Sources and methods for public service productivity estimates

Sources and methods information for the “Public service productivity: total, UK” publication, detailing the main concepts, output and inputs measures by service area.

Contact:
Sophie Barrand
productivity@ons.gov.uk
+44 (0)1633 455086

Release date:
13 March 2020

Next release:
To be announced

Table of contents

1 . Summary and main concepts

This article sets out the sources and methods used to construct estimates of productivity for total public services, most recently presented in Public service productivity: total, UK, 2017. It contains a summary of the data sources used and a breakdown of how the Office for National Statistics (ONS) calculates estimates of productivity in each service area.

For recent methodological changes, please refer to Improved methods for total public service productivity: total, UK, 2017. Further information on the methodology used and details on the strengths and limitations are included in the Public service productivity: total, UK Quality and Methodology Information (QMI).

The main concepts and methods common to all service areas are explained in this section, with specific detail on each service area's output and inputs measures contained in Sections 2 and 3 respectively.

Productivity

At the most aggregate level, productivity is the measure of how many units of output are produced from one unit of inputs and is calculated by dividing total output by total inputs. Adopting P, O and I to indicate productivity, output and inputs respectively, and including a subscript t for time periods:

$$P_t = \frac{O_t}{I_t}$$

Total public service output and inputs indices are calculated by aggregating output and inputs for the following service areas :

- healthcare
- education
- adult social care
- children's social care
- social security administration
- public order and safety
- police
- defence
- other government services (this includes general government services, economic affairs, environmental protection, housing, recreation, and other public order and safety)

Total public service productivity is then calculated by dividing this index of output by the index of inputs.

Statistics are published on a UK geographic basis from 1997 to the latest available year, usually two years prior to the publication date.

Output and inputs indices for each service area are aggregated together using their relative general government (combined central and local government) expenditure weight, using data from the UK National Accounts on a Classification of the Functions of Government (COFOG) basis.

Quantity output

For most service areas, output is measured in direct volume terms by the number of activities performed by that service area. Activities are weighted together into a cost-weighted activity index (CWAI). The CWAI calculates the change in the number of activities undertaken, weighting each activity by its cost such that a change of one unit of activity for a high-cost activity has a greater effect on the output than a change of one unit of activity for a low-cost activity.

Three service areas (police, defence and other public services) are largely “collective” services, and therefore output from these sectors is more difficult to measure directly. Instead, an “output-equals-inputs” convention is applied, where output volume is assumed to equal the volume of inputs used to create them, so productivity is constant.

Quality adjustment

Where data are available and relevant, output measures are quality adjusted. Quality adjustments are currently applied to four service areas: healthcare, education, adult social care, and public order and safety.

These adjustments provide a more accurate picture as to whether output has increased in line with desired outcomes, for example, with increased attainment in GCSE-level attainment scores for the education service area. For more detail on quality adjustments, see A guide to quality adjustment in public service productivity measures.

The reasons for quality-adjusting public service output are well-documented and follow from recommendations made in the Atkinson Review (PDF, 1.07MB).

Inputs

Inputs comprise volume estimates of labour, goods and services (intermediate inputs), and capital assets used in delivering public services. For most service areas, inputs are measured indirectly by using current expenditure adjusted by a suitable deflator. In some areas inputs are measured directly, such as the number of full-time equivalent staff.

Deflation

Where direct inputs volume measures are unavailable, or indirect volume measures are more precise, expenditure from the UK National Accounts are deflated by an appropriate price deflator in order to remove the effect of price inflation. Two common deflators are the GDP Price Deflator (YBGB) and the Index of Labour Costs per Hour (ILCH). Where appropriate (for example, common deflators are unavailable or are weak approximations of price inflation for specific service areas) composite deflators are constructed.

Composite deflators are constructed by sourcing more relevant data on the prices and quantities of specific inputs. The changes in the prices of different inputs are aggregated into a Paasche price index, which weights the changes in prices by their relative volumes in the current year.

For example, the growth in average gross pay for different fire and rescue staffing groups (a price change in labour) are weighted together using staffing numbers (the quantity) to create a composite labour deflator. This better approximates the overall price changes in labour for a service area with fairly homogeneous labour inputs.

Public sector procurement data for different service areas are used to create composite intermediate consumption deflators that better reflect price changes in the cost of goods and services relevant to specific service areas. Procurement data are sourced from the Subjective Analysis Return, which is published as an annex to Local authority revenue expenditure and financing.

Therefore, where inputs are measured indirectly, revisions to inputs estimates can result both from changes to expenditure and changes to the deflator used.

Splining

Where data are received on a financial or academic year basis a recognised statistical technique known as splining is used. This technique allows academic year volume estimates and annual financial spending measures to be split into monthly data, which are then re-aggregated to create calendar year figures.

Index numbers

Indices can be used to determine how changes in the monetary value of economic transactions can be attributed to changes in price (to measure inflation) and changes in quantity (to measure sales volume or economic output) over time. Different indices are used depending on the data type and purpose. The approach taken is consistent with ONS methodology guidance, the Consumer Prices Indices technical manual and calculations carried out in the UK National Accounts.

Volume activity series are constructed using a cost-weighted Laspeyres index (base year-weighted arithmetic mean).

This method follows the formula:

$$P^{0,t}_{Laspeyres\ volume} = \frac{\sum_{i=1}^{n} q_i^t \cdot p_i^0}{\sum_{i=1}^{n} q_i^0 \cdot p_i^0} = \sum_{i=1}^{n} w_i^0 \ . \ R_i^{0,t}$$

where w_i^0 is the value share of item i in the base period 0, and $R_i^{0,t}$ is the volume relative (the ratio of the quantity of an activity to the quantity of the same activity in the base period).

In the context of public service output the weights (w_i) are indicative of the relative value of different activities. Unit costs can be used to approximate the “price” of an activity (p_i) given the difficulty of accurately estimating the relative social and economic value of different activities. However, in practice, expenditure shares from public finance data are generally used to approximate relative value (w_i) of activities. The weights for different activities are those taken from the first year of each activity pair (the base year 0).

For example, if we were combining activity series for each of the devolved UK nations for 2010, we would weight each of the activity growths from 2009 to 2010 for England, Scotland, Wales or Northern Ireland by their respective expenditure shares in 2009.

