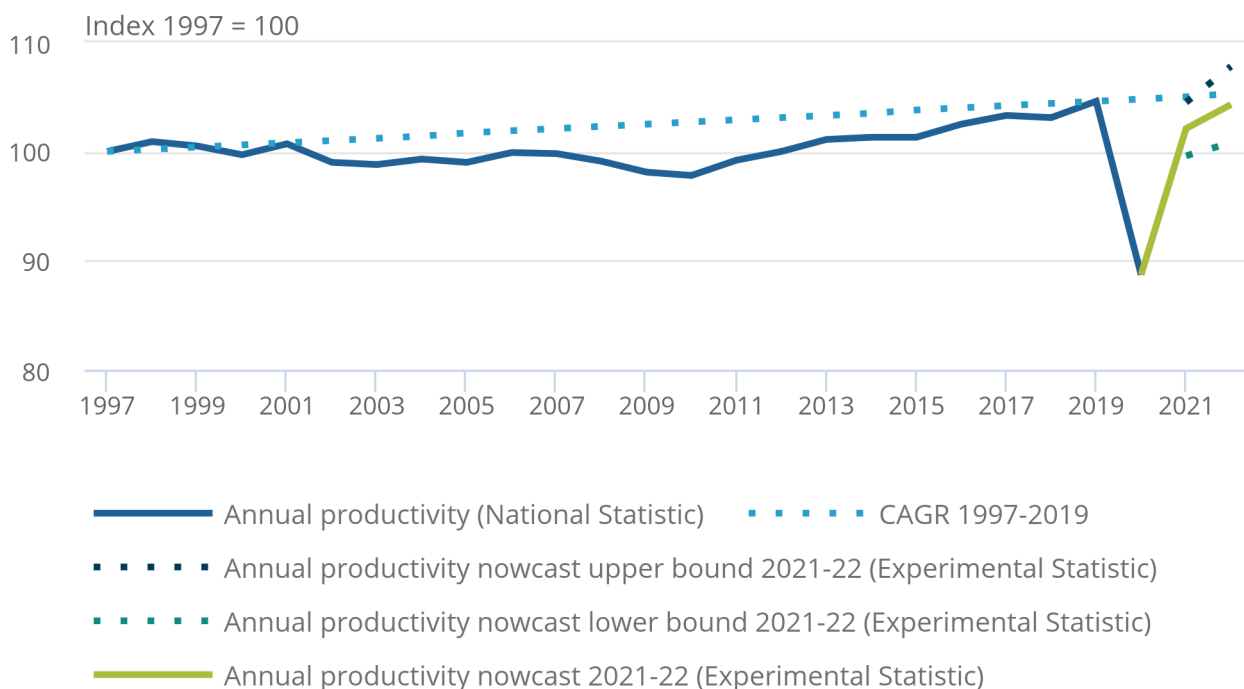
Our growth estimates in 2021 range between the lower bound (12.3%) and the upper bound (17.8%). Meanwhile in 2022, our estimates suggest productivity growth between 1.2% and 3.1%. In any particular year of the nowcast period, public service productivity growth is expected to lie somewhere within these growth rates on 95 out of 100 occasions.

### Figure 4: Total public service productivity is estimated to be 0.3% lower than pre-coronavirus (COVID-19) pandemic levels by 2022

Total public service productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022

Figure 4: Total public service productivity is estimated to be 0.3% lower than pre-coronavirus (COVID-19) pandemic levels by 2022

Total public service productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022



Source: Public service productivity from the Office for National Statistics

Notes:

- Confidence intervals are at the 95% level.
- In response to additional data being available for healthcare outputs in 2021, we have applied a downwards adjustment to the annualised quarterly healthcare and total output during that period. See text for details.

If we apply our CAGR of 0.2% from 2019 onwards, the level of annual total public service productivity for 2022 would be 0.9% higher than our regression-based nowcast estimate.

