

# Information paper

## Summary Quality Report for Total Public Service Output, Inputs and Productivity

### 1 Introduction

This report is part of a rolling programme of quality reports being introduced by the Office for National Statistics (ONS). The full programme of work being carried out on [Statistical Quality](#)<sup>1</sup> is available on the National Statistics website. Summary Quality Reports are overview notes which pull together key qualitative information on the various dimensions of quality as well as providing a summary of methods used to compile the output.

This report relates to estimates published in [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> on 27 July 2010. The last time that a single indicator of total public service productivity was published was in 2009 in [Total Public Service Output and Productivity](#)<sup>3</sup>. Updated estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are published on an annual basis. These statistics are experimental and subject to development.

[Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> is the latest in a series of reports from the UK Centre for the Measurement of Government Activity (UKCeMGA), which was formed in 2005 to take forward the recommendations of the [Atkinson Review: Final Report](#)<sup>4</sup> on the measurement of public service output and productivity.

The focus of this report is the estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup>. Additional summary quality reports are available, which provide information about the estimates for component public service areas.

### 2 Summary of Quality

#### 2.1 Relevance

*The degree to which the statistical product meets user needs for both coverage and content.*

Estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> were published in July 2010, covering the period 1997 to 2008 inclusive. These experimental statistics provide a unique illustration of productivity of the public services.

[Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> estimates are calculated in accordance with the [OECD Manual, Measuring Productivity](#)<sup>5</sup>. While some other countries, for example, Italy, Denmark, and the Netherlands, are developing their public service productivity estimates, the UK is leading the work in this field.

A breakdown of total public service output, inputs and productivity is provided for nine categories of public service: Healthcare, Education, Adult Social Care, social security administration, Children's Social Care, Public Order and Safety, Police, Defence, and Other (which includes General Public Services, Economic Affairs, Environmental Protection, Housing and Community Amenities and Recreation, and Culture and Religion).

The users of the [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> article include:

- government departments (to inform policymaking and evaluation)
- academics (for research)
- international statistical organisations (for example, the Organisation for Economic Cooperation and Development)
- other areas of the Office for National Statistics (for example, the output estimates are used in the calculation of the expenditure measure of Gross Domestic Product for the UK National Accounts)
- the public (by reading newspaper articles about the estimates)

UKCeMGA has mechanisms in place to ensure that user needs are considered and met as far as possible. The work of UKCeMGA is overseen by an advisory board, which comprises leading academics. Additionally, the Departmental Output and Productivity Advisory Group was set up to support the work of UKCeMGA and is made up of officials from various government departments.

Members of UKCeMGA meet regularly with their colleagues in the National Accounts area of ONS to ensure that the data supplied meet their requirements. Any major changes to the methods used are put through a stringent peer group appraisal process before being implemented in the National Accounts.

## 2.2 Accuracy

*The closeness between an estimated result and the (unknown) true value.*

The possible sources of statistical error in the data used to estimate public service output and productivity are described in [A Framework for Identifying Sources of Statistical Error in Estimates of Public Service Output and Productivity](#)<sup>6</sup>, published in 2008.

As there are no comparable estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> (see section 2.6), it is not feasible to estimate the accuracy of the statistics. However, the following factors contribute to the accuracy of the statistics.

### Geographical coverage error

The estimates cover the United Kingdom and, where possible, are based on data for England, Scotland, Wales and Northern Ireland. Where data are not available for all four countries, the assumption is made that the available data are representative of the UK. This can happen for output or inputs data. For example, as Adult Social Care output data are only available for England and Scotland, the assumption is made that the change in output in these countries is representative of the change in output across the UK. Secondly, in the case of the inputs series for some public service components (for example, Healthcare inputs), an assumption is made about price movements, that is price changes in Healthcare services in England are representative of price changes in Healthcare services in the whole of the UK.

Where data are available for all four countries of the UK (as is the case for Education output) and refer to the same concept, there may be slight variations in definitions or reporting conventions between countries.

### Activity coverage error

For most of the public service components the estimates of output are compiled using activity data (see section 3). For some components (for example, Healthcare) the available activity data are not comprehensive. In these cases, the assumption is made that the change in measured activities also represents the change in the unmeasured activities.

### Forecasting and interpolation error

The financial year administrative data used to produce estimates tend to lag behind the current period (see section 2.3). Therefore, each of the financial year series is converted to calendar year format as follows:

1. The available financial year series is used to forecast a value for the next (financial) year (e.g. the financial year series for up to 2007-08 is used to forecast a value for 2008-09)
2. The extended financial year series is interpolated to form a quarterly series using the cubic spline method
3. Each set of four calendar quarters is added together.