Where prices indices (for example, deflators) are weighted together, these are constructed using Paasche indices (current year-weighted harmonic mean).

This method follows the formula:

$$P^{0,t}_{Paasche\ price} = \frac{\sum_{i=1}^{n} p_i^t \cdot q_i^t}{\sum_{i=1}^{n} p_i^0 \cdot q_i^t} = \frac{1}{\sum_{i=1}^{n} \frac{w_i^t}{R_i^{0,t}}}$$

where w_i^t is the value share of item i in the current period t, and $R_i^{0,t}$ is the price relative (the ratio of the price of a good or service to its price in the base period).

For example, data on price changes in the cost of labour, goods or services and their quantities are used to construct composite price indices. Nominal expenditure data are deflated to real expenditure by dividing by the appropriate price index.

Further guidance on indices methodology can be found at ONS's index numbers guidance.

Comparability

Unlike other measures of productivity produced by the ONS, public service productivity estimates include goods and services, as well as labour and capital, as inputs. This is necessitated by the fact that public service output measures are gross output (total output) measures, rather than value added measures as used in labour productivity and multi-factor productivity, meaning that estimates are not comparable. We will be publishing an article comparing the various methods of calculating productivity in due course.

2 . Output

Different measurement techniques for output are adopted for different service areas. Healthcare and education, as well as adult social care, children's social care, social security administration, and public order and safety, all involve some degree of direct volume measurement in the form of a cost-weighted activity index (CWAI).

Output estimates for police, defence and other government services are all based on the "output-equals-inputs" convention. Within healthcare, we assume that "output-equals-inputs" for approximately 12% of its output; this output is services delivered by non-NHS providers. It is worth noting that "output-equals-inputs" is also assumed for GP prescribing, however, in this case we calculate the volume of outputs and set the inputs as equal to this.

Similarly, within children's social care, we assume that "output-equals-inputs" for approximately 67% of its output; this output relates to "non-looked after" children. In total, approximately 41% of output is measured using the "output-equals-inputs" convention, the other 59% is measured directly. All figures stated here refer to Public service productivity: total, UK, 2017.

Healthcare

A detailed explanation of the data sources and methods used to calculate public service productivity estimates: healthcare statistics is given in Sources and methods for public service productivity estimates: healthcare (PDF, 328KB) and more information on the quality and methodology can be found in Public service productivity estimates: healthcare QMI. A summary follows.

Quantity output

The quantity of healthcare is estimated using data on a range of healthcare services provided within the following sectors:

- Hospital and Community Health Services (HCHS); this includes hospital services, community care, mental health and ambulance services
- Family Health Services (FHS); this includes general practice, publicly funded dental treatment and sight tests
- GP prescribing; this includes prescription drugs dispensed in the community
- non-NHS provision; this includes healthcare funded by the government but provided by the private or third sector and is indirectly measured ("output-equals-inputs" approach).

Of these components, HCHS, FHS and GP-prescribing output are all measured using data on the number of activities undertaken and their unit costs by service type in a cost-weighted activity index (CWAI). Healthcare quantity is aggregated first by country, and then into a UK aggregate using a cost-weighted Laspeyres index.

HCHS and FHS activity data used in the output calculations are adjusted to account for the fluctuations caused by year-to-year changes in the number of working days and total days.

Non-NHS provision is calculated using the same deflated expenditure data that are used to calculate inputs and is therefore an "output-equals-inputs" component. The CWAI produced for GP-prescribing is also used in the inputs on an "output-equals-inputs" basis. Therefore, both non-NHS provision and GP-prescribing do not contribute to changes in productivity.

Table 1 describes the data sources and geographic coverage for healthcare quantity output.

Table 1: Data sources for estimates of UK healthcare quantity and output

	Geographical Area			
Sector	**England**	**Wales**	**Scotland**	**Northern Ireland**
Hospital and Community Health Services				
Inpatients Day Case Other	DH RC 1997/98 –	WG analysis 2004/05 –	SG analysis 2004/05 –	DHSSPS analysis 2003/04 –
Outpatients	DH RC 1997/98 – 2002/03 NHS Digital 2003/04 –	WG analysis 2004/05 –	SG analysis 2004/05 –	DHSSPS analysis 2003/04 –
Family Health Services				
Ophthalmic	General Ophthalmic Council		SG analysis 2004/05 –	DHSSPS analysis 2003/04 –
Dental	General Dental Council			
GP Consultations	Survey Data 1997/98 – 2008/09 Imputed 2008/09 –			
GP Drugs				
Prescriptions Non-NHS Provision	PCA 2002/03 –	WG analysis 2004/05 –	SG analysis 2004/05 –	DHSSPS analysis 2003/04 –
Expenditure	DH 1997/98 –	WG analysis 2004/05 –		

Source: Office for National Statistics

Notes:

1. DH: Department for Health, WG: Welsh Government, SG: Scottish Government, DHSSPS: Department of Health, Social Services and Public Safety Northern Ireland. 2) RC: Reference Costs, PCA: Prescription Cost Analysis.

Quality adjustment

Quality adjustment of public service health output: current method (PDF, 152KB) provides a detailed description of the quality adjustment methodology.

A quality adjustment is applied to the quantity output index where a positive quality adjustment indicates that the quality of healthcare services provided, as defined by the selection of indicators used in the quality adjustment, has improved. A quality adjustment is then applied to UK output, based on the following elements and data from England:

- short-term post-operative survival rates, derived from Hospital Episodes Statistics (HES)
- estimates of health benefit from procedures, derived from research studies, ONS Life Tables and Patient Reported Outcome Measures
- waiting times, from HES
- aggregate data on clinical measures recorded on GP practice computers, from the Quality and Outcomes Framework
- patient experience surveys, from NHS England

The first three bullets in this list constitute the hospital procedures quality adjustment and are applied to output using a dataset provided by the Centre for Health Economics at the University of York.

Hospital and Community Health Services (HCHS) and Family Health Services (FHS) are quality adjusted, but no quality adjustment is applied to GP-prescribing or non-NHS provided services.

Table 2 provides detail of the coverage of the quality adjustments.

