ARTICLE

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Education productivity

SUMMARY

This article is a summary of the third Office for National Statistics (ONS) education productivity article and supporting papers published in December 2009, which extended the analysis of output and the triangulation of outcome measures.

Background

This article continues work to incorporate recommendations of the Atkinson (2005) and subsequent methodological developments endorsed in ONS (2007a). While the methods and data for this article are based on the National Accounts, there are a few differences which are explained in this article.

Education is a complex product with several outcomes related to wider social and economic aims as well as to immediate academic attainment (for example United Nations 1989). It is therefore important to interpret any single measure carefully and alongside other measures such as inspection data on teaching standards, indicators of well-being and research on class size and inclusion.

This article presents estimates of multi-factor productivity growth. This is defined as the growth in the ratio of the volume of output to the volume of inputs (see **Figure 1**).

The estimates presented in this article are constructed in the same way as those presented in ONS (2009a) from 1997 to 2007. However, this article presents more detailed analysis and provides estimates from 1996 to 2008 using the latest data.

Productivity of education in the UK

Latest estimates of productivity show that productivity was the same in 2008 as in 1996 (**Figure 2**). This is because over the whole period output grew by 33.4 per cent, with an annual average increase of 2.4 per cent and inputs grew by 33.3 per cent, with an annual average increase of 2.4 per cent.

However, within the whole period there were three distinct periods of productivity change:

- from 1996 to 2000, productivity grew by 8.1 per cent, with an annual average increase of 2.0 per cent, driven by

Source: Office for National Statistics

Figure 2
Growth in education output, inputs and productivity estimates, 1996–2008

Source: Office for National Statistics

relatively strong growth in the school age population coupled to relatively weak growth in inputs

- from 2000 to 2005 productivity fell by 6.8 per cent, an annual average fall of 1.4 per cent. This resulted from a steady rise in the number of pupils attending school, once adjusted for quality, being outstripped by a sharp rise in inputs, mainly through the employment of more school support staff
- from 2005 to 2008, productivity was fairly flat and fell on average by 0.2 per cent, as output and inputs grew at a similar pace

In the most recent year between 2007 and 2008, output grew by 2.0 per cent and inputs grew by 2.7 per cent causing productivity to fall by 0.7 per cent.

Changes in England dominate the pattern of education productivity change in the UK. The pattern reflects four key changes in the data behind this measure: decreasing school pupil numbers, improving school attendance and attainment, extra support staff and expansion in nursery and health professional provision.

The secondary-school-age population in the UK increased from 1996 to 2004 then declined from 2005 to 2008. The primary school population fell sharply from 1998 to 2008. These demographic changes reduced education quantity. Measured productivity falls if fixed and semi-fixed costs are spread over fewer pupils, for example, where pupil numbers fall and it is not locally feasible to close schools or reduce the number of classes. Attendance rates, GCSE and equivalent and Standard Grades improved in the UK from 1996 to 2008. These changes increased education output as they more than offset the decline in the school age population. However, the improvements have required some targeted resources.

Between 1996 and 2008 there was a large

increase in the number of support staff, which caused inputs to rise. These increases were intended to reduce teacher workload and unpaid overtime, as agreed by a work reform package in 2003. During this period, there was also a rapid expansion in nursery provision and health professional students. Publicly funded nursery places increased following the introduction of a policy to provide a number of hours of free childcare per week for three- and four-year-olds, while an increase in trainee nurses, particularly at degree level, has driven the rise in health professional students.

Three further areas to consider are:

- unmeasured improvements in the quality of education
- expenditure on initiatives, and
- time lags between investment and attainment measured at the end of compulsory schooling

For example, increases in support staff numbers have helped integrate pupils with special needs into mainstream education. The outcomes from expenditure on initiatives such as *Every Child Matters* (Treasury 2003) and *Narrowing the Gap in Outcomes* (Local Government Association 2007) are not currently captured in the output measure, but the expenditure increases the volume of inputs. The expansion in pre-school education will not yet have had an impact on the current quality measure.