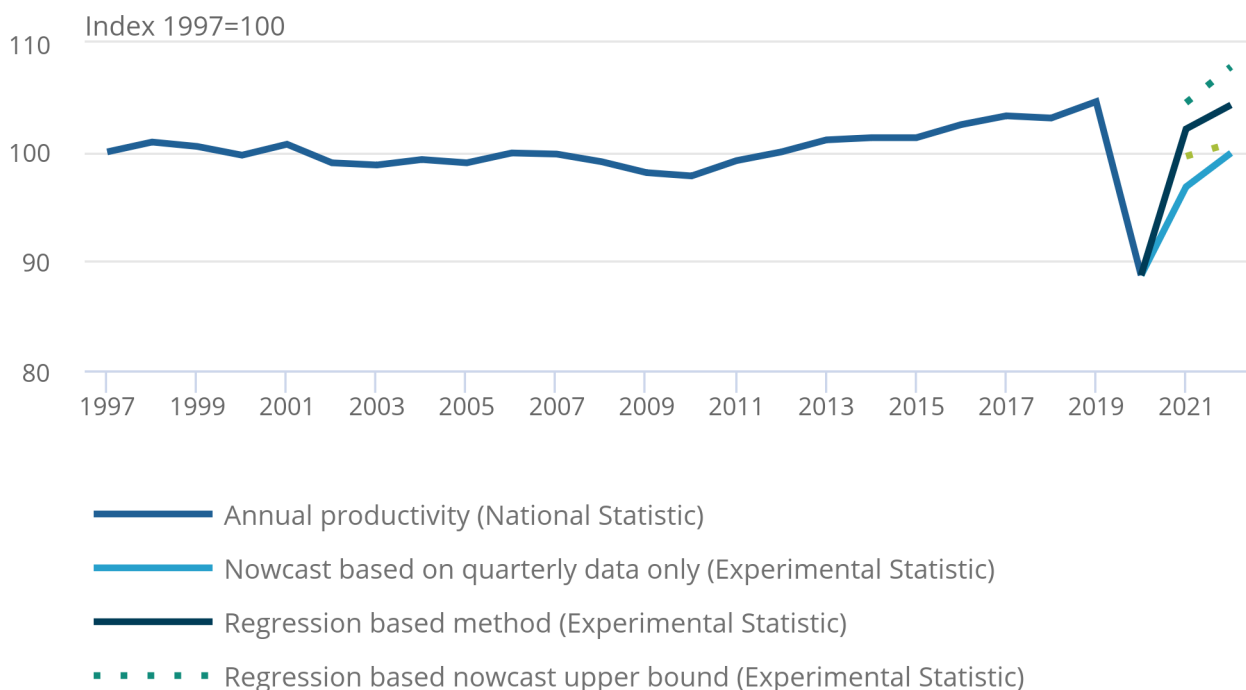
Compared with the current nowcast estimates in our [Public service productivity overview, UK: April to June 2023 article](#) (that assume annual growth rates mirror those in the annualised quarterly series), our experimental nowcast approach assumes public service productivity grew faster post-pandemic. This is because of the inclusion of a quality adjustment element and methodological differences in our data. Figure 5 demonstrates the difference between the two nowcast measures.

**Figure 5: Public service productivity may demonstrate a stronger "bounce-back" in 2021 using a dynamic regression nowcast approach**

Comparison of nowcast methods for total public service productivity, UK, Index 1997=100 ,1997 to 2020, and nowcast 2021 to 2022

Figure 5: Public service productivity may demonstrate a stronger "bounce-back" in 2021 using a dynamic regression nowcast approach

Comparison of nowcast methods for total public service productivity, UK, Index 1997=100 ,1997 to 2020, and nowcast 2021 to 2022



Source: Public service productivity from the Office for National Statistics

Notes:

1. Confidence intervals are at the 95% level.
2. In response to additional data being available for healthcare outputs in 2021, we have applied a downwards adjustment to the annualised quarterly healthcare and total output during that period. See text for details.