Table 2: Measures of quality

	Measure				
Sector	**Health gain**	**Short term survival**	**Waiting times**	**National Patient Survey**	**Primary care outcomes**
Hospital and community health care					
Day cases	Y	Y	Y	Y	
Elective inpatients	Y	Y	Y	Y	
Non-elective inpatients	Y	Y		Y	
Outpatients				Y	
Emergency				Y	
Mental health				Y	
Other					
Family health services					
GP consultations				Y	Y
Ophthalmic serv.					
Dental serv.					
Other					
Prescription drugs					
Non-NHS provision					

Source: Office for National Statistics

Education

A detailed explanation of the data sources and methods used to calculate education estimates can be found in Sources and methods: public service productivity estimates: education, last updated in 2017. Data sources concerning attainment at GCSE or equivalent, and the “cohort” approach are explained in Improved methods for total public service productivity: total, UK, 2017. A summary follows.

Education output consists of an estimate of quantity, which is then adjusted for quality. Quantity is the sum of full-time equivalent (FTE), publicly funded pupil and student numbers within the following sectors (weighted by cost of education):

- pre-school education, including places funded in the private, voluntary and independent sector (PVI)
- government-maintained primary, secondary and special schools; for England only, city technology colleges (CTCs) and academies are included; all of these figures are adjusted for attendance
- further education colleges
- higher education training of teachers: initial teacher training (ITT)
- higher education training of health professionals

Table 3 provides detail of the components of education quantity and geographical coverage.

Table 3: Current sources of education output data

	England	Wales	Scotland	Northern Ireland
Schools				
Students	DfE	WG	SG	DENI
Expenditure				-
Attainment			SQA	DENI
Initial Teacher Training				
Students	DfE	WG	SG	DELNI
Expenditure				
Attainment		-	-	-
Health Professional Training				
Students	DH	WG	SG	DHSSPSNI
Expenditure				
Further Education				
Students	DfE	WG	Infact	DfENI
Expenditure	EFSA		SFC	-

Source: Office for National Statistics

Notes

1. DfE: Department for Education, DH: Department for Health, ESFA: Education and Skills Funding Agency, WG: Welsh Government, SG: Scottish Government, SQA: Scottish Qualifications Authority, SFC: Scottish Funding Council, DENI: Department of Education Northern Ireland, DELNI: Department for Employment and Learning Northern Ireland, DHSSPSNI: Department for Health, Social Services and Public Health, DfENI: Department for Economy Northern Ireland. Back to table

2. Student data are provided on an academic year basis, while expenditure data are provided on a financial year basis. Data in academic and financial years are converted to calendar years by applying a spline process. Back to table

Output in primary and secondary schools, CTCs and academies are adjusted using different GCSE-level attainment measures for each of the devolved nations. As exam performance varies across geographical areas and because education is a devolved policy area that affects the courses studied and exams taken, different quality adjustments are applied to output in each country separately.

Different attainment measures are used over different years, in keeping with changing headline measures' outcomes. The current attainment measures and data sources are listed below for each country:

- England, Attainment 8, Department for Education (DfE)
- Scotland, National 5s and Skills for Work and Personal Development courses pass rates, Scottish Qualifications Authority (SQA)
- Wales, Capped 9, Welsh Government (WG)
- Northern Ireland, Threshold measure including English and Maths, NI Department of Education (DENI)

For further information on how attainment measures have changed over time, refer to Improved methods for total public service productivity: total, UK, 2017.

Attainment for GCSE-level examinations are normally taken during the student's 11th year of total schooling, or fifth year of secondary schooling. Growing qualification scores are deemed to reflect greater scholastic attainment arising from improvements in the quality of education delivered. When a new attainment measure is published, it reflects the secondary education provision over the entire five years (or equivalent).

From Public service productivity: total, UK, 2017 onwards, our education attainment measures adopt a "cohort split" approach, whereby a new attainment measure is proportionally applied to the contributing years. The new "cohort split" approach applies certain percentages of the new attainment data back to previous years, subject to their contributions (as deemed appropriate). These contributions are outlined in Table 4.

Table 4: Contribution to attainment by year group

Year group	Contribution to attainment
Year 7	10%
Year 8	10%
Year 9	20%
Year 10	30%
Year 11	30%

Source: Office for National Statistics

For example, for attainment data released in academic year ending 2018, this is attributed to 10% of teaching when that cohort were in year 7 (in academic year ending 2014), 10% in year 8 (academic year ending 2015) and so on, with academic year ending 2018 receiving 30% of this score. Where there are incomplete years, that is, where students have received teaching, but have not completed GCSE-level examinations, available contributions are rescaled to total 100%.

This approach is supported by the Atkinson Review (PDF, 1.07MB), which recognised that "The GCSE results are the outcome of 11 years of compulsory schooling" but also that there would be a large time lag in fully measuring attainment. As such, the adjustment is applied retrospectively to the previous five years when new data becomes available.

The delivered quantity of initial teacher training (ITT) courses is also adjusted for quality, but the cohort method is not applied. In this case, the proportion of students who achieve qualified teacher status (QTS) each year is used as a quality indicator. ITT quantity in each geographical area of the UK is adjusted using the QTS award rate for England, which is provided by the DfE.

Estimates of quality-adjusted output are carried out in several steps:

1. Time series data are compiled using:
    - pupil numbers, which are adjusted for attendance at primary, secondary and special schools
    - the level of expenditure in each educational service
    - the attainment at GCSE level and the ITT QTS award rate as outlined previously
2. The cohort method is applied to the relevant quality-adjustment measures for schools, and these along with ITT pass rates are converted into indices.
3. A chain-linked Laspeyres volume index of quality-adjusted output is produced for each educational sector and aggregated to a UK level.

When education sectors are aggregated together using their relative cost weights, an overall UK level, chain-linked Laspeyres volume index of quality-adjusted output is calculated.

Adult social care

Further information on the methods used to produce the quality adjustment for adult social care (ASC) output can be found in Public service productivity: adult social care: sources and methods, 2019 update .

ASC services provide care and support to older people, adults with learning or physical disabilities, adults with mental health problems, drug and alcohol misusers, and carers. Provision of ASC is the responsibility of local authorities in Great Britain. Because of a lack of inputs and output data, measures for Northern Ireland are not included in the ASC productivity estimates.

ASC services include:

- placements in residential and nursing care
- provision of home care services
- day care services
- supported living and accommodation
- “meals on wheels”
- equipment and home adaptions
- care assessments and support services

Local authorities can provide ASC services themselves or contract ASC services from independent sector providers. Our estimates cover both forms of provision.