An equivalent process is used to convert academic year data into calendar year format. The forecasting error is the difference between the forecast value and the actual value. It can only be calculated once the actual value becomes available. The interpolation error is the difference between the interpolated value and the actual value. It cannot usually be quantified.

Further details can be found in Annex B of [Documentation of UKCeMGA methods used in National Accounts](#)<sup>7</sup> and in sections 5 and 6 of [From Holt-Winters to ARIMA Modelling: Measuring the Impact on Forecasting Errors for Components of Quarterly Estimates of Public Service Output](#)<sup>8</sup>

### Sampling error

The vast majority of the source data used to calculate estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are taken from a wide range of administrative systems. This means that the data are free from sampling error, but remain subject to other kinds of error. Some data are taken from sample surveys (for example, the hours data for teachers which are used in the volume of labour inputs estimates are taken from a workload survey). Such data are subject to sampling error, but the extent of the error (in terms of the estimates of public service output and productivity) is unknown.

### Reliability

Revisions analyses can be used to estimate the reliability of statistics. [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> includes a section about revisions (section 7).

## 2.3 Timeliness and Punctuality

*Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the time lag between the actual and planned dates of publication.*

The article [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> published in July 2010 contains estimates for 1997 to 2008 inclusive. In simple terms, there is an 18 month lag between the reference period for the data and the publication date. However, this is a crude estimate of timeliness, as explained below.

The estimates for 2008 are partly based on forecast values. This is because many of the contributory data items are provided for financial or academic years rather than calendar years. For example, some of the activity data for Healthcare are provided for financial years and the Education activity data are provided for academic years. As explained in section 2.1, the data for calendar year 2008 are initially estimated based on the data for up to and including the financial year 2007-08 (or the academic year 2007/08).

If timeliness were defined as the lag between the period to which the *reported* data refer and the publication date, then the lag is 15 months for output estimates and 27 months for inputs estimates.

It should be noted that the estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are based on many data series, some of which are more timely than others. In general, the data required for the output estimates are more timely than those needed for the inputs estimates. As with many statistics, a trade-off is necessary between timeliness and accuracy: the earlier the publication date, the more the estimates rely on forecast values.

It is intended to publish [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> articles on an annual basis. For more details on [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> releases, the [UK National Statistics Publication Hub](#)<sup>9</sup> is available online and provides twelve months' advanced notice of release dates. In the unlikely event of a change to the pre-announced release schedule, public attention should be drawn to the change and the reasons for the change should be explained fully at the same time, as set out in the [Code of Practice for Official Statistics](#)<sup>10</sup>.

## 2.4 Accessibility and Clarity

*Accessibility is the ease with which users are able to access the data, also reflecting the format(s) in which the data are available and the availability of supporting information. Clarity refers to the quality and sufficiency of the metadata, illustrations and accompanying advice.*

[Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> is available free of charge from the ONS website (in pdf format). The article will also be replicated in a forthcoming edition of [Economic and Labour Market Review](#)<sup>11</sup>.

Where possible, the data used to calculate the estimates in [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are taken from published sources. Often, the data cannot be used directly from the published source, because of differences in definitions. In such cases, UKCeMGA obtains adjusted data from the relevant government department or agency.

The concepts and calculations used in [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are explained in the article itself. A comprehensive list of references is also included. Related articles, including methods papers, articles discussing public service productivity for specific components, and further background documentation can be found on the [UKCeMGA publications pages](#)<sup>12</sup> of the ONS website.

General queries on public service productivity can be emailed to: [ukcemga@ons.gov.uk](mailto:ukcemga@ons.gov.uk).

## 2.5 Comparability

*The degree to which data can be compared over time and domain.*

[Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> estimates are presented on a consistent basis for 1997 to 2008 inclusive. The output estimate for a given year covers the output provided using the input consumed in that year.

The estimates for each of the nine public service components are comparable, both over time and with each other, subject to some caveats. For example, the output estimates are only quality adjusted for two of the public service components: Healthcare and Education. Healthcare output estimates are quality adjusted from 2001 onwards.

The estimates published in [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup> are experimental statistics. Future articles are likely to include revisions to the historical series, as UKCeMGA makes use of the most recent data and makes further improvements to the calculation methods. Data suppliers and academic advisors will be consulted before changes are made. These stakeholders are represented on the Departmental Output and Productivity Advisory Group, and the UKCeMGA Advisory Board.

## 2.6 Coherence

*The degree to which data that are derived from different sources or methods, but which refer to the same phenomenon, are similar.*

There are no comparable estimates of [Total Public Service Output, Inputs and Productivity](#)<sup>2</sup>. Related statistics include labour productivity statistics and multi-factor productivity estimates (see below).