Our regression-based estimates for 2021 and 2022, unlike the method used in our [Public service productivity overview, UK: April to June 2023 article](#), account for the relationship between the observed annual series and annualised quarterly series in 1997 to 2019. This might account for differences in growth rate estimates.

We do not have timely data on public service delivery outcomes. Therefore, we cannot test the extent to which quality has improved or deteriorated over the nowcast period. If quality was to improve slower than pre-pandemic or deteriorated between 2021 and 2022 this nowcast could be an over-estimate of annual public service productivity growth in 2021 and 2022.

## 5 . Productivity by public service area for 2021 and 2022: a dynamic regression approach

We have also produced modelled estimates for 2021 to 2022 for the following service areas: healthcare, education, and public order and safety. We exclude estimates for service areas which follow the “output-equals-input” output measure (more details can be found in Section 6 of our [Public service productivity: total, UK Quality and Methodology Information \(QMI\)](#)), these include: defence, social security administration, police and other services. We also exclude adult social care and children’s social care, given data limitations.

To nowcast estimates for 2021 to 2022, we require annualised quarterly data for each service area, as described in [Section 4: Public sector productivity for 2021 to 2022: a dynamic regression approach](#). This requires us to select the most appropriate quarterly regressors to estimate the 2021 to 2022 annual values for these series. Each service area uses the most appropriate corresponding regressor; for example, public order and safety uses justice and fire.

Modelled estimates take into consideration past observations of the annual series, and the more up to date annualised quarterly series data for each service area. This means it is not possible to weight and aggregate individual service area estimates in line with estimates of total public service productivity described in [Section 4: Public sector productivity for 2021 to 2022: a dynamic regression approach](#).

## Healthcare

Healthcare represents the largest service area included in public service productivity (around approximately 40% expenditure share of total public service provision). The coronavirus (COVID-19) pandemic caused widespread cost pressures and disruption to healthcare inputs and outputs. Consequently, annual healthcare productivity fell by 23.0% in 2020 on a quality-adjusted basis.

During the coronavirus pandemic period, there were several fundamental changes to the delivery of healthcare services (for instance, some non-urgent services were stopped to reduce the spread of COVID-19) and challenges in data collection.

Because of the exceptional impact of the pandemic on healthcare services, we conducted an additional quality assurance of our new experimental nowcasts, reaching out to external and other government departmental stakeholders. The universal message we received is that the post-pandemic environment the NHS is facing is still materially different from the pre-pandemic environment. Moreover, the NHS, while receiving additional resources, has had to heavily focus on returning quantity of outputs to pre-existing levels. The opportunity to consider improvements to quality of services appears very restricted. Therefore, we recommend that the lower bound confidence interval in our experimental methodology for healthcare is likely to better reflect growth in healthcare productivity across this period.

Using our experimental nowcast approach, we assume annual healthcare productivity on a quality-adjusted basis has grown by 26.6% in 2021 and 1.1% in 2022. This represents a recovery from much of the previous falls seen during the pandemic.

Our estimates of growth in 2021 range between the lower bound (22.2%) and the upper bound (30.9%), while in 2022, our estimates suggest productivity growth between 0.3% and 1.8%. Therefore, in any particular year of the nowcast period, healthcare productivity growth is expected to lie somewhere within these growth rates on 95 out of 100 occasions.