The measure of adult social care output is based on the quantity of social services activities measured either in terms of time (for example, number of weeks of residential care) or number of items (for example, number of meals provided).

ASC quantity output is produced via a cost-weighted activity index, where activity data are available, and on an "output-equals-inputs" basis where they are not. England activities are weighted together by their share of net expenditure to generate the overall measure of output growth. These weights are updated annually. Data are not available for Wales and Northern Ireland, but where available, Scotland residential, and nursing and community data are included.

The activities cover a variety of services: assessments of need, day care, home care (home care and provision of meals and, in England, also provision of equipment) and provision of care home places. Care home places are divided in England into residential and nursing care, but this breakdown is not available for Scotland. As the nursing care element of costs in care homes is now NHS funded, the remaining costs are not greatly different.

Where the data are available, services are measured separately for different client groups. These are: older people aged 65 years and over (including those with mental health needs) and younger adults aged 18 to 64 years with physical disability, learning disability or mental health needs.

The quantity of ASC output is adjusted for changes in the quality of service provided. The quality adjustment for ASC output is based on the concept of adjusted social care-related quality of life from the Adult Social Care Outcomes Framework (ASCOF), the main source of outcomes data for ASC services in England.

Separate quality adjustments have been developed for community care, and residential and nursing care, both using data from NHS Digital's Adult Social Care Survey (ASCS) from financial year ending 2012 onwards. The ASCS is a sample survey of clients in local authority (LA)-supported care in England. Coverage includes clients whose care is partly- or wholly funded by a LA, including those in receipt of direct payments, or clients in LA-organised care who are fully self-funding. Full details of this can be found in Section 8 of Measuring adult social care productivity in the UK and England: 2016.

Each level of response on care needs across each of the eight domains is then weighted to account for its importance in affecting quality of life, using weights developed from a separate survey of community care users. Factors predominantly outside the influence of ASC services, but which affect the likelihood of needs being met, are then controlled for to derive the change in social care-related quality of life resulting from changes in ASC service quality.

For community care, factors from the calculations used in the ASCOF are applied to the person-level data in the ASCS to remove the influence on care-related quality of life of clients' age, health status, suitability of clients' home for meeting their needs and clients' ease of travelling around outside in their local environment. As the factors used in ASCOF only relate to community care users, for residential and nursing care, a regression model is used to calculate the impact of ASC services on care-related quality of life, controlling for these external factors.

The quality adjustment is applied separately for residential and nursing care, and community care and for the different client groups listed previously (for age and disability categories).

Children's social care

Children's social care (CSC) is the provision of social work, personal care, protection or social support services to children in need or at risk. CSC includes, in its output measures, looked-after children, children in need, Sure Start schemes, adoption and other activities.

Children's social care activity data are used to estimate the part of the output, which is measured directly as looked-after children (LAC). Expenditure data are used as cost weights to aggregate the components in the direct part of the measure, and also for the indirectly measured output using the "output-equals-inputs" convention. This indirectly measured part of the output refers to non-looked-after children (non-LAC).

LAC are classed by a local authority if a court has granted an order to place them in care, or a council's children's services department has cared for the child for more than 24 hours. Output is the number of children in care, accounting for 33% of expenditure on children's social care services within Public service productivity: total, UK, 2017. Non-LAC are classified as such if they are not taken out of their home environment but are being monitored.

Activities data for Scotland and Wales are supplied by the Scottish and Welsh Government respectively, and for England and Northern Ireland they are supplied by the Department for Education and the Northern Ireland Department of Education respectively.

The activities (output measures) used are:

- a count of the total number of days during the financial year that LAC spend in placements, including days spent in short-term placement, and excluding unaccompanied asylum-seeking children
- fostering services: activities data on children placed for adoption and foster placements
- the number of children currently in secure accommodation
- children's homes: activities data on residential schools and children's homes
- activities from other-LAC; this is calculated by subtracting the sum of measured LAC activity from total LAC activities

Expenditure data are composed of net current expenditure (£ thousands) on the following services:

- fostering services
- secure accommodation
- children's homes
- other children looked after
- non-LAC
- total expenditure on children's and families services

To calculate an index for LAC, activity in fostering, children's homes and other are aggregated into a single series, with secure accommodation left separate. These two series are weighted by expenditure shares to produce a direct measure of CSC output on a financial year basis. More information on this approach can be found in Measuring the output of children's social care: an alternative method for looked after children (PDF, 121KB). These estimates are splined, lagged and backcast to produce a series of appropriate length.

Expenditure on non-LAC is taken as a residual following the LAC processing, split into components, deflated and aggregated to an indirect output index using the same method as is used in the inputs calculations.

The two contributions to growth are then aggregated by their respective expenditure shares to produce output series for children's social care.

Social security administration

Social security administration (SSA) is the administration and implied costs associated with administering different types of benefits including the processing of new benefit claims and maintaining existing benefit load. SSA output is a quarterly measure of the output associated with these in volume terms.

In total, there are 29 sub-component activity series in the SSA output system, covering a variety of benefits and activities (such as State Pension, Housing Benefit, Disability Living Allowance, Child Benefit and Incapacity Benefit) each with a corresponding unit cost series. These sub-components are aggregated to form a chained volume measure of SSA output. Data suppliers include the Department for Work and Pensions, HM Revenue and Customs and Ministry of Defence.

Public order and safety

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

The aggregated POS output index consists of the following components:

- fire
- courts, which itself has five further sub-components: magistrates' courts, county courts, Crown Courts, Crown Prosecution Service, legal aid
- probation
- prisons

All POS output is currently estimated using activity indicators, with some quality adjustments applied. Full details of the quality adjustments can be found in Quality adjustment of public service public order and safety output: current method. A summary follows.

For each component, a cost-weighted activity index (CWAI) is constructed. We use direct output measures for all components. Table 5 outlines the output measures for each component and where data are quality adjusted. A quality adjustment is not applied to fire protection or county courts services, which deliver civil cases. This is because these services are deemed to have different outcomes to the criminal justice elements of POS and have data limitations.

