

# Public Service Productivity Estimates: Healthcare, 2010

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## Abstract

This release contains updated output, inputs and productivity estimates for publicly-funded healthcare in the UK between 1995 and 2010. It provides analysis of healthcare output by component and describes the impact of the quality-adjustment factor that is applied. Healthcare inputs are analysed by component. New analysis of changes in the average cost of providing healthcare is presented and compared to growth in the GDP deflator.

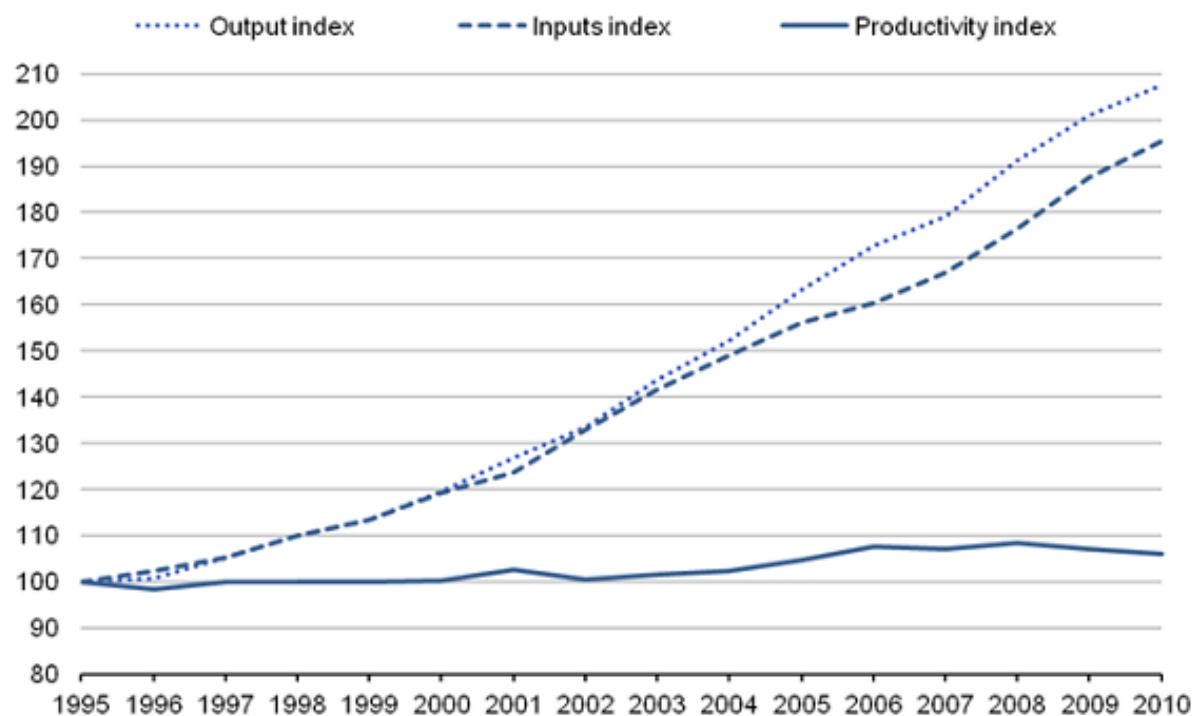
## Summary

### Key points

- Productivity growth is calculated by comparing growth in the total amount of healthcare output to growth in the total amount of input used. We estimate average **productivity growth** for publicly funded healthcare to be **0.4% per year** between 1995 and 2010. This compares to an estimate of -0.2% per year between 1995 and 2009 in the previously published article (ONS 2011a).
- There are two main reasons for this relatively large change in the productivity estimate and change in sign. The first is that the methodology used to produce estimates of healthcare output in this release has been revised to infer a rate of growth for previously unmeasured healthcare activity provided by non-NHS organisations. This is based on known expenditure on non-NHS organisations in England and Wales. See Methods changes in public service productivity estimates: Healthcare 2010 (ONS 2012a).
- The second reason is that a relatively large number of data revisions and improved data sources have been applied to estimates of healthcare quantity contained in this release. As inputs estimates have remained broadly unchanged, upward revisions to healthcare quantity and output feed directly through to upward revision of the productivity estimate. The revisions section provides more details on the effect of these changes compared to previously published estimates.
- For most of the 15 year period since 1995, productivity has remained broadly constant. The period 2003 to 2006 saw some improvement in productivity which has since levelled off or slightly declined.

**Figure 1: Healthcare output, inputs and productivity estimates 1995-2010**

UK, Index numbers 1995=100



Source: Office for National Statistics

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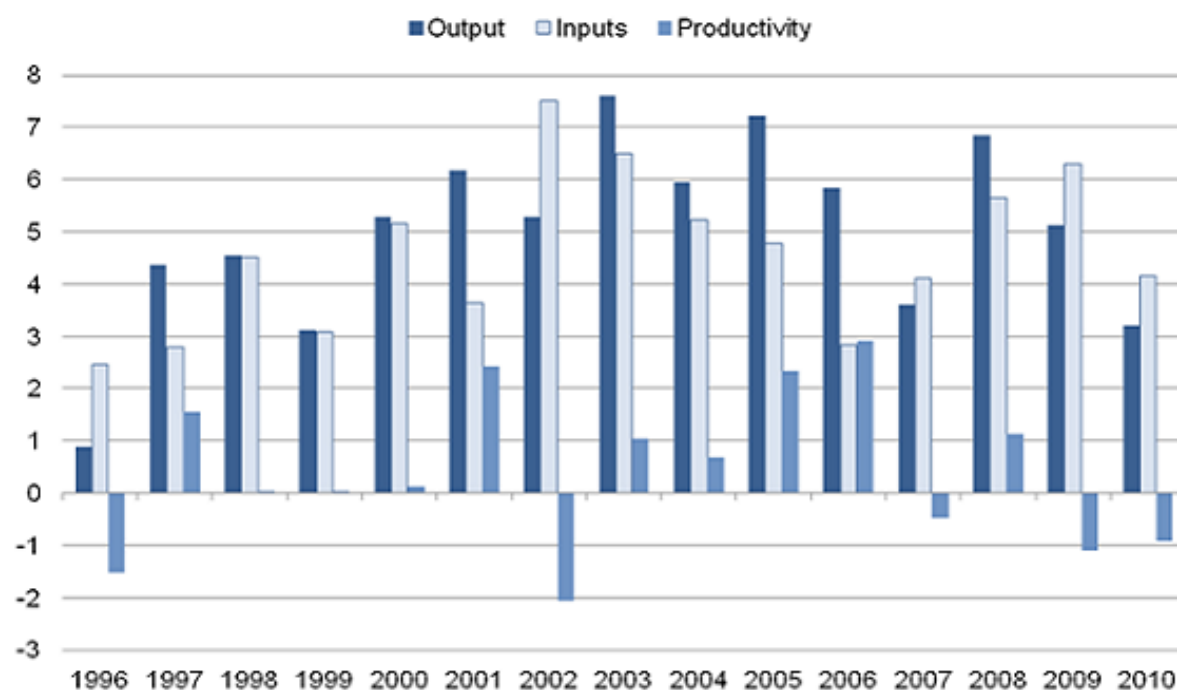
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**Output, inputs and productivity**

Figure 2 shows the variation in annual growth rates for output, inputs and productivity since 1995.

**Figure 2: Growth rates for healthcare output, inputs and productivity 1996-2010**

UK, Percentages



Source: Office for National Statistics

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Between 1998 and 2000, the growth in output matches the growth in inputs leading to zero productivity growth in those years. However, output growth is greater than input growth in 1997, 2001, 2008 and between 2003 and 2006, leading to periods of positive productivity growth in those years. Productivity fell on the other hand in 1996, 2002, 2007, 2009 and 2010 when input growth was greater than output growth.