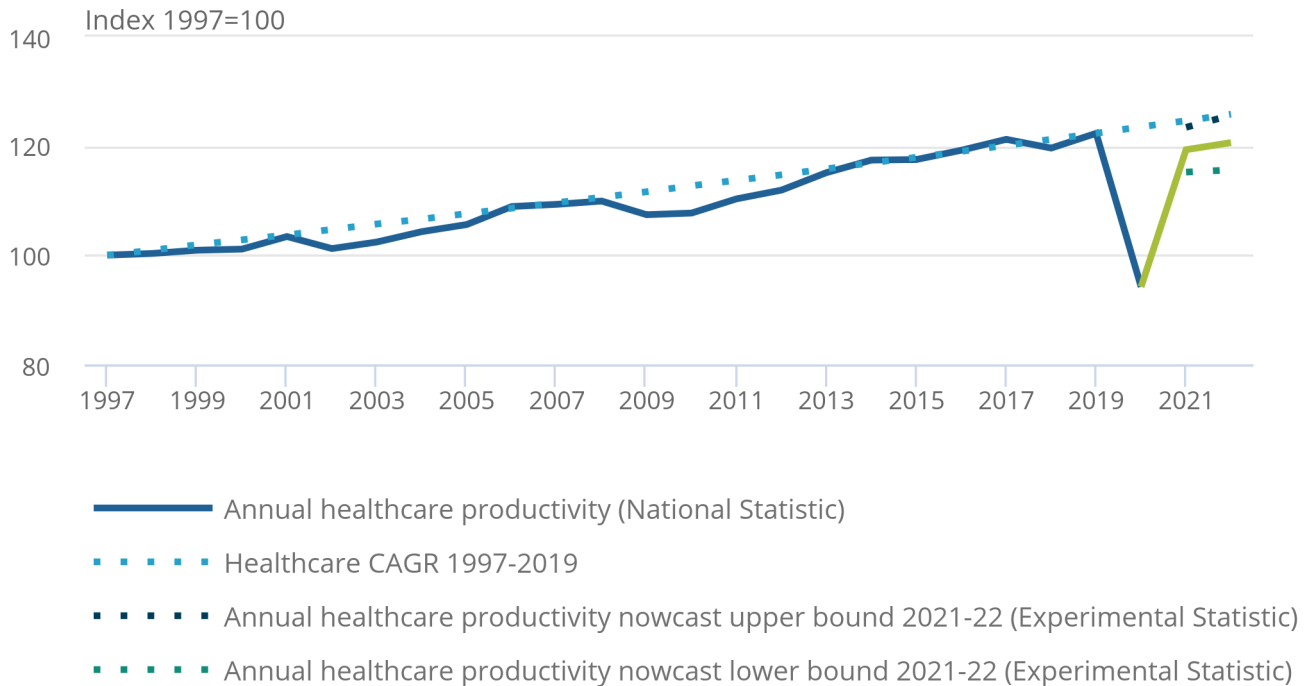
As noted previously, an adjustment has been applied to our nowcast for healthcare productivity to reflect more accurately the most up-to-date indicators of service area outputs.

**Figure 6: Annual healthcare productivity on a quality-adjusted basis is estimated to be 5.5% below pre-coronavirus (COVID-19) pandemic levels, using our lower bound estimate**

Healthcare productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022

Figure 6: Annual healthcare productivity on a quality-adjusted basis is estimated to be 5.5% below pre-coronavirus (COVID-19) pandemic levels, using our lower bound estimate

Healthcare productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022



Source: Public service productivity from the Office for National Statistics

Notes:

1. Confidence intervals are at the 95% level.
2. In response to additional data being available for health outputs in 2021, we have applied a 25% downwards adjustment to the annualised quarterly health output during that period.

## Education

Education represents the second largest service area in public service productivity by expenditure share. As with healthcare, annual education productivity on a quality adjusted basis fell sharply (26.1%) in 2020. The coronavirus pandemic affected the delivery of education services through remote learning on teaching hours, teaching materials provided, and increased sickness rates. Educational attainment in 2020 was also affected by the pandemic. More information on how the coronavirus pandemic affected education productivity can be found in our [Public service productivity: total, UK, 2020 article](#).

Using our experimental nowcast approach, annual education productivity on a quality-adjusted basis is assumed to have grown by around 26.7% in 2021 and 7.4% in 2022. This represents a recovery from much of the previous falls seen during the pandemic.