Output of education in the UK

Latest estimates of output show that between 1996 and 2008 output grew by 33.4 per cent with an average annual increase of 2.4 per cent and output grew in every year (Figure 2). Growth was strongest from 1996 to 1998, averaging 3.3 per cent annually. Only growth in England (37.1 per cent) was stronger than that in

the UK as a whole (see **Table 1**). Education output grew in Wales by 21.5 per cent, in Scotland by 10.6 per cent and in Northern Ireland by 26.3 per cent.

Education output is quantity adjusted for quality. Education quantity includes attendance-adjusted pupil numbers at government-maintained schools; full-time equivalent places in pre-school education (including publicly funded places provided by the private, voluntary and independent sector) and the number of students on initial teacher training and health professional courses funded directly by government.

Those aged under 19 on publicly funded further education courses, for example in sixth form colleges, are also included. This makes sense in a productivity measure specific to education, but differs from the National Accounts where further education is included in the Non-Profit Institutions Serving Households (NPISH) sector as public sector funding comes indirectly via grants.

As recommended by Eurostat (2001), pupil numbers in primary, secondary and special schools throughout the UK, and city technology colleges (CTCs) and academies in England are adjusted for attendance in order to reflect more accurately the quantity of education services delivered. As attendance at these institutions is compulsory, changes over time are largely driven by demographic patterns. A fall in the number of live births throughout the 1990s has led to falling pupil numbers, though an increase in the number of live births from 2003 is just beginning to affect pre-school pupil numbers and will lead to rising primary school pupil numbers in future years.

Currently no attendance adjustments are made to the quantity of UK pre-school education, initial teacher training (ITT), health professional training and further education (FE) as these are not part of compulsory education. This follows Eurostat guidance that in further and higher education the number of students is a better reflection of output.

Education quantity grew by 4.6 per cent between 1996 and 2008 (see **Table 2**), with an average annual increase of 0.4 per cent. The largest observed increase in CTCs and academies was due to a rapid policy-driven expansion in academies since 2000 although most of this increase came from the conversion of existing secondary schools. Health professional training and pre-school education grew rapidly. Further education for under 19s also grew over the

Table 1
Education output in the United Kingdom by country, 1996-2008

	Index (1996=100)													Average annual percentage change 1996-2008
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
United Kingdom	100.0	103.5	106.7	110.2	112.2	114.1	117.4	119.4	121.9	125.0	127.5	130.8	133.4	2.4
England	100.0	103.8	107.0	110.4	112.4	114.3	118.2	120.4	123.3	127.0	130.0	134.1	137.1	2.7
Wales	100.0	105.0	107.9	112.1	115.1	117.0	118.5	119.5	120.6	120.9	121.4	121.1	121.5	1.6
Scotland	100.0	100.9	103.6	108.5	110.9	111.9	112.0	112.4	112.3	111.4	111.6	110.2	110.6	0.8
Northern Ireland	100.0	102.9	105.9	108.5	109.5	110.5	112.6	114.1	116.3	119.1	120.8	123.5	126.3	2.0

Source: Office for National Statistics

Table 2
Quantity measure of education, 1996-2008

United Kingdom														Average annual percentage change
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Pre-schools	100.0	102.2	108.7	121.7	140.3	153.9	161.8	165.9	161.2	161.8	166.4	169.9	170.8	4.6
Primary Schools	100.0	101.0	101.1	101.3	100.5	99.6	98.8	97.5	96.7	95.2	94.0	93.5	92.7	-0.6
Secondary Schools	100.0	101.3	102.1	104.1	105.7	106.6	108.2	109.7	110.0	109.5	108.7	107.7	106.1	0.5
Special Schools	100.0	100.5	101.0	101.1	99.9	98.5	98.1	96.7	94.8	93.2	92.5	92.3	92.0	-0.7
CTC / Academies	100.0	107.1	109.2	112.7	114.2	115.2	125.0	157.7	198.2	229.3	292.3	433.2	663.4	17.1
Initial Teacher Training	100.0	95.1	89.0	82.3	79.8	83.0	85.1	90.0	92.2	91.5	93.3	90.5	86.1	-1.2
Health Professional Training	100.0	108.4	119.2	131.2	142.1	153.4	169.1	192.2	213.8	229.6	233.2	227.8	214.3	6.6
Further Education for U19s	100.0	103.2	99.9	98.1	98.4	99.0	104.9	109.6	113.8	119.1	124.7	125.9	124.4	1.8
Total	100.0	101.3	101.7	102.7	103.4	103.8	105.0	105.8	105.9	105.6	105.4	105.2	104.6	0.4