[Labour productivity statistics](#)<sup>13</sup> are published by ONS on a quarterly basis. These statistics are not comparable with Total Public Service Productivity because:

- they represent the whole economy, rather than the productivity of publicly-funded public services
- they are for output per worker, rather than quality-adjusted gross output per unit of input

[Multi-factor productivity estimates](#)<sup>14</sup> are published by ONS on an annual basis. These statistics are not directly comparable with Total Public Service Productivity because:

- they represent the whole economy, rather than the productivity of publicly-funded public services
- they are for change in gross value added divided by change in labour and capital combined, rather than change in quality-adjusted gross output divided by change in labour, capital and procurement of goods and services combined

It would not be meaningful to extract a public service productivity estimate from this source and compare it to the Total Public Service Productivity estimates, because of the different calculation

method and also because of a difference in the classification method (Standard Industrial Classification rather than public expenditure/not public expenditure).

The issues are discussed further in [Comparing the different estimates of productivity produced by the Office for National Statistics](#)<sup>15</sup>.

## 3 Summary of Methods Used to Compile the Output

### 1. Volume of output

The volume of output is measured for each of the nine public service components. Where possible, outputs are measured directly using a quality-adjusted cost-weighted activity index.

Briefly, the cost-weighted activity index for each public service is calculated as follows:

- obtain a breakdown of the activities provided and their associated costs
- obtain the quantity of each activity provided in each year
- for each category of activity, calculate the change in the number of activities provided between two years
- multiply the change in each category by the cost of that activity in the earlier of the two years
- add all the cost-weighted changes together

This type of index is known as a chain-linked Laspeyres index. More details can be found in [Documentation of UKCeMGA methods used in National Accounts](#)<sup>6</sup>.

Quality adjustments are applied where available. The purpose of quality adjustments is to take account of the improvement in the outcome for the service user that could reliably be attributed to the relevant activity. At present the output estimates for Healthcare and Education are quality-adjusted.

The output figures for Education are quality-adjusted from 1997 onwards using GCSE (Standard Grades in Scotland) average point scores. The Healthcare output figures are quality-adjusted from 2001 onwards, using an overall adjustment that incorporates adjustments for:

- patient experience (reflecting how patients are treated)
- clinical outcomes in general practice
- health effects (measuring impact in terms of life expectancy, health gains, survival rates and waiting times)

Total public service output is the weighted combination of the change in each of the nine volume of outputs indices. The weights are the expenditure shares of each public service component in the previous year (as is expected for a chain-linked Laspeyres index). See paragraph 4 below for details of the source data used to calculate the expenditure shares.

### 2. Volume of inputs

The volume of inputs is measured for each of the nine public service components. For each component, the volume of inputs is measured for three categories: labour, goods and services, and capital.

#### 2.1 Labour

The change in the volume of labour inputs can be measured directly or indirectly:

- the direct labour method involves calculating a chain-linked Laspeyres index of the change in the number of full time equivalent staff (adjusted for hours worked if possible) broken down by type of job, and weighted together using average salaries as a measure of skill level
- the indirect labour method involves deflating expenditure on staff costs, broken down by type of job if possible. The deflator is a measure of pay inflation. Sometimes different pay deflators are used for different categories of staff or, equivalently, a composite pay deflator is calculated

Where possible, both the direct and indirect methods are used to derive two measures of the volume of labour inputs, and the measures are compared. The choice of preferred method depends

on the availability and quality of source data. The direct method is used for Healthcare and for Education.

## 2.2 Goods and Services

The change in the volume of goods and services is measured indirectly, that is by removing the effect of price changes from expenditure using a suitable deflator. In most cases, a composite deflator is calculated as follows. A detailed breakdown of expenditure on goods and services is obtained and suitable deflators are sought for each category. An overall deflator is calculated by weighting together all the different deflators using the expenditure shares.

## 2.3 Capital

Ideally capital inputs are measured using a capital services measure (volume index of capital services). Where this is not possible, a capital consumption method is used, which calculates an estimate of the volume of capital consumed (used up) during the year.

## 2.4 Total volume of inputs

The total volume of inputs index for a particular service (for example Healthcare) is calculated as a weighted combination of the change in the volume of labour index, the volume of goods and services index, and the capital index for that service. The weights are the expenditure shares of each component in the previous year (as is expected for a chain-linked Laspeyres index). See paragraph 4 below for details of the source data used to calculate the expenditure shares.

## 3. Productivity

For each public service component, the value of the productivity index in any given time period is calculated as the volume index of output in that time period divided by the volume index of inputs in that time period (multiplied by 100).

The value of the Total Public Service Productivity index in any given time period is calculated as the total volume of output index in that time period divided by the total volume of inputs index in that time period (multiplied by 100).