Confidence intervals for annual education productivity nowcasts are wider than those for healthcare and public order and safety, highlighting a higher degree of uncertainty with these estimates.

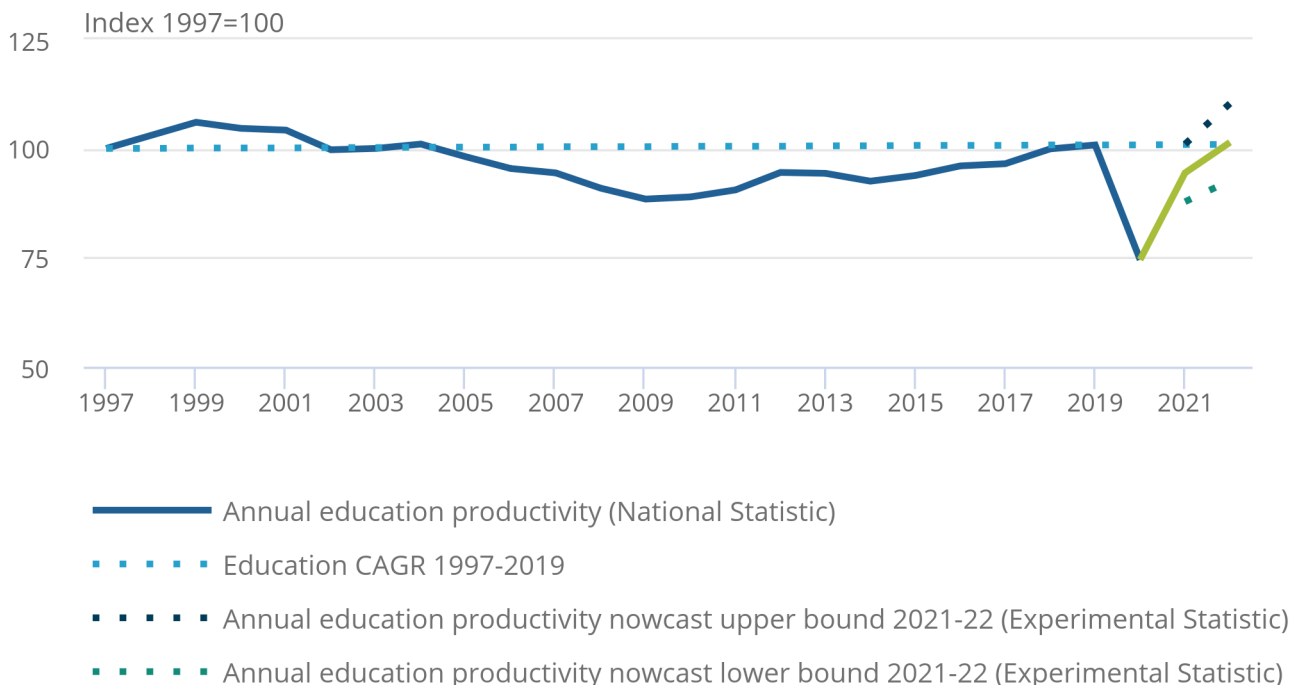
Our estimates of growth in 2021 range between the lower bound (17.9%) and the upper bound (35.6%), while in 2022, our estimates suggest productivity growth between 5.4% and 9.2%. Therefore, in any particular year of the nowcast period, education productivity growth is expected to lie somewhere within these growth rates on 95 out of 100 occasions.

**Figure 7: Our nowcast for 2021 and 2022 estimates annual education productivity returns to the pre-coronavirus (COVID-19) pandemic level in 2022**

Education productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022

Figure 7: Our nowcast for 2021 and 2022 estimates annual education productivity returns to the pre-coronavirus (COVID-19) pandemic level in 2022

Education productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022



Source: Public service productivity from the Office for National Statistics

Notes:

1. Confidence intervals are at the 95% level.

## Public order and safety

Within the public order and safety (POS) service area, there are four main components: fire, courts, probation, and prisons. Police is measured separately to POS and is, therefore, excluded from these measurements.