The indexed data in Table 1 shows that although productivity growth was 0.4% on average over the 15 year period – this covers a period of lower growth of 0.1% per year in the early part of the series between 1995 and 2002, and a period of higher growth of 0.7% per year after 2002. These growth rates are not of a sufficient order of magnitude however to have a large compounding effect over time. Table 1 shows that with 1995 as the base year, productivity is only 6.2 percentage points higher in 2010 than in 1995.

**Table 1: Indices of output, inputs and productivity, 1995-2010**

United Kingdom, index numbers 1995=100

	Output index		Inputs index	Productivity index
1995	100.0	100.0	100.0	
1996	100.9	102.4	98.5	
1997	105.3	105.3	100.0	
1998	110.1	110.0	100.0	
1999	113.5	113.4	100.1	
2000	119.5	119.3	100.2	
2001	126.9	123.6	102.6	
2002	133.6	132.9	100.5	
2003	143.7	141.5	101.5	
2004	152.2	148.9	102.2	
2005	163.2	156.0	104.6	
2006	172.8	160.4	107.7	
2007	179.0	167.0	107.1	
2008	191.2	176.5	108.4	
2009	201.0	187.6	107.2	
2010	207.4	195.4	106.2	
<b>Percentages, annual average growth</b>				
1995-2010	5.0	4.6	0.4	
1995-2002	4.2	4.1	0.1	
2002-2010	5.7	4.9	0.7	

**Table source:** Office for National Statistics**Table notes:**

- Means are geometric

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These estimates revise those published in 2011 (ONS 2011a), and reflect changes in both data coverage and methods. The next section discusses the productivity estimates in more detail and provides a sensitivity analysis of making the new assumption about activity provided by non-NHS organisations. More detail about the rationale for this change is given in *Methods changes for Public Service Productivity Estimates: Healthcare 2010* (ONS 2012a).

Reference tables are available to download containing more detailed data. A [user feedback survey](#) is also included in this article so we can gather feedback on the usefulness and relevance of the statistics in this release.

Background notes contain a guide to interpretation of the estimates in this release and [Annex B \(21.6 Kb Pdf\)](#) contains a user guide to the key statistics in this release including the concept of average total costs of output.

## Estimates of productivity

Productivity is calculated by dividing the index of output by the index of inputs. Figure 2 shows that over the period, healthcare productivity growth has been quite volatile, with periods of positive and negative growth, as well as periods of zero productivity growth.

In aggregate, our estimates show that growth in output volume is broadly matched by growth in inputs volume for most of the time period since 1995. It is hard to say whether this applies to all areas of healthcare output, as family health services or those provided by local authorities require a very different set of inputs to acute and hospital-based care. There is currently insufficient data on inputs and directly measured output to enable more disaggregated productivity estimates to be made.

## Including indirectly measured activity by non-NHS organisations

During the 15 years between 1995 and 2010 the quantity of services funded by the NHS but provided by other bodies has increased significantly.

In this article, we have changed the assumption regarding the treatment of expenditure and implied activity provided by non-NHS organisations such as private companies, charities and local authorities. As explained in *Methods changes for Public Service Productivity Estimates: Healthcare 2010* (ONS 2012a), only a fraction of the output and expenditure associated with these non-NHS organisations is formally included in the regular statistical outputs of Department of Health and the devolved administrations.

In the past, ONS has assumed that real expenditure on non-NHS organisations translates into activity at the same rate as measured NHS activity. However, we have consulted with health analysts and believe that the information on the nature of activity provided by non-NHS organisations is sufficiently different to measured activity to warrant a change in assumption.

To better reflect the real expenditure and activity levels provided by non-NHS organisations, ONS has taken a statistically conventional  $\text{inputs} = \text{output}$  approach by assuming that expenditure on non-NHS organisations to deliver healthcare, once suitably deflated, represents the equivalent growth in

output volumes. This adds a new, indirectly measured component to the coverage of government-funded healthcare output in the UK.

The revisions section provides analysis of the effect of this changed assumption on estimates of healthcare quantity compared to previously published estimates (ONS 2011a). This, in turn, has a direct effect on the productivity estimate, as estimates of inputs are unchanged. Over the period since 1995, the changed assumption for non-NHS provision explains the majority of the revision to productivity, with the remainder accounted for by using revised data sources and more consistent processing techniques.

### **Sensitivity testing the new assumption for non-NHS provision**

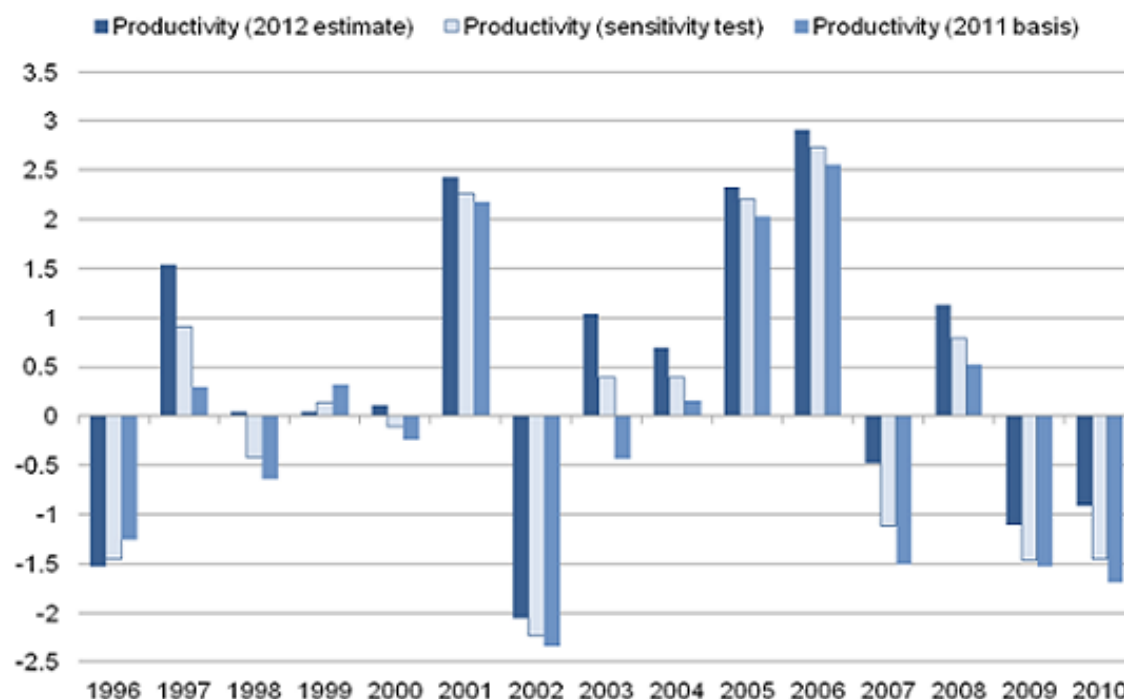
The prior method used by ONS included the indirect component for non-NHS provision within inputs estimates, but it was excluded from output estimates. The effect of this was to assume that the growth in non-NHS provision was represented by the growth in the components of activity that are included in the output estimate. If we had maintained this assumption in this release but used all the other updates, corrections and revisions to output and inputs data, we would find that healthcare productivity fell by an average of 0.1% per year between 1995 and 2010, or was completely unchanged on average between 1995 and 2009. This compares to a fall of 0.2% on average between 1995 and 2009 in the previous estimate (ONS, 2011a).

An alternative approach to calculating productivity is to use the assumption of either including or excluding the indirect component from both inputs and output estimates. This is the approach taken by Bojke, C, Castelli, A et al (2012) in their recent report on productivity for the NHS in England. Using the assumption that the non-NHS component is excluded from both inputs and output estimates, but using the updated data sources contained in this release, ONS estimate that healthcare productivity would have grown by an annual average of 0.1% per year between 1995 and 2010 or 0.2% per year between 1995 and 2009. When both inputs and output estimates do contain the non-NHS component of activity, we reach the published estimate of average productivity growth of 0.4% per year between 1995 and 2010.