Table 5: Public order and safety

Category	Quality adjusted	Sub-category	Unit of output	Data source
Fire protection services	No	Response (Dwellings, commercial premises, vehicle, chimney, false alarms)	Number of Incidents attended	Department for Communities and Local Government, Home Office, SFRS, NIFRS, StatsWales, WG
		Prevention (Inspections, investigation, community safety e.g. fitting fire alarms)	Number of, workload in hours	
		Special (Road and non-road)	Number of incidents attended	
Law courts	In part (excl. county courts)	Crown, county, Magistrates courts, family (private, public, divorce, adoption cases)	Caseload	MoJ
Prisons	Yes		Prisoner population	HMPPS, MoJ, SPS, NI DoJ
Probation	Yes		Number of people under supervision	HMPPS
Legal Aid	Yes	By case type and fee	Caseload	Legal aid agency (England and Wales only)

Source: Office for National Statistics

Notes

1. SFRS: Scottish Fire and Rescue Service NIFRS: Northern Ireland Fire and Rescue Service, WG: Welsh Government, MoJ: Ministry of Justice, HMPPS: Her Majesty's Prison & Probation Service, SPS: Scottish Prison Service, NI DoJ: Northern Ireland Department of Justice Back to table

Fire

Fire output activities are categorised into three groups:

- fire response (FR)
- fire prevention (FP)
- fire special services (FS)

These groups all form part of the Fire and Rescue Service (FRS). Activity measures for the FRS are based on the number of incidents attended for fire response and fire special services activities, and staff hours spent on fire prevention activity.

Appropriate cost weights are based on the Economic Cost of Fire estimates for different fire incidents. The output measure combines the different activities into a single cost-weighted activity index (CWAI) using the associated unit costs as their weights, and an overall output index is then constructed as a chain-linked Laspeyres index using the previous year's prices.

Courts

The output of criminal courts is currently estimated using direct output methods, although some forecasting and estimation is necessary because of gaps in activities and cost data. Separate cost-weighted activity-indices for different areas of the courts system are constructed and then further aggregated based on expenditure shares.

Civil and family courts:

Data from the Ministry of Justice on applications, hearings and final orders are used to produce a "weighted caseload". Unit costs are periodically sourced from the Ministry of Justice and are used as weights for the output index.

Crown Courts:

Data are provided on the number of Crown Court cases broken down into the following categories:

- committals for trial: actuals
- cases for sentence: actuals
- appeals: actuals

Historic data on unit costs are used as weights for the output index.

County courts:

Growth rates from activity series within the civil and family courts data are used to predict activity growth in this area. Predictions are informed by historic case data that is no longer available.

Magistrates' courts:

A "weighted caseload" is available up to 2014 from which an output index can be calculated. Completed proceedings are counted in the following 14 case types. Weightings are then applied to each case type, to provide an overall unitary value of caseload. The weights are calculated from large samples of cases and reflect the average time required to complete each type of case.

- indictable: adult indictable and triable either way offences
- breaches: all breaches and revocations of sentences
- non-motor summary: non-motoring offences
- motoring summary: motoring offences
- youth: all youth crime, indictable and summary, including breaches
- Section 8 Children Act: Section 8 orders (private law)
- EPOs Children Act: emergency protection orders
- care proceedings: Children Act care proceedings (public law)
- other family/child: all other family proceedings and Children Act cases, for example, adoptions, financial and so on
- licence sessions: licensing applications heard by licensing committees
- licence petty: licensing applications heard by magistrates in petty sessions
- other civil work: any other civil complaints, made to obtain an order, for example, dangerous dogs
- means enquiries: all means enquires with defendant present
- legal aid: all applications for legal aid granted or refused

Crown Prosecution Service (CPS):

The indices for magistrates courts and Crown Courts are used to predict activity growth in this area. Both indices are aggregated based on their expenditure shares to approximate the growth in activity for the CPS.

Legal aid:

Data on legal representation expenditure and fees are used to construct a cost-weighted activity-index for legal aid. Data are categorised by the following fee types:

- lower standard fees
- higher standard fees
- non-standard fees and exempt cases
- second claims for deferred sentencing

Probation

Output for probation is measured by the number of offenders supervised by the Probation Service. Coverage is for England and Wales only. The criteria for inclusion are as follows:

- offenders supervised by the Probation Service at end of period, under court orders and pre- and post-release supervision
- each person is counted only once in the total even if they were subject to several types of sentence at the year-end

Prisons

Output for prisons is measured by the average number of prisoners in UK prisons. These data are collected on a monthly basis and coverage is for the whole of the UK.

Quality adjustment

Quality adjustments are not applied to fire protection or county courts services, which deliver civil cases, as they are deemed to have different outcomes to the criminal justice elements. Table 6 outlines quality adjustment coverage.

Table 6: Public order and safety quality adjustments

Component	Recidivism (applied from 2000)	Prison safety (applied from 1997)	Custody escapes (applied from 1997)	Courts' timeliness (applied from 2011)
Fire	-	-	-	-
Prisons	29.2%	37.5%	33.3%	-
Probation	100%	-	-	-
Courts				
Magistrates Courts	50%	-	-	50%
Crown Courts	50%			50%
County Courts	-	-	-	-
Crown Prosecution Service	100%	-	-	-
Legal Aid	100%	-	-	-

Source: Office for National Statistics

The recidivism adjustment:

This approximates the effect the Criminal Justice System (CJS) has on reducing the volume and severity of further crimes being committed by those who have gone through it.

This adjustment is composed of three parts, the first being the change in the number of proven re-offences committed by adults and juvenile offenders categorised between crime types. An adjustment is made to adult offenders, to account for differences between cohort characteristics and their likelihood to re-offend. No such adjustment is made for juvenile offenders after 2005. The final adjustment made provides a weighting by which to aggregate together all re-offences. This weighting is based upon the relative severity of the re-offence and is derived from the ONS's Crime Severity Score for England and Wales.

The prisons safety adjustment:

This relates to the number of incidents of assaults, self-harm and deaths that occur in prison custody.

We measure the number of incidents per 1,000 prisoners, which are grouped into “Severe”, “Less severe” and “Those resulting in a death”. These groups are subsequently weighted and aggregated together based on their relative cost. This is achieved by using the total cost to society of workplace injuries as a proxy, taken from the Health and Safety Executive.