## 4. Source of expenditure shares

The expenditure shares of each public service component are calculated using a breakdown of General Government Final Consumption Expenditure by Classification of Function of Government (COFOG). ONS publishes this breakdown in [ESA table 11](#)<sup>16</sup>, and provides the data to Eurostat for the European Deficit Procedure (EDP) in accordance with the Maastricht Treaty.

The EDP source is used for the following reasons:

- Consistent time series are available for all public service components (main reason)
- The data are published on a regular basis
- A detailed breakdown is available, allowing us to separate, for example, Adult Social Care, Children's Social Care and Social Protection

Before the data are used in the Total Public Service Output and Inputs calculations, an estimate of expenditure on that part of Further Education dealing with under-19s is added to the Education category.

## 5. Annual average growth rate

Throughout the article "mean" refers to the mean annual compound growth rate. This is calculated by taking the  $n$ th root of total growth over a period of  $(n+1)$  years. For example, over the 12 year period, 1997 to 2008, this is calculated as follows:

- a) divide the index value for 2008 by the index value for 1997
- b) take the 11<sup>th</sup> root of the result in a)
- c) subtract 1
- d) multiply by 100 (to obtain the percentage)

## 4 References

	<b>Title of Reference</b>	<b>Website Location</b>
1	Statistical Quality Programme	<a href="http://www.ons.gov.uk/about-statistics/methodology-and-quality/quality/index.html">http://www.ons.gov.uk/about-statistics/methodology-and-quality/quality/index.html</a>
2	Total Public Service Output, Inputs and Productivity	<a href="http://www.statistics.gov.uk/ci/article.asp?id=2488">http://www.statistics.gov.uk/ci/article.asp?id=2488</a>
3	Total Public Service Output and Productivity	<a href="http://www.statistics.gov.uk/ci/article.asp?ID=2212">http://www.statistics.gov.uk/ci/article.asp?ID=2212</a>
4	Atkinson Review: Final Report	<a href="http://www.statistics.gov.uk/about/data/methodology/specific/PublicSector/atkinson/final_report.asp">http://www.statistics.gov.uk/about/data/methodology/specific/PublicSector/atkinson/final_report.asp</a>
5	Measuring Productivity, OECD Manual	<a href="http://www.oecd.org/LongAbstract/0,3425,en_2649_34445_1905860_1_1_1_1,00.html">http://www.oecd.org/LongAbstract/0,3425,en_2649_34445_1905860_1_1_1_1,00.html</a>
6	A Framework for Identifying Sources of Statistical Error in Estimates of Public Service Output and Productivity	<a href="http://www.statistics.gov.uk/CCI/article.asp?ID=2038">http://www.statistics.gov.uk/CCI/article.asp?ID=2038</a>
7	Documentation of UKCeMGA methods used in National Accounts	<a href="http://www.statistics.gov.uk/CCI/article.asp?ID=1985">http://www.statistics.gov.uk/CCI/article.asp?ID=1985</a>
8	From Holt-Winters to ARIMA Modelling: Measuring the Impact on Forecasting Errors for Components of Quarterly Estimates of Public Service Output	<a href="http://www.statistics.gov.uk/ci/article.asp?ID=2037">http://www.statistics.gov.uk/ci/article.asp?ID=2037</a>
9	UK National Statistics Publication Hub	<a href="http://www.statistics.gov.uk/hub/index.html">http://www.statistics.gov.uk/hub/index.html</a>
10	Code of Practice for Official Statistics	<a href="http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html">http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html</a>
11	Economic and Labour Market Review	<a href="http://www.statistics.gov.uk/statbase/Product.asp?vlnk=14692">http://www.statistics.gov.uk/statbase/Product.asp?vlnk=14692</a>
12	UKCeMGA publications	<a href="http://www.ons.gov.uk/about-statistics/ukcemga/publications-home/publications/index.html">http://www.ons.gov.uk/about-statistics/ukcemga/publications-home/publications/index.html</a>
13	Productivity Statistical Bulletin	<a href="http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=7476">http://www.statistics.gov.uk/StatBase/Product.asp?vlnk=7476</a>
14	Multi-factor productivity: estimates for 1998 to 2007	<a href="http://www.statistics.gov.uk/ci/article.asp?id=2147">http://www.statistics.gov.uk/ci/article.asp?id=2147</a>
15	Comparing the different estimates of productivity produced by the Office for National Statistics	<a href="http://www.statistics.gov.uk/CCI/article.asp?ID=2391">http://www.statistics.gov.uk/CCI/article.asp?ID=2391</a>
16	ESA table 11 – General Government Total Outlays by classification of function of government	<a href="http://www.statistics.gov.uk/Statbase/Product.asp?vlnk=3766">http://www.statistics.gov.uk/Statbase/Product.asp?vlnk=3766</a>

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