This higher productivity growth, compared to the case where non-NHS activity is excluded from both inputs and output estimates, is accounted for by the different cost weights which apply to the non-NHS component between inputs and output estimates<sup>1</sup>. Figure 3 shows this sensitivity test measure of productivity and the estimate based on the 2011 healthcare productivity article, compared to the published estimates in this release.

**Figure 3: Sensitivity testing the new assumption for non-NHS provision**

UK, Percentages



Source: Office for National Statistics

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**Notes**

1. This is because the value, in real terms, of the additional spending on non-NHS providers has greater weight in the output estimates than inputs estimates. This is because inputs weights include all spending regardless of whether any directly measurable activity can be attributed to it, for example, central administration spending and capital consumption (mostly depreciation). Output weights on the other hand are derived mostly from aggregating activity and unit cost information from directly measured activity. As such, they are around 79% of the overall total spent on healthcare in the UK (based on National Accounts definitions).

**Volume of healthcare quantity****Methodology**

Two concepts are used to measure healthcare services in the UK. The quantity of delivered healthcare services is a cost-weighted activity index. Healthcare output consists of the quantity of healthcare adjusted for changes in the quality of delivered services. The reasons for quality-

adjusting public service output are well-documented and follow from recommendations made in the Atkinson Review (2005).

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 inpatient, day case and outpatient episodes. These procedures are distinguished by Health Resource Group (HRG) and include some recorded activity provided by non-NHS providers.
- Family Health Services (FHS). This includes GP and practice nurse consultations, publicly funded dental treatment and sight tests.
- GP prescribing. This includes all drugs prescribed by General Practitioners.
- Non-NHS provision. This is the indirectly measured component added this year which uses an inputs=output approach to estimation.

### **Geographic coverage**

Data on HCHS and GP prescribed drugs are provided by all four countries. Wales does not provide FHS data, and at present, no data is available from Scotland and Northern Ireland on non-NHS expenditure. Country specific data on quantity is aggregated according to Public Expenditure Statistical Analysis (PESA) weights for current price healthcare spending (HM Treasury, 2012 and previous years).

### **Estimates of healthcare quantity by component**

Figure 4 shows quantity growth for the UK in index form for each component of healthcare services. 1995 is the reference year.

Between 1995 and 2010 the quantity of delivered healthcare grew at an annual average rate of 4.6%, almost doubling over this period. Between 1995 and 2001, the quantity of healthcare grew at an annual average rate of 4.1%, before accelerating to an annual average rate of 5.1% between 2002 and 2010.

Examining the quantity series by component reveals that different elements of healthcare provision have grown at different rates. The strongest growth – as discussed above – has been in the quantity of delivered healthcare provided by non-NHS providers, which has grown at an annual average rate of 13.5%. The quantity of GP prescribed drugs has also grown strongly, by around 8.4%.

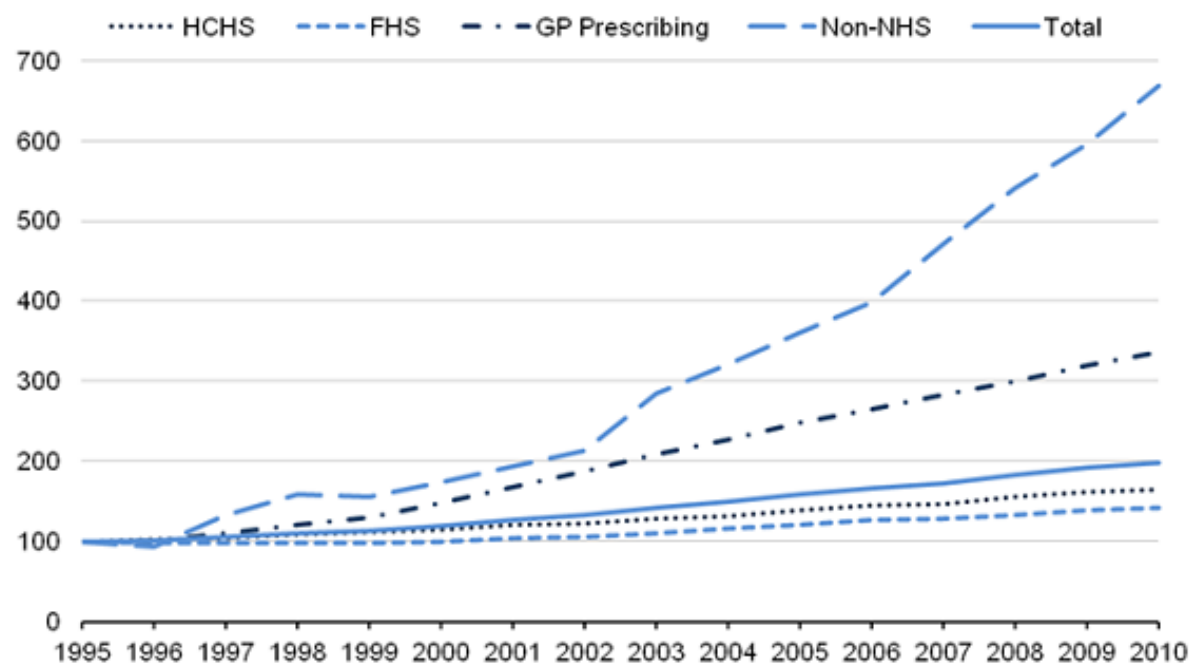
The largest components of healthcare quantity by cost (or expenditure) – HCHS and FHS – have grown relatively less strongly. The annual average growth rates between 1995 and 2010 for these elements of healthcare quantity were 3.4% and 2.3% respectively.

A report by Wanless, Appleby et al (2007) also confirms increasing activity in England across the board from elective admissions, outpatients attendances, emergency care, and in prescription drugs.



**Figure 4: Healthcare quantity by component, 1995-2010**

UK, Index numbers, 1995=100



Source: Office for National Statistics

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**Aggregating healthcare quantity**

Growth in the quantity of each component is weighted by its cost (or expenditure) share to calculate an estimate of aggregate growth in the quantity of delivered healthcare. Table 2 shows the expenditure shares of each component since 2003-04. Reference Table 1 provides data from 1994-95 to 2009-10.

**Table 2: Expenditure shares by component of quantity, 2003-04 to 2009-10**

United Kingdom, percentages

Financial years	HCHS	FHS	GP Prescribing	Non-NHS	Total
2003-04	61.6	14.3	18.1	6.0	100
2004-05	64.5	13.9	15.9	5.7	100
2005-06	62.0	15.2	15.9	6.9	100
2006-07	61.0	17.8	14.4	6.8	100
2007-08	60.0	18.0	13.9	8.1	100
2008-09	62.2	17.1	12.5	8.2	100
2009-10	62.9	16.6	11.8	8.6	100