The custody escapes adjustment:

The escape adjustment relates to ensuring prisons fulfil the role of public protection and is applied to activities used to measure the output of the prison service.

The measure is based on changes in the difference between the number of escapes and a baseline of 0.05% of the England and Wales prison population – a historic target used by the Ministry of Justice. The purpose of this being that as the absolute number of escapes approaches zero, the relative change year-on-year would have a disproportionate effect on a non-baselined quality adjustment index.

The courts’ timeliness adjustment:

The courts’ timeliness adjustment relates to the average time taken for criminal cases to be taken to completion, on the basis that the delivery of a sentence in a timely manner is favourable. However, there is currently no adjustment made to reflect whether there has been fair treatment of the suspect or victims, or to allow the appropriate time for preparations of criminal cases with differing levels of severity or complexity.

For magistrate courts, the measure is based on the mean average time of charge and laying of information to completion. For Crown Courts, the measure captures the average waiting times experienced by all defendants and the mean time from main hearing to completion. As implemented, the measure accounts for changes in the average time taken to completion by criminal courts because increases in volume may reflect a worsening.

Combining the components

For each component, we calculate an overall growth factor to be applied to the basic activity index. For those areas where multiple adjustments are applied, the growth factors are applied on a weighted average basis (Table 6 outlines the weights used). To then aggregate together all the components of public order and safety (POS) – including non-quality adjusted components – they are cost-weighted together to produce an aggregate index of POS quality adjusted output.

Police, defence and other government services

For these services, because of the largely collective consumption of these services, the difficulty in identifying output, and the difficulty in placing a value on services supplied as there are no market transactions, the outputs of these services are measured by their respective volume of inputs (“output-equals-inputs”).

3 . Inputs

Inputs comprise the volume of labour, goods and services and capital used in delivering public services. These series are aggregated together to form an overall estimate of the volume of inputs used to provide each of the public services identified in the total public service productivity articles.

The following sections describe the data sources and methods used in each of the service areas in detail.

Healthcare

Labour inputs are mainly measured through a Laspeyres cost-weighted labour index (CWLI), which uses administrative data on the health service's workforce to measure growth in full-time equivalent staff numbers weighted by their cost, in a similar manner to the cost-weighted activity index used for quantity output. However, it should be noted that agency staff are included in intermediate consumption inputs because they are not employed by the NHS, while NHS bank staff are included in labour inputs, because they are NHS employees.

The intermediate consumption of goods and services used in the provision of healthcare is also calculated using expenditure data deflated by relevant deflators to account for the cost inflation faced by the health service. From Public service productivity, healthcare, UK: 2017 onwards, many of the deflators used are taken from the NHS Cost Inflation Index (NHSCII), which is produced by the Department of Health and Social Care. This includes the overall NHSCII, sector-specific components of the NHSCII and a version specific to NHS providers' intermediate consumption produced by the Office for National Statistics (ONS).

The volume of capital inputs is measured by consumption of fixed capital, which covers the cost of depreciation of capital goods (items that are anticipated to be in use over several years, such as buildings and vehicles) over time. Data used for this element are estimated in the UK National Accounts using the perpetual inventory method.

The total inputs index is created by weighting the three components of healthcare input together according to their share of total healthcare expenditure recorded in the UK National Accounts. Where data are not provided by a country, it is assumed that this component grows in line with the rest of the UK.

Table 7 shows how the geographical coverage of the inputs data varies across the countries of the UK.

Table 7: Data sources for estimates of UK healthcare inputs

	Country			
Inputs	**England**	**Wales**	**Scotland**	**Northern Ireland**
Labour				
HCHS	NHS Digital	WG	SG	DHSSPSNI
GP services	NHS Digital	WG	SG	DHSSPSNI
Bank staff	NHSI			
Goods and services				
HCHS	DH	WG	SG	
Dental services	DH	WG	SG	
Ophthalmic services	DH	WG	SG	
Pharmaceutical services	DH	WG	SG	
GP Services	NHS Digital	WG	SG	
CHMS	DH	WG		
GP drugs	As for output	As for output	As for output	As for output
Non-NHS provision	DH	WG	SG	-
Agency staff expenditure	DH	WG		
Welfare food	DH	WG		
Health administration	DH			
Capital				
UK Capital Consumption	UK NA			

Source: Office for National Statistics

Notes

1. NHSI: NHS Improvement, DH: Department for Health, UK NA: UK National Accounts, WG: Welsh Government, SG: Scottish Government, DHSSPSNI: Department of Health, Social Services and Public Safety Northern Ireland. Back to table

Table 8 shows the geographic coverage for the deflators, which are either UK-wide or England only. In the case of England-only deflators, for example, sight test deflator, the same rate of price increase is assumed for the other countries of the UK.

Table 8: Expenditure components with matched deflators

Expenditure Component	Deflator	Geographic basis of deflator	Data source for deflator
HCHS non-pay	ONS-adjusted NHS Cost Inflation Index (NHSCII)	England only - assumed to apply to whole of UK	Published by PSSRU*
GP intermediate consumption	All items CPIH	UK	ONS
NHS Dental services	NHSCII Dentistry index	England only - assumed to apply to whole of UK	Published by PSSRU*
NHS Ophthalmic services	NHSCII Overall Index	England only - assumed to apply to whole of UK	Published by PSSRU*
Pharmaceutical services	NHSCII Overall Index	England only - assumed to apply to whole of UK	Published by PSSRU*
Central Health and Miscellaneous services (CHMS)	ONS-adjusted NHSCII	England only - assumed to apply to whole of UK	Published by PSSRU*
Volume of GP prescribed drugs	As for output estimation	Not applicable	Not applicable
Non-NHS provision	NHSCII NHS Providers Index	England only - assumed to apply to whole of UK	Published by PSSRU*
Welfare Food (England and Wales expenditure only)	CPIH Food	UK	ONS
DH Administration non-pay costs (England only expenditure)	ONS-adjusted NHSCII	England only - assumed to apply to whole of UK	Published by PSSRU*

Source: Office for National Statistics

Notes

1. NHSCII: NHS Cost Inflation Index, CPIH: Consumer Prices Index, including owner occupiers' housing costs, PSSRU: Personal Social Services Research Unit. Back to table

2. * the NHSCII has been developed by the Department of Health and Social Care (DHSC) working in conjunction with NHS England and NHS Improvement, the Centre for Health Economics at the University of York and the ONS. The NHSCII is produced by DHSC and is published by the PSSRU at the University of Kent as part of their annual publication, Unit costs of health and social care. Back to table

Education

The ONS publishes estimates of publicly funded education inputs in the UK from 1997 onwards. The inputs index is an aggregate of three elements: labour, goods and services, and capital, broken down as follows:

- local authority (LA) direct labour
- central government indirect labour
- goods and services (provision)
- goods and services (administration)
- consumption of fixed capital

A direct measure of LA-maintained schools' labour input is estimated, based on full-time equivalent (FTE) teacher and support staff numbers (split by school and academies for England only) and weighted together using data on salaries from the Annual Survey of Hours and Earnings (ASHE).