As explained in [Section 3: Trends in public service productivity](#), annual POS productivity on a quality-adjusted basis has fallen steadily between 1997 and 2019. Restrictions to deal with the coronavirus pandemic contributed to a further fall of 13.2% in 2020.

Our nowcast method estimates that annual POS productivity almost recovers to the pre-coronavirus (COVID-19) pandemic trend level in 2021 and 2022 with annual growth of around 0.4% and 6.8%, respectively.

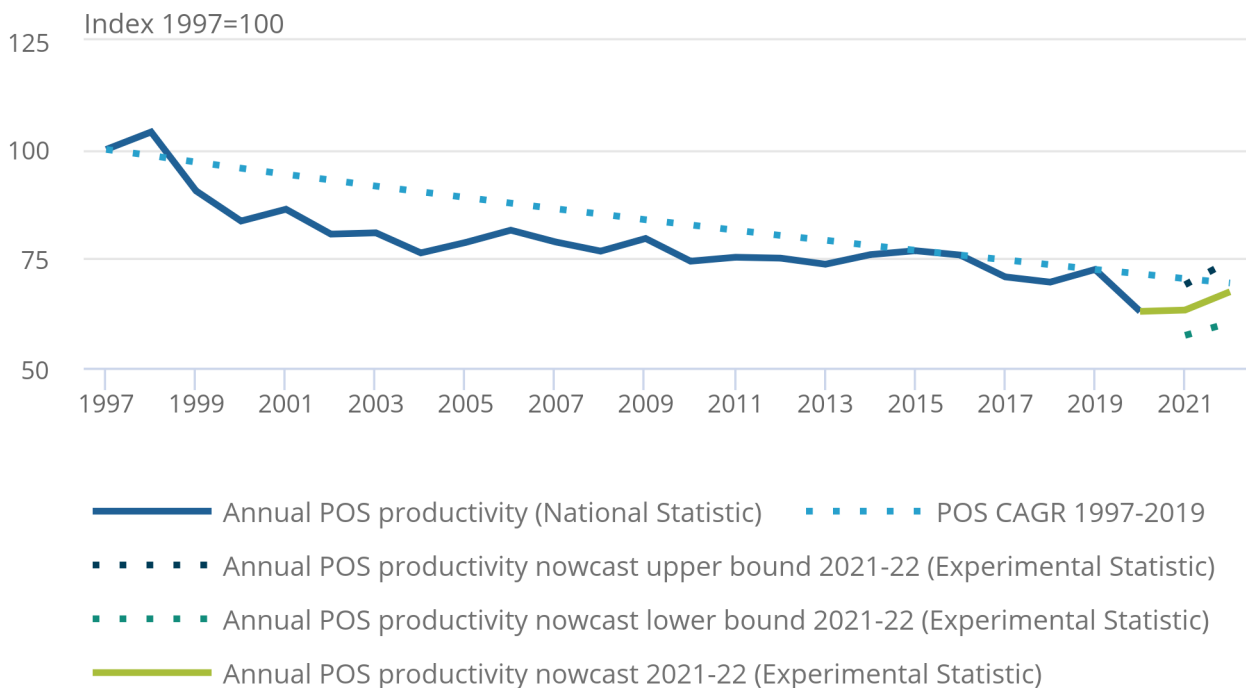
As with healthcare and education, we have provided confidence intervals around our central estimate. Our estimates in 2021 range between the lower bound (negative 8.8%) and the upper bound (9.7%), while in 2022, our estimates suggest productivity growth between 5.2% and 8.1%. Therefore, in any particular year of the nowcast period, POS productivity growth is expected to lie somewhere within these growth rates on 95 out of 100 occasions.