**Table source:** Office for National Statistics**Table notes:**

1. Figures may not sum due to rounding

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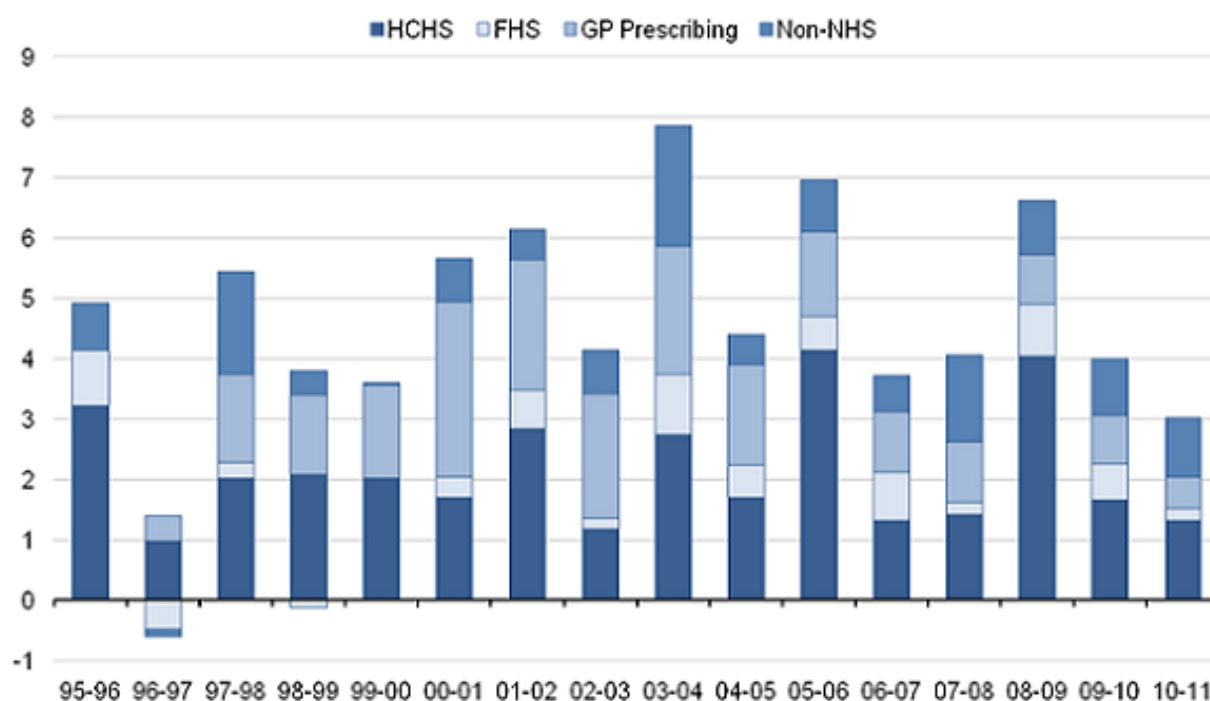
The expenditure share accounted for by each component of the quantity of delivered healthcare changes only very slightly over time. HCHS is the largest component, accounting for between 60% and 65% of UK healthcare expenditure between 2003-04 and 2009-10. FHS is the second largest component, accounting for between 14% and 18% of expenditure over the same period.

The other two components – GP Prescribed drugs and non-NHS provision – account for the remaining 20-25% of expenditure. However, the balance between these two has shifted in recent years. Reflecting the growth of non-NHS services, the expenditure share of this component has risen from 6.0% in 2003-04 to 8.6% in 2009-10. Over the same period, the proportion of expenditure accounted for by GP prescription drugs has fallen from a high of 18.1% to just under 12%.

Figure 5 shows the contributions to growth in UK healthcare quantity, by component.

**Figure 5: Contributions to growth by component of quantity, 1995-96 to 2010-11**

UK, Percentages



Source: Office for National Statistics

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The major contributor to growth in healthcare quantity since 1995-96 is HCHS, followed by GP prescribing. Since 2003-04 the contribution of the new assumption for non-NHS provision has also broadly matched the contribution of GP prescribing, despite having a lower expenditure weight. The large contribution by HCHS throughout the period is driven by its much higher expenditure weight, but more moderate volume growth rate.

**Quality adjustment of healthcare output****Methodology**

In line with the recommendations of the Atkinson Review (2005) a quality-adjustment factor is applied to the estimate of healthcare quantity.

ONS uses quality measures and methods developed by the Centre for Health Economics (CHE) and National Institute of Economic and Social Research (NIESR) (Dawson et al 2005) and the Department of Health (DH 2005, 2007). The method was developed using data for England and implicitly assumes that the rest of the UK follows the same trend as England.

ONS (2012c) explains the methodology for the current health quality adjustment in more detail.

The adjustment reflects two dimensions of quality:

- the extent to which the service succeeds in delivering its intended outcomes,
- the extent to which the service is responsive to users' needs.

Within the first dimension, there is a measure for HCHS services that reflects short-term survival rates, health gain following treatment in hospital and changes in waiting times. Outcomes from primary care are measured by the percentage of certain groups of patients meeting target ranges for cholesterol levels and blood pressure.

Within the second dimension of quality, the National Patient Survey results are used to gain a measure of patient experience of hospital inpatient services, mental health services, primary care, outpatients and accident and emergency services.

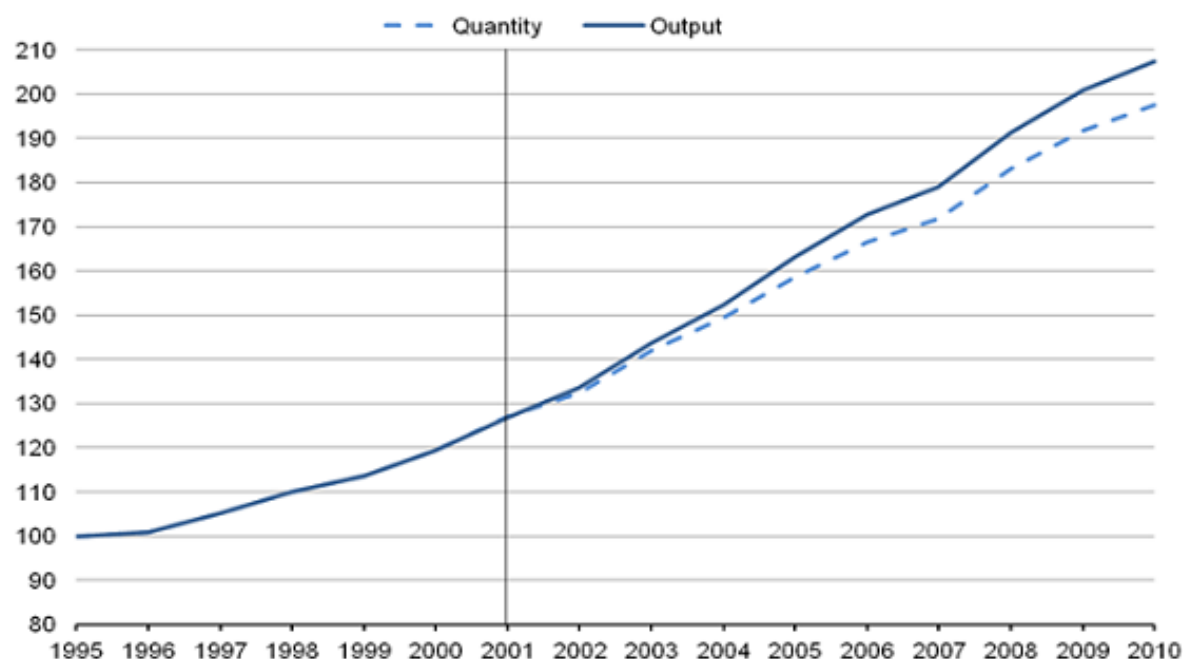
### **Impact of quality adjustment on healthcare output**

The complete set of data required to calculate the quality-adjustment factor is only available from 2002-03 onwards. The method used at ONS to convert data to calendar years shows a break in the series is identified between 2001 and 2002.

Figure 6 shows the impact of applying the quality-adjustment factor to estimates of healthcare quantity. Over the period from 2002, the quality adjustment adds 0.5% per year on average to output growth estimates (rounding to 1 decimal place). Its effect over the longer period since 1995 is 0.3% per year.