Labour force numbers are aggregated by staff type and school type and are adjusted by average hours worked for each school type. Country-specific FTE numbers are weighted by salary data from a number of sources (see Table 9 for more details). All data that are collected on an academic year basis are splined to calendar years before aggregating.

The direct labour data are combined with indirectly measured components for central government labour, which also include an estimate for further education inputs and is deflated using the Average Weekly Earnings: Public Administration Index, to form a total education labour inputs index.

Consumption of fixed capital national accounts expenditure data is deflated using a constructed education general government capital deflator. Goods and services expenditure data are split between provision and administration so that relevant deflators can be applied. Provision is deflated using a constructed composite Paasche education intermediate consumption deflator and administration is deflated using the Gross domestic product-implied deflator.

The labour, goods and services, and capital indices are then aggregated together using their respective UK National Accounts general government expenditure shares, to form a chain-linked Laspeyres volume index.

Table 9 shows the sources of education inputs data and geographic coverage.

Table 9: Sources of education inputs data

Description	Source
School staff numbers	
England	DfE
Wales	WG
Scotland	SG
Northern Ireland (teaching staff only)	DENI
Salary data	
England and Wales	DfE
Scotland and Northern Ireland	ONS ASHE
Earnings data for school support staff	ONS ASHE
Labour, goods and services and capital expenditure	
Local authority labour expenditure	Expenditure: ONS NA
Central government labour expenditure	Expenditure: ONS NA
Goods and services expenditure incurred by Local Authorities	Expenditure: ONS NA Deflator: constructed education intermediate consumption deflator
Goods and services expenditure incurred by central government	Expenditure: ONS NA Deflator: GDP-implied deflator
Capital expenditure	Expenditure: ONS NA Deflator: constructed education general government capital deflator

Source: Office for National Statistics

Notes

1. DfE: Department for Education, WG: Welsh Government, DENI: Department of Education Northern Ireland, ASHE: Annual Survey of Hours and Earnings, NA: National Accounts. 2) Data in academic and financial years are converted to calendar years by applying a spline process. Back to table

Adult social care

Details on the current sources and methods for measuring adult social care (ASC) inputs are explained in Public service productivity: adult social care, sources and methods, 2019 update. A summary follows.

ASC inputs consist of two main components: public expenditure on ASC services and deflators measuring changes in the cost of inputs. Of the inputs components, goods and services is the largest and includes all services contracted from independent sector providers and services purchased by clients using direct payments, as well as local authorities' (LA) intermediate consumption of goods and services.

The quantity of ASC inputs is estimated by deflating expenditure using appropriate deflators; national accounts expenditure data are used for the UK productivity measure. An alternative data source is used for England-only expenditure – NHS Digital's Adult Social Care Activity and Finance Report and its predecessors. Within the England measure, national accounts data are still used to estimate capital consumption, and the proportion of ASC expenditure on LA labour inputs, LA capital inputs and other inputs.

Local authority inputs expenditure for the UK

Public service ASC is primarily funded by LAs in Great Britain. The LA current expenditure data used are part of the measure of social protection expenditure used in the national accounts. These national accounts data in turn are produced using the Local authority revenue expenditure and financing data return for England, and equivalent data sources for Scotland and Wales.

LA capital consumption is also measured using data from the national accounts and is estimated using the perpetual inventory method. Because of a lack of inputs and output data, measures for Northern Ireland are not included in the ASC productivity estimates.

There are a few adjustments made to the expenditure data from the national accounts to maintain a consistent time series to cover ASC services specifically. The most substantial of these adjustments is to remove housing services expenditure.

Non-local authority ASC expenditure in inputs

LA-organised ASC services are also partly funded by care clients themselves and by transfers from the NHS. Because our measures cover only publicly funded services, client contributions to funding ASC services are excluded from the ASC inputs and output is also adjusted to remove activity funded by client contributions. LAs also receive funding for ASC services from the NHS.

NHS transfers to LAs are measured using the same data source as inputs expenditure for England. Because of data availability, NHS transfers for social care are not included in the measure in the years before financial year ending 2005. NHS funding for ASC services is also not included for the devolved administrations, so England data are used in both the England and UK measures. Symmetrical adjustments are made to the output calculations to remove activity funded by client contributions and include activity funded by the NHS.

Accounting for cost inflation

Table 10 illustrates the deflators used and the components of expenditure that they deflate. Capital consumption inputs are calculated in volume terms in the national accounts and these volume data are used as inputs. A similar approach to deflation is taken for both the UK and England productivity measures.

Table 10: Adult social care inputs deflators

Deflator element	Input element deflator applied to	Deflator produced by	Source of price data	Source of expenditure weights
Labour (LA)	LA labour	DHSC	FYE 2014 onwards: SfC NMDS-SC/ Before FYE 2014: ASHE	Skills for Care (SfC) National Minimum Dataset for Social Care (NMDS-SC)
Labour (independent sector)	Estimated proportion of goods and services	DHSC	FYE 2014 onwards: SfC NMDS-SC/ Before FYE 2014: ASHE	SfC NMDS-SC
Intermediate consumption (local authority)	Estimated proportion of goods and services	ONS	Subcomponents of: CPI, SPPI, PPI, RPI, AWE	MHCLG SAR, part of LA Revenue Expenditure and Financing collection
Intermediate consumption (independent sector residential and nursing care)	Estimated proportion of goods and services	ONS	DHSC pay deflator, Subcomponents of the CPI and SPPI	LaingBuisson's Care Cost Benchmarks
Intermediate consumption (independent sector home care)	Estimated proportion of goods and services	ONS	DHSC pay deflator, Subcomponents of the CPI, SPPI and PPI	UKHCA's Cost of Home Care report
Direct payments	Estimated proportion of goods and services	ONS	CPI and its subcomponents	Data collected from LA's by ONS/ LondonADASS Improvement Programme