Source: Office for National Statistics

Table 3
Expenditure-based education weights, 1996-2008

United Kingdom														Per cent
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Pre-schools	1.9	2.0	1.9	2.3	3.1	4.1	4.2	5.3	5.1	5.4	6.0	6.1	6.1	
Primary Schools	43.0	42.3	43.3	41.4	40.3	40.3	39.7	39.2	38.2	37.7	37.2	37.1	37.1	
Secondary Schools	36.4	36.5	35.9	38.6	40.3	40.5	40.5	40.6	40.4	39.9	39.6	39.4	39.4	
Special Schools	7.2	7.5	7.5	7.6	6.7	5.7	5.9	5.1	5.7	6.2	6.0	6.1	6.1	
CTC / Academies	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.6	0.9	0.9	
Initial Teacher Training	1.3	1.2	1.1	0.9	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5	
Health Professional Training	1.8	1.9	2.0	2.0	1.9	1.9	1.9	1.9	2.2	2.2	2.2	2.0	2.0	
Further Education for U19s	8.2	8.3	7.9	7.1	6.8	6.7	6.9	6.9	7.3	7.5	7.9	7.9	7.9	
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	

Source: Office for National Statistics

period, with much of the rise coming from students taking qualifications suitable for entry into higher education.

A decrease in the five- to eleven-year-old population led to a fall in the quantity of primary school output. Special schools quantity reduced due to the integration of many children with special needs into mainstream schools. The quantity of ITT also fell, primarily due to a shift in demand from three- to one-year courses, which reduced the number of students.

Primary and secondary schools constitute the largest proportion of expenditure, accounting for around 77 per cent of the total in 2008 (see **Table 3**).

Between 1996 and 2008, the proportion of expenditure on primary and special schools fell as the school-age population

decreased. Conversely, the proportion of expenditure on pre-schools, secondary schools and CTCs and academies rose, as the number of children attending increased. The relative proportions of expenditure on other components remained largely unchanged.

Between 1997 and 2008 education quantity grew by 4.6 per cent. This growth was driven by positive contributions of 2.3 percentage points from secondary schools, 1.7 percentage points from further education for under-19s, 1.6 percentage points from health professional training 1.6 percentage points from pre-schools and 1.2 percentage points from CTCs and academies (see **Figure 3**). These were partially offset by negative contributions of 3.1 percentage points from primary schools,

0.5 percentage points from special schools and 0.2 percentage points from ITT.

Eurostat (2001) and Atkinson (2005) recommend measuring public service output in a way that adjusts for quality change. Currently, primary and secondary schools and ITT are quality adjusted. At present there are no quality adjustments applied to further education, health professional training, special schools and pre-schools.

The current schools adjustment uses the change in the uncapped average points score (APS) of GCSE and equivalent qualifications in England and Wales and Standard Grades and equivalent qualifications in Scotland to estimate quality change for government-maintained primary and secondary schools and CTCs

Figure 3
Contributions to education quantity growth, 1997–2008

Source: Office for National Statistics

Figure 4
Impact of quality-adjustments on education quantity, 1996–2008

Source: Office for National Statistics

and academies. These qualifications relate to the attainment of pupils at the end of Year 11 (pupils aged 15–16). A time series of GCSE scores for Northern Ireland was not available so the change in APS in England was used as a proxy. This quality method uses an additive model, which assumes that attainment is the sum of prior attainment and the amount of education received.