## Figure 6: Healthcare quantity and output, 1995-2010

UK, Index numbers, 1995=100



Source: Office for National Statistics

### Download chart

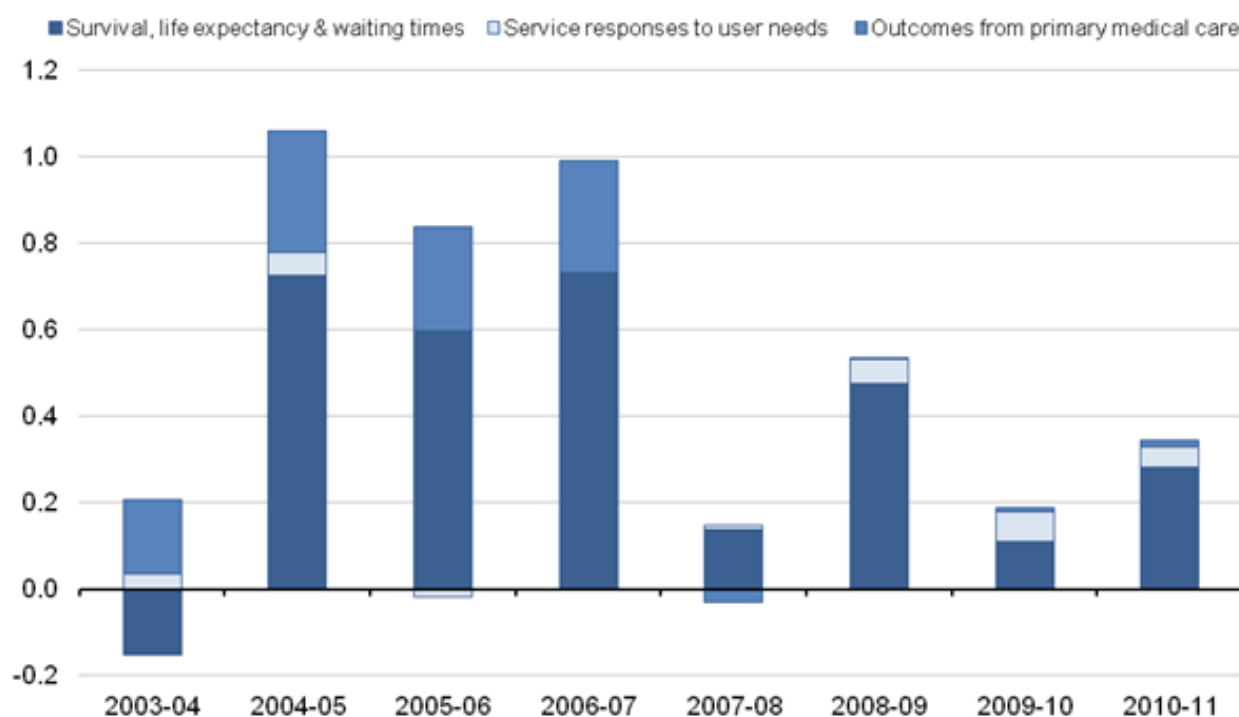
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Figure 7 shows the contribution to the quality adjustment factor from the elements described above. Survival, life expectancy and waiting times for HCHS services has provided the greatest contribution to the quality-adjustment factor since 2003-04. Primary care improvements provided a positive contribution to quality-adjustment between 2003-04 and 2006-07, as patients in particular groups were given appropriate treatments, but has tailed off as targets for treatment have approached 100%. The responsiveness to user needs component makes a fairly consistent contribution to the quality adjustment factor from 2008-09 onwards which partly reflects the data frequency of series.

**Figure 7: Contribution to growth of the quality adjustment factor 2003-04 to 2010-11**

UK, Percentages



Source: Office for National Statistics

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**Volume estimates of inputs**

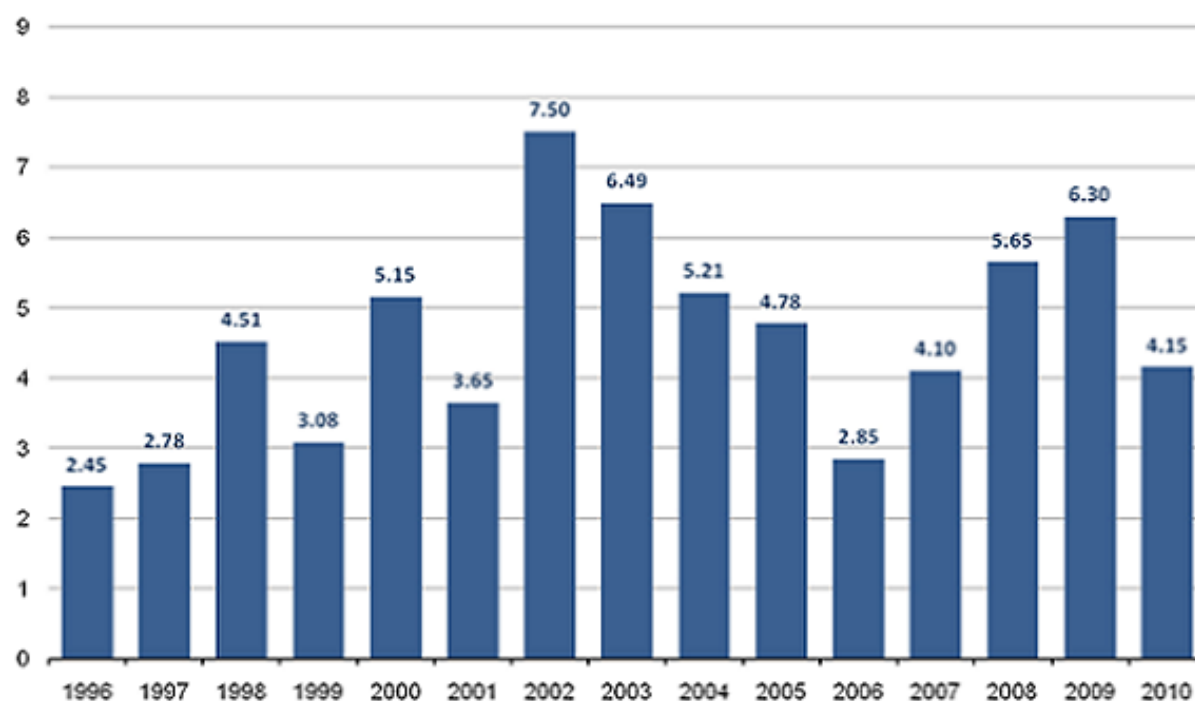
The latest estimates for the annual growth in the volume of publicly-funded healthcare inputs for the UK are shown in Figure 8.

This shows positive annual growth rates over the entire period, with an annual average growth rate of 4.6%. There is however variation in growth rates over the period. The highest annual volume growth of 7.5% was seen in 2002, followed by another year of strong growth of 6.5% in 2003.

2009 also saw growth of over 6%. Much lower growth of 3% per year or less was seen in 1996, 1997 and 2006.

**Figure 8: Annual growth rates of healthcare inputs, 1996-2010**

UK, Percentages



Source: Office for National Statistics

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**Policy context**

The overall volume of inputs increase we see reflects the implementation of the NHS Plan (DH, 2000) which aimed to expand the capacity of the NHS as part of a process of “catching up” the amount of GDP accounted for by healthcare expenditure with other developed economies. The NHS Plan and subsequent updates in 2002 and 2004 also set out to deliver major improvements in service. The Wanless Review (2002) provided an analysis of the long-term resources required for the NHS if it was to “catch-up” and stay “caught up” with other developed economies under three different scenarios.

Successive budgets and Spending Reviews between 2000 and 2008 confirmed significant additional real terms spending increases for the Health Service. The Government also published its reforms and strategies designed to increase patient choice, workforce development and improved quality of care. For example, the Department of Health’s NHS Improvement Plan (2004) and Agenda for Change (2004). The latter reformed the pay system for all NHS staff apart from those covered by the Doctors’ and Dentists’ Review Body. Contracts for hospital doctors, dentists and GPs were also reformed at around the same time which involved significant new investment in these services.

