Public Service Productivity Estimates: Education 2012

Author Name(s): Sarah Caul, Office for National Statistics

Abstract

This article provides updated estimates of growth in the volume of public service education output, inputs and productivity from 1996 to 2012. Estimates of education output include an adjustment for quality, based on GCSE and equivalent attainment levels of school pupils aged 15-16 years. The article also provides estimates of education inputs broken down into growth of labour, goods and services and capital.

Acknowledgements

1. The author would like to acknowledge contributions from Geoff Bright, Jamie Pritchard and Will Postins.

Key points

• Productivity growth is calculated by comparing growth in the total amount of education output to the growth in the total amount of input used. We estimate that public service education productivity grew by 4.3% in 2012. This is the fourth successive year of positive productivity growth.

• The productivity growth was caused by a 2.2% fall in inputs between 2011 and 2012, whilst quality-adjusted outputs continue to rise by 2.0%.

• The quality adjustment factor has had a negative effect on the output series; this is the first time it's happened since the series began.

• Over the period 1996-2012, the annual average growth rate for productivity is 1.1% per year.

• This article introduces a new data source for adjusting teacher numbers using their hours of work from the Labour Force Survey.

Components of inputs and output

Table 1 gives the components of Education output and inputs which are required to produce the estimates of Education productivity published in this release. More information on the data sources and methods for creating the productivity estimates is available in a separate publication (ONS 2012a). An updated Quality and Methodology Information paper is also available which explains how these productivity estimates are produced. (ONS 2014a)

Table 1: Components of Inputs and Output

<table>
<thead>
<tr>
<th>Input Source</th>
<th>Adjustment</th>
<th>2012 Expenditure as share of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher numbers – Full time equivalent</td>
<td>Teacher’s hours worked Weighted by salary</td>
<td>67.4%</td>
</tr>
<tr>
<td>Support Staff</td>
<td>Weighted by salary</td>
<td></td>
</tr>
<tr>
<td>Central government labour expenditure</td>
<td>Deflated Weighted by expenditure</td>
<td></td>
</tr>
<tr>
<td>Goods and services expenditure incurred by Central Government</td>
<td>Deflated Weighted by expenditure</td>
<td>27.2%</td>
</tr>
<tr>
<td>Goods and services expenditure incurred by Local Authorities</td>
<td>Deflated Weighted by expenditure</td>
<td></td>
</tr>
<tr>
<td>Capital Services</td>
<td>Deflated Weighted by expenditure</td>
<td>5.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output Source</th>
<th>Adjustment</th>
<th>2012 Expenditure as share of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-School</td>
<td>Weighted by Expenditure</td>
<td>6.6%</td>
</tr>
<tr>
<td>Publicly funded Private, Voluntary and Independent (PVI) pre-school places</td>
<td>Weighted by Expenditure</td>
<td></td>
</tr>
<tr>
<td>Input Source</td>
<td>Adjustment</td>
<td>2012 Expenditure as share of total¹</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Primary Schools (Maintained and Academies)</td>
<td>Quality adjustment: GCSE APS Score Adjusted by attendance rate Weighted by Expenditure</td>
<td>34.8%</td>
</tr>
<tr>
<td>Secondary Schools (Maintained, Academies and City Academies)</td>
<td>Quality adjustment: GCSE APS Score Adjusted by attendance rate Weighted by Expenditure</td>
<td>37.9%</td>
</tr>
<tr>
<td>Special Schools (Maintained and Academies)</td>
<td>Quality adjustment: GCSE APS Score Adjusted by attendance rate Weighted by Expenditure</td>
<td>5.0%</td>
</tr>
<tr>
<td>Further Education</td>
<td>Weighted by Expenditure</td>
<td>13.4%</td>
</tr>
<tr>
<td>City Technology colleges</td>
<td>Quality Adjustment: GCSE APS Score Adjusted by attendance rate Weighted by Expenditure</td>
<td>2.3%</td>
</tr>
<tr>
<td>Higher education training of Teachers</td>
<td>Quality adjustment: Pass rate Weighted by Expenditure</td>
<td></td>
</tr>
<tr>
<td>Higher education training of Health professionals</td>
<td>Weighted by Expenditure</td>
<td></td>
</tr>
</tbody>
</table>
Table source: Office for National Statistics

Table notes:
1. Figures may not sum due to rounding.