### Figure 8: Our regression-based nowcast estimates that annual POS productivity almost recovers to the pre-coronavirus (COVID-19) pandemic trend level by 2022

Public order and safety productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022

Figure 8: Our regression-based nowcast estimates that annual POS productivity almost recovers to the pre-coronavirus (COVID-19) pandemic trend level by 2022

Public order and safety productivity, UK, Index 1997=100, 1997 to 2020, and nowcast 2021 to 2022



Source: Public service productivity from the Office for National Statistics

Notes:

- Confidence intervals are at the 95% level.

## 6 . Public service productivity data

[Public service productivity nowcasts, UK](#)

Dataset | Released 17 November 2023

Experimental dynamic regression nowcast estimates of public service productivity.

## 7 . Glossary

### Classification of the functions of government

The [Classification of the functions of government \(COFOG\)](#) is the structure used to classify government activities. It is defined by the United Nations Statistics Division.

### Confidence interval

Confidence intervals use the standard error to derive a range in which we think the true value is likely to lie.

### Direct output measurement

Using a cost-weighted activity index to estimate the non-quality-adjusted of a service provided, such as the number of students in state schools, adjusted for attendance to produce an estimate of total hours of schooling delivered each year. Differs from indirect output measurement, where output is assumed equal to inputs.

### Public services

These are services delivered by or paid for by government (central or local). If paid for by the government, they may be delivered by a private body. For example, the provision of nursery places by the private sector, where these places were funded by the government.

### Quality adjustment

A statistical estimate of the change in the quality of a public service, using an appropriate metric, such as safety in prisons as part of the public order and safety adjustment.

### Service area

The way we refer to the breakdown of public services into nine areas, closely following COFOG.

## 8 . Data sources and quality



## Regression methods

The nowcasts are produced using dynamic regression and the relevant annualised quarterly series. Dynamic regression is a time series analysis method which allows nowcast to use information from past observations of the series and also information from predictor variables. The predictor variables used were the relevant annualised quarterly series. For example, total productivity (annual) is regressed on total productivity (annualised quarterly). Therefore, the nowcasts are a consequence of the observed annualised quarterly series in 2021 and 2022 and the relationship between the observed annual series and annualised quarterly series in 1997 to 2019 (2020 was excluded because of the effect of the coronavirus (COVID-19) pandemic). Dynamic regression is an extension of autoregressive integrated moving average (ARIMA) modelling; the extension allows inclusion of predictor variables. For example, a standard regression would be:

$$y_t = \beta_0 + \beta_1 x_{1,t} + \dots + \beta_k x_{k,t} + \varepsilon_t$$

Where the error is assumed to be uncorrelated. However, in dynamic regression, the error term is assumed to follow an ARIMA process. For example, if the error term followed an ARIMA process the model would be:

$$y_t = \beta_0 + \beta_1 x_{1,t} + \dots + \beta_k x_{k,t} + \eta_t, (1 - \phi_1 B)(1 - B)\eta_t = (1 + \theta_1 B)\varepsilon_t$$

This is where the final error term (epsilon) is assumed to be white noise.

## Acknowledgements

Mark Hogan, Dimitrios Nikolakis, Francis Dunnett.

## 9 . Related links

### [Public Services Productivity Review](#)

Web page | Released 12 October 2023

Reviewing and improving the methods for measuring public service productivity, as commissioned by HM Treasury.

### [Public service productivity, quarterly, UK](#)

Bulletin | Released 13 October 2023

Experimental estimates for UK total public service productivity, inputs and output to provide a short-term, timely indicator of the future path of the annual productivity estimates.

### [Public service productivity: total, UK, 2020](#)

Article | Released 28 April 2023

Updated measures of output, inputs, and productivity for UK public services between 1997 and 2020: service area breakdown, quality adjustment, latest revisions.

## 10 . Cite this article

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