A study by Wanless, Appleby et al (2007) confirmed that resource inputs (capital and labour) and outputs (activity) had increased in England since the introduction of the NHS Plan in 2000 and the original Wanless Review in 2002. It found that targets for increased labour inputs from the NHS Plan were exceeded, and that other plans for improved capital investment in new hospitals and equipment had been met. ICT investment, on the other hand, had been delayed. It also suggested that pay and price inflation accounted for 43% of the extra investment in the NHS in England since 2002.

### **Components of healthcare input**

Inputs to publicly-funded healthcare are broken down into three components:

- labour input, such as hospital consultants, registrars, nurses, technical staff, ambulance staff and support, General Medical Practitioners (GPs) and practice staff,
- goods and services input, such as pharmaceutical services, dental and ophthalmic services, and intermediate consumption by hospitals and GP practices. This component also includes GP prescribed drugs and services provided by non-NHS organisations,
- capital consumption – this is a measure, in volume terms, of the amount of capital stock used each year and is made up of depreciation and other capital charges.

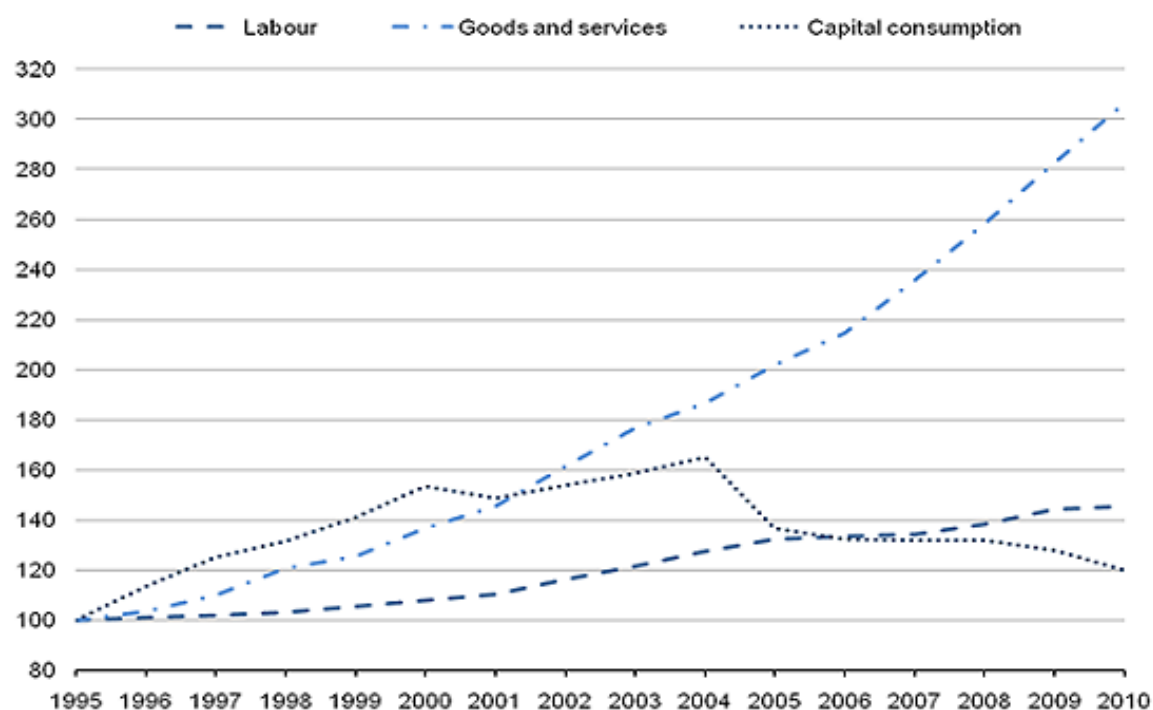
Geographic coverage has improved for the estimates in this release, with the inclusion of data on Scottish and Northern Ireland labour inputs, and data on Scottish goods and services input. England and Wales data on labour and goods and services was included in the previously published article (ONS 2011a). Capital consumption data is at a UK level only and taken from National Accounts data series. ONS will continue to work towards including Northern Ireland data on goods and services input in future releases.

Figure 9 shows these three components of input, in index form between 1995 and 2010. 1995 is the reference year.



**Figure 9: Volume of inputs by component, 1995-2010**

UK, Index numbers, 1995=100



Source: Office for National Statistics

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(20.5 Kb)

**Goods and Services**

The fastest growing component of inputs is goods and services which grew by an average of 7.8% per year between 1995 and 2010. In index terms goods and services inputs have trebled over the 15 year period. The trend in goods and services growth has accelerated slightly since 2003 to an average of 8.2% per year.

The main driver for this growth in England and Scotland is from HCHS non-pay costs rather than any other bought-in services such as pharmaceutical services, NHS dental treatment or ophthalmic services. HCHS non-pay costs also outweigh the contribution to overall goods and services growth from non-NHS spending and GP prescribed drugs in England – both of which are fast-growing areas of expenditure, but with lower weights within the overall goods and services index. In Wales, non-NHS spending and GP drugs however make a similar size contribution to goods and services growth to HCHS non-pay costs.

HCHS non-pay costs have the largest weight within each country's goods and services index and within this category some elements of expenditure have also been rapidly growing. Data between 1994-95 and 2009-10 from England indicates that the fastest growing element within HCHS non-pay costs are "Clinical supplies and services (excluding drugs)" and miscellaneous expenditure. Both

these elements have been growing in current price terms by around 11% per year. Hospital drugs and general supplies have grown around 7% per year. Other running costs such as premises and transport costs have grown by around 5% per year.

Similar analysis may be possible for other countries, data permitting.

It is clear that HCHS non-pay costs are a significant and growing element of NHS expenditure. Organisations such as the National Audit Office for example, have scrutinised the procurement practices for medical supplies by NHS providers (NAO 2011). In this report, various improvements in ordering frequency, rationalising product choices and collaborative procurement were recommended in order to obtain the best prices and efficiencies from the market.

## **Labour**

The volume of growth in labour input, in contrast to goods and services growth, is much more moderate, and has grown by 2.5% per year on average over the whole period. In index terms, labour input is 45.4% higher in 2010 than in 1995. Growth rates are at their highest at 3.5% to 5.4% between 2002 and 2005, before falling back to less than 1% growth in 2006 and 2007. Higher labour input growth returns in 2008 and 2009 before falling back to less than 1% again in 2010.

## **Capital consumption**

The volume index is seen to grow quickly between 1995 and 2000. It then levels out and starts to decline from 2004. These estimates are drawn from National Accounts data for the UK as a whole and reflect international accounting practices used for these purposes.