Download table
XLS XLS format
(34.5 Kb)

Education Productivity

Figure 1 - UK education productivity growth rates 1997-2012

Source: Office for National Statistics

Download chart
XLS XLS format
(27.5 Kb)

Figure 1 shows annual growth rates in Education productivity between 1996 and 2012. The series can be broken down into three main periods:
Between 1996 and 1999: productivity growth was positive due to annual falls in volume of inputs used while quality-adjusted output rose.

Between 2000 and 2008: inputs volumes increased each year, driven by a mixture of increased labour and procurement used to supply education. Apart from in 2003 and 2004, inputs growth was faster than quality-adjusted output growth, leading to negative productivity growth for 7 of the 9 years between 2000 and 2008.

From 2009 to 2012: inputs growth started to slow down and then become negative in 2011 and 2012. Quality-adjusted output continued to rise each year with the highest rate of growth of the series seen in 2009. The rises in output in these years were largely attributable to growth in attainment at GCSE and equivalent level. The continued growth in quality-adjusted output while inputs have been growing at a slower rate or falling has led to positive productivity growth in the period 2009 to 2012. The highest growth rate for productivity occurred in 2011 at 6.4%.

The average annual growth rate for productivity between 1996 and 2011 is unrevised at 0.9% per year. Adding the 4.3% growth rate for 2012, brings the annual average growth rate for education productivity between 1996 and 2012 up from 0.9% to 1.1%.

Reference tables are available for:

Table 1: Indices of output, inputs and productivity 1996-2012

Education Output

Education output consists of an estimate of volume (or quantity), which is then adjusted for quality. The reasons for quality-adjusting public service output are well documented and follow from recommendations made in the Atkinson Review (2005).

Estimates of education quantity

Before any quality-adjustment is applied, education quantity is estimated by aggregating FTE student and pupil numbers, funded by Government, from each of the countries in the UK across the institutional settings given in Table 1. Figure 2 shows the contributions to growth in the main types of education setting between 1997 and 2012. Data labels refer to Total growth rates each year.
Growth in Education quantity has varied throughout the period although within a fairly narrow range of + or – 1.5% for most of the time. The annual average rate of growth in education quantity is 0.4% per year.

**Between 1997 and 2004:** apart from 1998, quantity increased each year, driven mainly by increases in secondary and Further Education numbers. This growth was not fully offset by falls in primary school numbers.

**Between 2005 and 2010:** quantity of education output fell each year as growth in secondary school pupils reversed, and re-inforced the picture of primary school numbers which continued to fall.

**Since 2010:** primary school numbers have started to increase, supplemented by increases in Further Education numbers in 2011 and 2012. 2012 saw the biggest growth in education quantity at 2.4%.

The rise in the primary sector in recent years reflects the increase in population and birth rate in the UK. We would expect this population growth to feed through into the secondary sector from around 2016 onwards.
The rise in further education in 2011 and 2012 could be attributed to poorer employment prospects in the labour market due to low output growth in the UK economy during this time.

Reference tables are available for:

Table 2: Full-time equivalent pupil/student numbers, by education sector and country, 1995-96 and 2012-13
Table 3: Absence rates by school type, 1995-96 to 2012-13
Table 4: Output indices 1996-2012
Table 5: Expenditure shares by education sector, 1996-2012

Adjusting for Education Quality

A quality-adjustment factor is applied to the estimate of education quantity. Information on how the quality-adjustment is applied can be found in the sources and methods paper for Public Service Productivity Estimates: Education (ONS 2012a)

The main quality-adjustment factor\(^1\), which is used only to produce public service education productivity estimates and not used in the UK National Accounts, is based on the growth in Average Point Scores (APS) for GCSEs and equivalent qualifications in England, Wales and Northern Ireland (England APS is used to adjust Northern Ireland output, due to a lack of data.), and Standard Grades and equivalent qualifications in Scotland.