This methodology assumes that the change in the APS:

- should be applied to all pupils in primary and secondary schools (from reception class to the end of the sixth form) in the UK and CTCs and academies in England
- is an adequate approximation for all education outcomes, for example attainment after 16 and development of wider outcomes such as citizenship
- is the best measure for the annual change in the quality of output, based on current research

In addition to compulsory schooling, ITT is also adjusted for quality using the change in the proportion of final-year students who attain Qualified Teacher Status (QTS) in

England. Data are available from 2001/02 and these have been used to construct a quality adjustment that is applied to the whole of the UK.

The impact of the quality adjustments on education quantity is to increase total growth over the period 1996 to 2008 from 4.6 to 33.4 per cent, with the average annual percentage change increasing from 0.4 to 2.4 per cent (**Figure 4**). This difference illustrates the importance of applying measures that capture quality change fully.

Inputs to education in the UK

Latest estimates of the volume of inputs show that between 1996 and 2008, inputs grew by 33.3 per cent, with an annual average increase of 2.4 per cent (**Figure 2**). Between 1996 and 1997, inputs fell by 0.3 per cent but grew in all other years. In particular between 2000 and 2002, inputs grew strongly, by 9.7 per cent.

Data for 2008 uses provisional estimates. Education expenditure used in the inputs calculations totalled just under £64 billion in 2008 (**Table 4**), including approximately £4 billion on further education for those aged under 19. In 2008 education was the second largest component of General

Government Final Consumption Expenditure (GGFCE) after healthcare. Total education input as defined here is around 4 per cent of the expenditure measure of Gross Domestic Product.

Education input comprises three components: labour (for example teaching staff), goods and services (such as learning materials and electricity), and capital services (for example the flow of services provided by a vehicle or building in a given period). Expenditure on labour and goods and services in current prices measure what was actually paid. They are based on GGFCE estimates for education expenditure in the National Accounts and estimates of expenditure on further education for young people (those aged under 19) from the Learning and Skills Council and the devolved administrations. Figures for capital services are estimates of the value of the flow of services from education capital. While not explicitly part of publicly funded education expenditure, they represent the annual input provided by capital assets owned and so are included alongside actual current expenditure. Estimates are calculated as part of the experimental Volume Index of Capital Services (VICS) developed by ONS; see ONS (2009d).

Labour costs are the largest component of education expenditure. In 2008, at current prices, labour expenditure was £41 billion, about two-thirds of the total that year. Teachers' pay is the largest element of labour costs. Teacher numbers were relatively stable from 1996 to 2008 but expenditure on support staff, particularly teaching assistants, has increased sharply as support staff numbers more than doubled over the same period. Labour costs also include expenditure on indirect support services, such as staff time on policy development, standards setting, finance and training.

In 2008, £16 billion was spent on goods and services, about a quarter of all the expenditure on education inputs. This component consists of the goods and services procured from the market sector consumed in the production of education services in any given year. This includes items or services such as teaching aids, electricity, building maintenance and transport. Government purchases of ITT, health professional courses and private nursery places are part of the goods and services component.

The smallest component of education inputs is capital services, estimated at approximately £7 billion in 2008, about a

Table 4
Education input components from 1996–2008, current prices

United Kingdom														£ billions
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual average percentage change
Labour	19.5	20.1	20.8	22.0	23.8	26.6	29.0	31.2	33.3	35.5	37.6	39.7	40.7	6.3
Goods and Services	6.4	6.3	6.6	7.6	7.9	8.3	9.6	10.5	11.7	12.8	14.0	15.0	16.4	8.1
Capital Services	3.0	2.8	3.3	3.4	3.5	4.1	4.2	3.8	3.4	4.4	4.1	4.2	6.8	6.9
Total	29.0	29.2	30.6	33.0	35.3	38.9	42.9	45.5	48.4	52.7	55.7	58.9	63.9	6.8