## **Additional analysis of labour input by country**

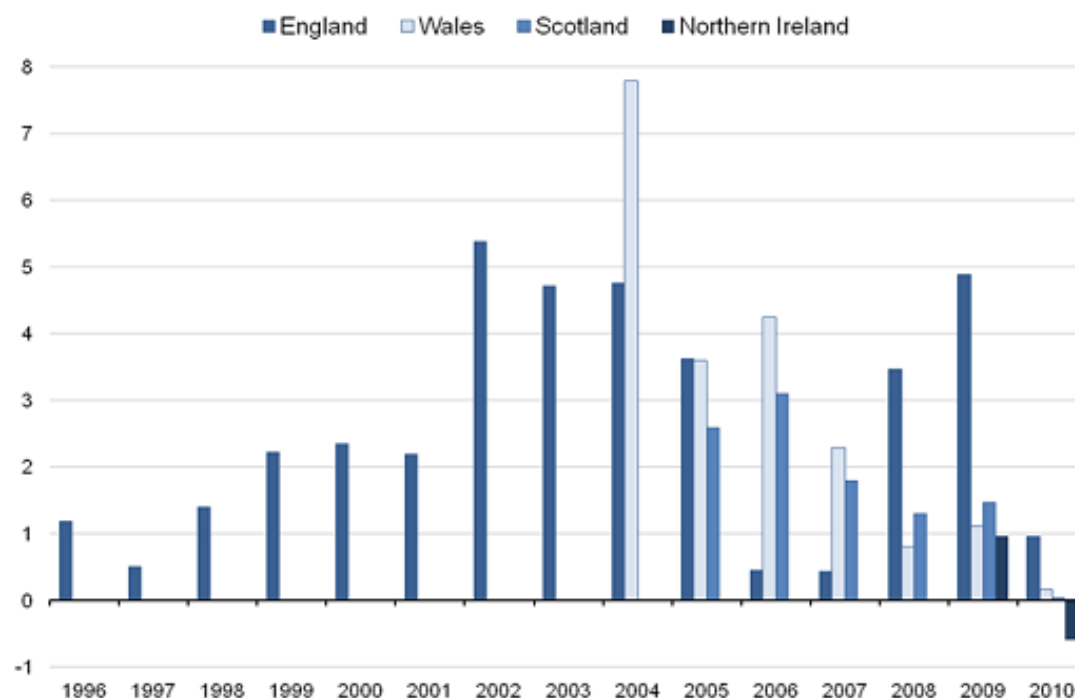
With the inclusion of staff and salary data for Scotland and Northern Ireland for the first time, it is possible to produce estimates of labour input growth by country. Scottish data is available from 2004 and Northern Ireland data from 2008. Welsh data has been available from 2003 and English data from 1995.

Figure 10 shows estimates of the growth in the volume of labour for each of the four countries in the UK. The volume of healthcare labour input has grown at an average rate of 2.6% per year in England over the period since 1995. Data is available for shorter time periods for Wales, Scotland and Northern Ireland, and growth rates vary year by year.

All countries have experienced a slow-down in labour input in 2010. Given that England has the greatest weight in terms of healthcare expenditure of the four health administrations, changes in the labour input mix in England will drive the overall UK labour input estimates.

**Figure 10: Growth in healthcare labour inputs, by country 1996-2010**

Per cent



Source: Office for National Statistics

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**Aggregating healthcare inputs**

Changes in the three components of input volume are added together using their relative shares in overall government expenditure on healthcare to form the equivalent of a chain-linked Laspeyres volume index. This is the same statistical technique as used to estimate the volume of output series. More information on this technique is published in the background notes.

Table 3 shows the expenditure shares for the components of input and how they have changed since 1995. This data is drawn from UK National Accounts. Reference Table 2 shows this data for all years between 1995 and 2010.

The share of labour input in total expenditure was fairly constant until 2005, and then fell by almost ten percentage points from 61.2% in 2005 to 52.2% in 2010. This expenditure share was entirely gained by the goods and services component implying a movement in relative prices over this period.

We can infer that in the period up to 2005, implicit labour prices were rising faster than implicit goods and services prices - the same proportion of expenditure was buying less volume of labour than goods and services. In the period since 2005, it appears that relative prices of labour and goods and

services have become more equal, allowing both volumes to increase but with differing expenditure shares.

The capital consumption weight at the end of the period has fallen by 1.5 percentage points from 3.3% in 1995 to 1.8% in 2010.

**Table 3: Expenditure shares, by component of input, selected years, 1995 to 2010**

United Kingdom, percentages

	Labour	Goods and services	Capital consumption
1995	61.1	35.6	3.3
2000	58.1	38.8	3.1
2005	61.2	36.8	2.0
2010	52.2	46.0	1.8

**Table source:** Office for National Statistics

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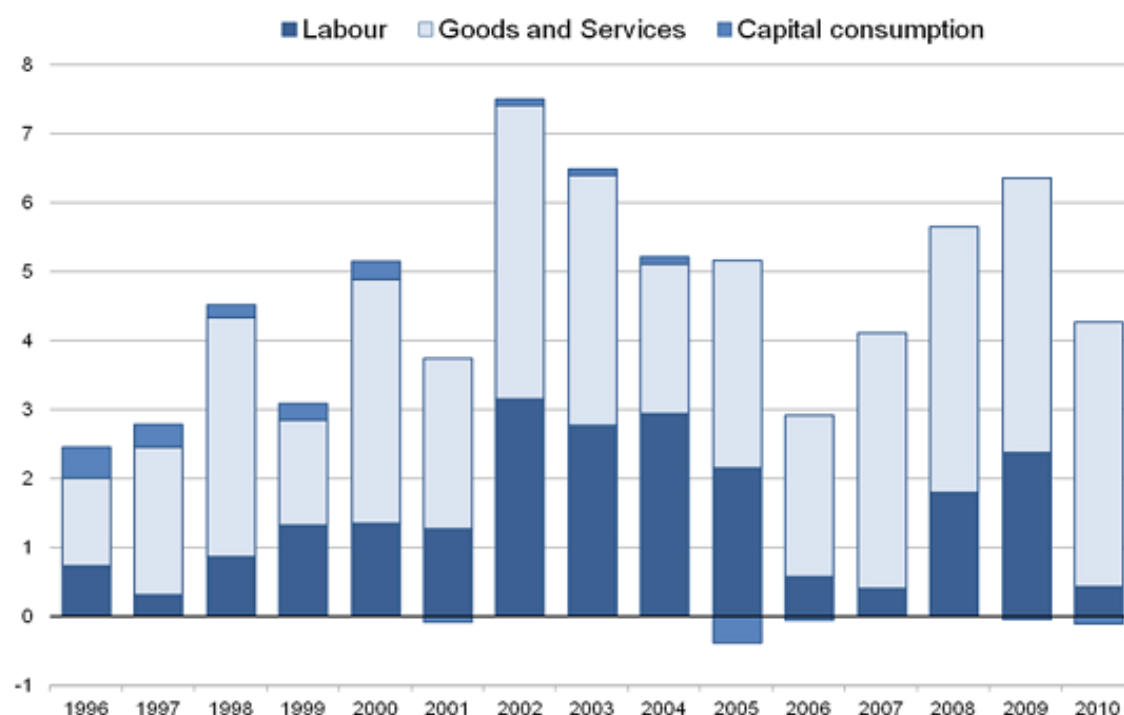
### Contributions to inputs growth, by component

Figure 11 shows that the largest contribution to the growth of overall inputs in most years is from goods and services. This is due to its high volume growth and increased expenditure share, compared to the other components.

The contribution to growth from the labour component of inputs was strongest between 2002 and 2004 at around 3 percentage points. This coincides with the implementation of the NHS Plan, the introduction of Agenda for Change reforms and an expansion in recruitment within the NHS. In 2006, 2007 and 2010 labour's contribution to growth fell to around 0.5 percentage points. The contribution of the volume of capital consumption is much smaller over the entire period.

**Figure 11: Contributions to growth by input component 1996-2010**

UK, Percentages



Source: Office for National Statistics

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**Relating healthcare expenditure to productivity**

It is possible to use the estimates in this release to analyse the relationship between overall healthcare expenditure and estimates of inputs, output and productivity. Phelps (2009) explains the theoretical background, and the technical note from this paper is included at Annex A.

In simple terms:

(1) Expenditure on healthcare = Implicit price of inputs x volume of inputs

This can be re-written as:

(2) Implicit price of inputs = Expenditure on healthcare / volume of inputs.

Equation (2) can be presented in index form and derived from the volume of inputs estimates contained in this release. Figure 12 and Table 4 show that the implicit price of inputs grows by an average of 2.8% per year.

If we wish to see how expenditure translates into output (the average cost of providing the output) we can divide expenditure on healthcare by the volume of output.

(3) Average cost of output = Expenditure on healthcare / volume of output

Figure 12 and Table 4 show that this average cost of output grows by an average of 2.4% per year. The difference between the average growth rate of cost of output and input prices is the improvement in productivity of 0.4% per year. In Figure 12, the difference between the two data series is given by the multiplicative productivity factor (1/productivity). If productivity had fallen over time, instead of slightly improving, average growth in the cost of output would be higher than the growth in implicit input prices. Equation (4) shows how these terms are related.