The quality-adjustment for each country is applied to the Primary (including academies), Secondary (including academies) and City Technology Colleges sectors. For example, if pupils in one year did better in assessments, measured by the APS, than the pupils taking their exams in the previous year, then the growth in the APS index would be positive and increase the estimate of Education output. Conversely if the APS score falls in any year, this would have a negative effect on the estimate of Education output growth.

In 2003-04, England included a wider set of equivalent examinations alongside GCSEs. For Wales, equivalent qualifications were included from 2007-08. Scotland has had a consistent time series throughout the period.
Figure 3: Impact of quality adjustment on growth, 1997-2012

UK

Source: Office for National Statistics

Notes:
1. 2012 shows the first negative contribution from the quality adjustment.

Download chart

XLS format

(29 Kb)

Figure 3 shows that 2012 is the first year where the quality-adjustment factor has had a negative effect on education output. The overall growth rate in 2012 can be attributed to the quantity of output which we have identified as being due to a rise in primary school pupil numbers and Further Education students. Data labels refer to Total growth rates each year.

Annex B (24 Kb Word document) contains a discussion of the issues involved in measuring education quality, and highlights areas for further development by ONS.

Reference tables are available for:

Table 6: Average Point Score by country between 1995-96 and 2012-13
Notes

1. A different quality-adjustment factor based on completion rates is applied to Initial Teacher Training, but has no significant effect on output volume growth (to 1 decimal place).

Education Inputs

There are three components that make up education inputs; Labour, Goods and Services, and Capital services. More information on the data sources and methods for creating the inputs estimates is available in a separate publication (ONS 2012a).

Teacher numbers, which are included in Labour, are adjusted for their hours worked. Previous articles used the Teacher Workload Diary (DfE 2010 and previous editions), but is now estimated using Labour Force Survey data. The reasons for this change and a sensitivity analysis of how the estimates for Education inputs are affected by the change in data source are given in a separate methods change paper (ONS 2014a).

An updated Quality and Methodology Information paper is also forthcoming which explains how the productivity estimates are produced and incorporates the data source change for teacher hours (ONS 2014b).

Figure 4: Contributions to input volume growth, by component 1997-2012

Source: Office for National Statistics
Figure 4 shows inputs continued to fall by 2.2% in 2012, following a 1.9% fall in 2011. This can be attributed to falls in Labour and Goods and Services. Data labels refer to Total growth rates each year.

Growth in inputs was negative for the period 1997-1999, growth was positive between 2000 and 2010 and has become negative for 2011 and 2012.

In 1997, capital services made a small negative contribution, for the rest of the series, capital services have always shown positive growth, contributing its highest value of 0.4% in 2005.

Growth of the inputs of goods and services have been positive for most of the series with highest contributions in 2002 and 2008, with 3.8% and 3.4% respectively. There were negative contributions in the first two years of the series, in 2007 and in the last three years of the series.

Labour has had a mostly positive contribution over the time period, with negative contributions in 2011 and 2012. The falls in labour in later years can be attributed to a fall in teacher and support staff numbers.

Reference Tables are available for:

Table 7 Volume of inputs by component 1996-2012
Table 8 Expenditure shares, by component of input, 1996-2012

Revisions

Although there have been revisions to estimates of output, inputs and productivity in individual series and years, the annual average growth rates for each series between 1996 and 2011 remain unchanged (to one decimal place) at 2.7%, 1.8% and 0.9% respectively.
Figure 5 shows that revisions to output growth rates range from -0.3 percentage points to +0.7 percentage points. These are due to changes throughout the series in the Further Education component and from City Academies now being counted in the Secondary sector rather than in the City Technology Colleges category.