Source: Office for National Statistics

Notes

1. LA: Local Authority, DHSC: Department of Health and Social Care, FYE: Financial Year Ending. SfC: Skills for Care, NMDS-SC: National Minimum Dataset for Social Care, ASHE: Annual Survey of Hours and Earnings, ONS: Office for National Statistics, CPI: Consumer Prices Index, SPPI: Services Producer Price Index, PPI: Producer Price Index, RPI: Retail Prices Index, AWE: Average Weekly Earnings, MHCLG: Ministry of Housing, Communities and Local Government, SAR: Subjective Analysis Return, UKHCA: UK Home Care Association, ADASS: Association of Directors of Adult Social Services. Back to table

2. Data in academic and financial years are converted to calendar years by applying a spline process. Back to table

To calculate the final overall inputs index, growth rates from each of the three indices (labour, intermediate consumption including direct payments and capital consumption) are weighted by their respective expenditure shares. This is then splined from financial year to calendar year.

Children's social care

Inputs for children's social care (CSC) are based on expenditure data collected from England, Scotland and Wales for financial year ending 2001 onwards. UK national accounts expenditure is used for each component of inputs.

The volume of labour inputs is calculated by deflating expenditure by a constructed pay deflator. Pre-2011 labour expenditure is deflated using salary data from the Annual Survey of Hours and Earnings (ASHE), mapped by Standard Occupational Classification (SOC) codes. From 2011 onwards, the Index of Labour Costs per Hour (ILCH) deflator is used.

The volume of goods and services inputs is calculated by deflating expenditure by a constructed composite Paasche deflator. The wages element is deflated by the pay deflator used in the labour inputs estimates.

The volume of capital inputs is calculated by deflating consumption of fixed capital by a constructed social protection local government capital deflator, using ONS price indices.

Finally, the three components of inputs are aggregated together, using their relative expenditure weights to produce a UK estimate of children's social care inputs.

Social security administration

To calculate an index for inputs, current price expenditure drawn from the national accounts is deflated to produce a constant price series. Compensation of employees is deflated using the Index of Labour Costs per Hour (ILCH). Expenditure data for goods and services is obtained from net expenditure on intermediate consumption, and then deflated using the GDP-implied deflator. Net expenditure on capital consumption is deflated by a constructed central government capital deflator using ONS price indices.

Changes in the constant price series are weighted according to their expenditure share, and a Laspeyres volume index of inputs is constructed.

Public order and safety

Inputs estimates are calculated for:

- fire
- courts (including probation)
- prisons

The public order and safety volume of inputs series is a weighted combination of these three series (chain-linked using the UK National Accounts expenditure weights).

The volume of labour inputs is the current price expenditure on labour deflated by the Index of Labour Costs per Hour (ILCH) for courts and probation, and deflators constructed from salary data from the Annual Survey of Hours and Earnings (ASHE) for fire and prisons. The fire and prisons labour deflators are constructed by weighting together changes in the salaries of the main occupations by their shares of total staff headcount or full-time equivalents in the service area.

The volume of goods and services inputs is the current price expenditure on goods and services deflated by a GDP-implied deflator. The volume of capital inputs is the current price expenditure on the consumption of fixed capital deflated by a constructed combined local and central government public order and safety capital deflator.

Police

Police inputs are estimated by deflating expenditure on labour, goods and services, and capital.

The volume of local government labour inputs is measured directly from data on full-time equivalent employees (FTEs) and relative salaries for different groups. FTE data are sourced from Police workforce statistics for England and Wales and Workforce statistics for Police Scotland. Equivalent breakdowns for Northern Ireland are not available. The volume of central government labour inputs is measured indirectly. Expenditure data are deflated by the Average Weekly Earnings (AWE) Index for Public Administration.

The deflator for goods and services expenditure is constructed from subjective analysis returns (SAR) within local government financial statistics and Producer Price Indices. The deflator for capital consumption is constructed on a local and central government basis to deflate the respective UK National Accounts expenditure data, using ONS price indices.

Net expenditure on capital consumption is deflated by a constructed central government capital deflator using ONS price indices.

A cost-weighted Laspeyres index is then calculated for the volume of police inputs, using chain-linked expenditure shares, and assumed to equal the volume of police output.

Defence

The volume of inputs is estimated by deflating current price expenditure on defence by a derived deflator. This is based on the Classification of the Functions of Government (COFOG 2).The deflator is derived from current price expenditure on defence and constant price military defence expenditure.

The resulting constant price expenditure series on defence is converted into an index, and assumed to equal the volume of defence output.

Other government services

Central government expenditure data is obtained for:

- general public services, for example, executive and legislative organs, basic research
- economic affairs, for example, general economic, commercial and labour affairs including transport, agricultural, forestry and fishing
- environmental protection, for example, waste management, pollution abatement
- housing and community amenities, for example, housing development, water supply and street lighting
- recreation, culture and religion, for example, recreational and sporting activities, broadcasting and publishing
- other public order and safety, for example, research and development

Total current expenditure on these categories is deflated using the GDP-implied deflator to obtain a constant price expenditure series. This series is then used to generate an index of volume of inputs, which is assumed to equal the volume of output.

4 . Users and stakeholder needs

The Office for National Statistics (ONS) actively seeks feedback from users of its public service productivity statistics in order to inform its future work priorities. We are particularly interested in user views on the value of these statistics to inform policy debates and research projects within the academic and national accounts fields. The updated Quality and Methodology Information (QMI) for the total public service productivity article includes further information on user needs and perceptions.

We use various methods to engage with users about our statistics, including regular stakeholder engagement, pre-publication quality assurance from government experts, user consultation meetings and pre-announced methods changes, such as Improved methods for total public service productivity: total, UK, 2017.

In addition, we have produced a blog post answering some frequently asked questions and providing users with a short explanation of the main concepts relating to public service productivity and how they relate to other issues such as “efficiency” and “value for money”.

Any feedback or comments are welcome and can be sent to productivity@ons.gov.uk.