Source: Office for National Statistics

Table 5
Volume of education inputs by component, 1996–2008

United Kingdom														Index (1996=100)
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Annual average percentage change
Labour	100.0	100.8	101.9	99.4	101.0	106.2	109.2	109.6	112.1	113.5	115.0	115.8	119.0	1.5
Goods and Services	100.0	96.2	98.4	110.2	112.8	114.7	130.7	138.1	149.9	160.5	167.1	174.7	178.6	4.9
Capital Services	100.0	99.7	100.4	101.8	102.9	106.3	110.1	114.0	117.6	125.4	132.1	143.0	148.8	3.4
Total	100.0	99.7	101.0	102.0	103.8	108.1	113.9	116.0	120.4	124.0	127.0	129.8	133.3	2.4

Source: Office for National Statistics

tenth of the total. Goods such as IT equipment and buildings are medium- to long-term investments used for several years, so they are classified as capital items.

In current prices, total expenditure on education inputs increased by just over 120 per cent between 1996 and 2008. As this includes effects caused by pay and price changes, education inputs are also measured in volume terms. Inputs can be measured directly, for example, using hours worked or a measure of staff numbers in the case of labour inputs. Where data do not allow for a direct measure of inputs, a volume measure can be derived by dividing current price spending figures by an appropriate estimate of price (the deflator). The volume of UK education inputs grew by 33.3 per cent between 1996 and 2008. The volume of labour, the largest inputs component, grew by 19.0 per cent. The other two components grew faster than total volume of inputs: goods and services by 78.6 per cent and capital services by 48.8 per cent (see **Table 5**).

OECD (2001) recommends measuring labour inputs directly and 94 per cent of education labour inputs in the UK are measured directly in these estimates. The calculation method uses a breakdown of full-time-equivalent teaching and support staff numbers and weights them together by average salary. Teachers are also adjusted for actual hours worked using data from the Office of Manpower Economics. The remaining 6 per cent of labour inputs are measured indirectly, by dividing current price expenditure by an

appropriate pay deflator. As this small part is a measure of the inputs of central government staff working in education, the most appropriate pay deflator is the public sector Average Earnings Index (AEI) including bonuses.

Goods and services inputs are measured indirectly, using appropriate deflators to remove the effect of price changes. Expenditure on goods and services in the UK can be split into expenditure on both local authorities (around four-fifths) and central government (around a fifth). Specific price deflators have been derived for each component using ONS producer, retail and service sector price data.

The capital component is measured using the VICS for local authority and central government education.

Further developments

Jointly with parents, guardians and other institutions, schools have responsibilities towards pupils that extend beyond academic outcomes. These wider concerns include physical and mental health, safety and the transfer of social knowledge and skills. If possible, quality adjustment improvements will take into account research into quantifying attribution and correlation in these wider outcomes relating to children, for example the five outcomes of the *Every Child Matters* agenda in England. There is a supporting triangulation article ONS (2009f) which presents further discussion on each source of evidence.

ONS will continue to work with DCSF; the Department for Business, Innovation and Skills (BIS); the devolved

administrations and others on developing the measures of inputs and the quality and quantity components of output.

Development work on output quantity will aim to extend the coverage of the further education quantity measure to cover students of all ages and identify publicly funded output from higher education institutions. This will need to account for the fee and transfer arrangements in each of the devolved administrations and the research work that universities undertake, as well as the number of students they teach. Future work will also look into the development of a quality measure for health professional courses and for further education, for example using student retention and achievement data.

Work is ongoing to develop a quality measure for pre-school places. The National Institute of Economic and Social Research (NIESR) is currently investigating the relationship between outcomes and quality in early years education as part of the Quality Measurement Framework project which is funded by Treasury under the *Invest to Save Budget*. ONS will be working with NIESR to create a quality adjustment based on the results of this research.

As well as periodical review and improvement of the inputs measures ONS will aim to improve the inputs measure of further education for those aged under 19, for example by investigating whether expenditure data are available for the three components of further education inputs, which deflators may be appropriate and whether a direct labour measure could be calculated.

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