Revisions to Inputs growth rates are larger than for output and range from -1.4 percentage points to +1.4 percentage points. This is mainly due to the new method that is used to adjust the FTE teacher numbers for hours worked and some revisions from the new data on Capital services.

Subsequent revisions to productivity have been mainly because of changes to the inputs series. The largest downward revisions to productivity were in 2000 and 2009. The largest upward revisions were in 2008 and 2011 with only the last revision due to an upwards revision in output rather than a change in the estimate of inputs.
Triangulation Evidence

It is useful to consider a range of other evidence when producing productivity estimates, to place the statistics in their wider context.

We have looked briefly at three areas which relate to education quantity, inputs, and quality-adjustment.

Education quantity

The main determinant of growth in education quantity is changes to the school age population, as schools make up around 80% of total quantity by expenditure share. Figure 6 shows the changes in school-age populations within the 5-9 year old age band, and the 10-14 age band.

Given schooling is compulsory from the age of 5 in the UK, these population trends are reflected directly in the pupil census data that are used in the estimates of education output used in this article.

Figure 6: Population estimates, Age 5-9 and 10-14, 2006-2012

UK

Source: Office for National Statistics

Download chart

XLS XLS format
(19 Kb)

Education inputs
Our estimates suggest that the volume of labour used across the education sector has been falling in 2011 and 2012. This can be verified by considering published workforce census data for schools in each of the countries of the UK which is directly used in the production of the input estimates. Other measures, such as the numbers of civil servants employed by the Department for Education, can also be seen to be falling for these years. (ONS 2014c)

Average class sizes also can give an indication of trends in school inputs and pupil numbers. Figure 7, using data for England only, shows this to be falling slightly in secondary schools, but rising in primary schools where pupil numbers are growing strongly.

**Figure 7: Average class size 2006-2012**

![](image)

**Notes:**
1. Source: Department for Education

**Download chart**

[XLS](XLS format) (18.5 Kb)

**Quality-Adjusting school output**

The overall APS for England fell by 2.7% between academic year 2011-12 and 2012-13. This is the key driver of the 0.5% fall in the quality-adjustment factor for 2012 seen in Figure 3. The attainment results for Wales and Scotland increased by 7.2% and 2.7% respectively, but given their smaller weighting, were not sufficient to offset the fall seen in England.

It is useful to consider a range of other measures of pupil attainment to see if a similar picture arises.
For England, falling measures included:

- The capped APS for all state-funded schools in England which uses the best eight results for the pupil also fell in 2012-13. This fell by much less than the uncapped APS by 0.4% from 343.3 points to 342.0.
- the percentage of pupils achieving 5 A* - C grades in all State-funded schools fell very slightly by 0.1 percentage points from 83.0% to 82.9% between 2011-12 and 2012-13.

Rising measures of attainment in England for years 2011-12 to 2012-13 included:

- the percentage of pupils achieving 5 A*-C grades including English and Maths rose by 1.8 percentage points from 58.8% to 60.6%.
- the percentage of pupils making expected progress in English and Maths between Key stage 2 and Key stage 4 increased for all State-funded schools by 2.4 percentage points in English and by 2 percentage points for Maths. (DfE 2014, 2013b)

The reason for the larger fall in the uncapped APS compared to the capped APS is likely to be due to pupils being entered for and achieving a lower volume of passes rather than the average grade of exams taken deteriorating. There is evidence to suggest the volume effect has occurred, as data from DfE show that the average number of exam entries at Key Stage 4 for courses that are equivalent to GCSEs fell by 12.8% between 2011-12 and 2012-13. Given the reduced volume of entries per pupil, the total points able to be scored per pupil will be smaller than in previous years. This change to the number of vocational qualifications taken is likely to be in preparation for changes to the school performance tables coming into place from 2013-14 onwards.

Given this and other evidence on the many different ways to measure pupil attainment and the significant changes in curricula, mode of examination, and school performance tables being implemented in England, Wales and Scotland, ONS has begun a review of the education quality-adjustment used for schools.

Annex B (24 Kb Word document) contains a brief update of this review and outlines an area of research identified for further investigation.

References


Background notes

1. **Chain linked Laspeyres volume index**

   A methodology paper by Robjohns (2006) explains how ONS annually chain-links data series. This technique of annually updating the base period weights produces a rate of change in volume terms over the reference period for the data series.

   ONS use this technique to produce estimates of the volume of output and input for public service education, and other measures of government services such as health and social services. See ONS (2008) for more information on this method and how Laspeyres volume indices are calculated for the estimates in this article.

2. **Interpreting estimates of public service education productivity**

   It is important to recognise that the productivity statistics published in this article are based on a concept of output as measured by government consumption expenditure rather than government or state production. This follows from the submission of the estimates of the volume of government output that are used in this article (prior to any quality-adjustment) to the GDP (E) (expenditure) side of the UK national accounts. This means that we are using a measure of government purchased output, regardless of what type of business unit produced the output.

   In the case of education, most expenditure is used to fund state providers of education and its administration i.e. maintained primary, secondary and special schools across the four countries of the UK. There is, however, significant expenditure on private or voluntarily-provided pre-school education which is counted as a component of government output in our articles, even though it is provided (or supplied) by business units which are classified as private business or NPISH units in the National Accounts.

   Traditional measures of productivity, including those published by ONS, use a supply or production framework. These measures of productivity use Standard Industrial Classification (SIC 07) categories of production as the measure of output and are on a gross value-added (GVA) basis. Input measures count the labour used in the production of these services to estimate labour productivity series such as those produced by ONS. (See ONS 2014d) Multifactor productivity estimates include labour and capital services as inputs. See Franklin (2014) for an article on multifactor estimates of productivity for the UK economy.

   No account is therefore taken of the way in which these production activities are funded. For example, in pre-primary education the entire output of these services will be included in the traditional GVA output estimates, but in the expenditure based estimates only that part of the pre-school output that is funded by government is counted as output for pre-school education.
The interpretation of the expenditure based productivity estimates presented in this article should therefore be taken as a measure of the technical efficiency with which government is enabling the provision of education services for individuals in the UK (from whatever type of business unit) not producing that service itself. Caution should therefore be used when considering the differences between productivity measures published using the expenditure approach and those using the traditional production approach. Jurd (2011) and Phelps (2010) describe some of these differences in approach in more detail.

3. **Quality and Methodology Information (QMI)**

There is a QMI paper (ONS 2014b) which describes the intended uses of the statistics presented in this article, their quality and a summary of the methods used to produce them.

4. **Education Sources and Methods paper**

There is a sources and methods paper (2012a) which describes the methodology of producing these statistics. A worked example is also provided which provides a simplified simulation of how the statistics are generated.

5. **Contacts**

Statistical contact: Sarah Caul Tel: 01633 456490

Email: [sarah.caul@ons.gsi.gov.uk](mailto:sarah.caul@ons.gsi.gov.uk)

Issuing body: Office for National Statistics

Planned date of next article: Summer 2015

Media contact details: Telephone 0845 604 1858 (8.30 am – 5.30 pm weekdays)

Emergency out of hours (limited service): 078697 906553

Email: [media.relations@ons.gsi.gov.uk](mailto:media.relations@ons.gsi.gov.uk)

6. Details of the policy governing the release of new data are available by visiting [www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html](http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html) or from the Media Relations Office email: [media.relations@ons.gsi.gov.uk](mailto:media.relations@ons.gsi.gov.uk)

These National Statistics are produced to high professional standards and released according to the arrangements approved by the UK Statistics Authority.

**Copyright**

© Crown copyright 2014