Substituting equation (1) into equation (3) gives:

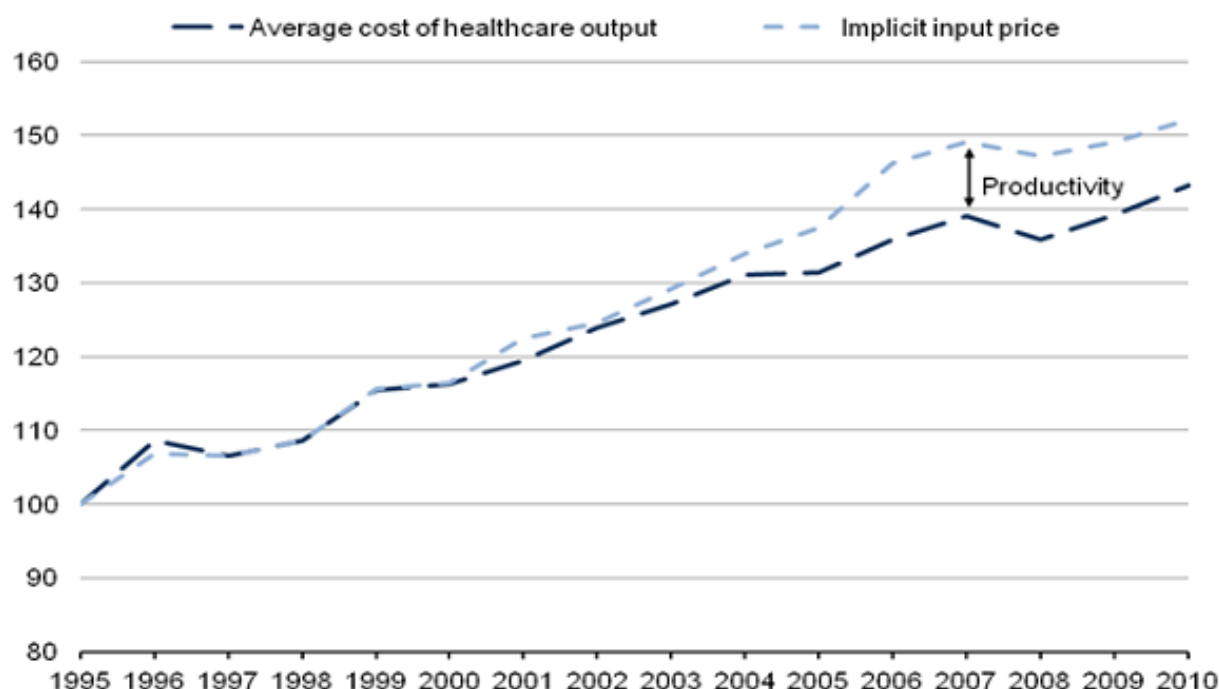
(4) Average cost of output = [Implicit price of inputs x volume of inputs] x (1/ volume of output)

The term (volume of inputs / volume of outputs) is the reciprocal of the productivity estimates presented in this release. So (4) can be re-written as:

(5) Average cost of output = Implicit price of inputs x [1/ productivity]

### Figure 12: Average cost of healthcare output and implicit input prices, 1995-2010

UK, Index numbers 1995=100



Source: Office for National Statistics

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(20 Kb)

**Table 4: Cost of public service healthcare, 1995-2010**

United Kingdom, index numbers 1995=100

	Current price Expenditure, £m	Average costs of output	Inputs/output	Implicit input price
1995	38,229	100.0	100.0	100.0
1996	41,870	108.6	101.6	106.9
1997	42,901	106.6	100.0	106.6
1998	45,736	108.7	100.0	108.7
1999	50,151	115.6	99.9	115.6
2000	53,132	116.3	97.5	116.5
2001	57,927	119.4	99.5	122.6
2002	63,266	123.9	98.5	124.5
2003	69,855	127.2	97.8	129.1
2004	76,293	131.1	99.7	134.0
2005	82,033	131.5	95.6	137.5
2006	89,713	135.8	92.9	146.3
2007	95,203	139.2	93.3	149.1
2008	99,351	135.9	92.3	147.3
2009	106,948	139.2	93.3	149.1
2010	113,594	143.3	94.2	152.1
<b>Percentages, annual average growth 1995-2010</b>	7.5	2.4	-0.4	2.8

**Table source:** Office for National Statistics**Table notes:**

1. Means are geometric

## Download table

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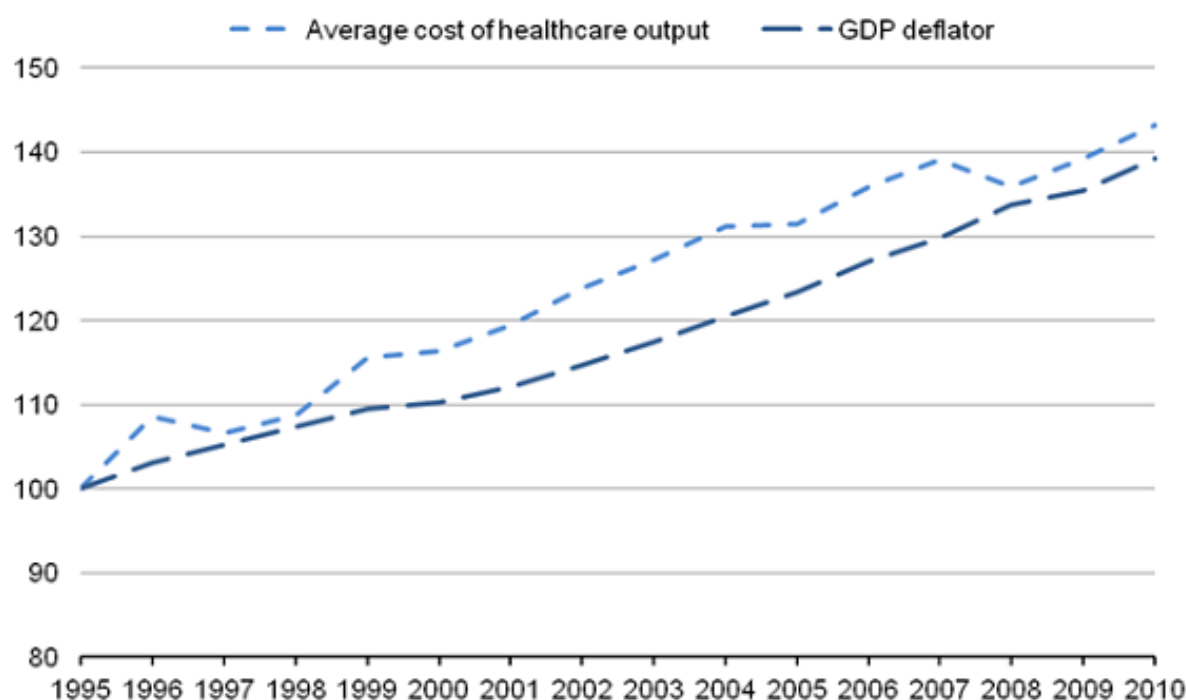
(22 Kb)

## Comparing to the GDP deflator

Over the whole period 1995-2010, average costs of providing healthcare rose by 2.4% per year, compared to the GDP deflator which rose by an average of 2.2% over the same period.

### Figure 13: Comparing average cost of healthcare provision with the GDP deflator, 1995-2010

UK, Index numbers, 1995=100



Source: Office for National Statistics

## Download chart

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(19.5 Kb)

The data show that healthcare average costs grow faster on average, but with more periods of acceleration and deceleration, compared to the smoother growth of the GDP deflator over the same time period.

A higher rate of cost inflation in the health sector may be expected, in that healthcare systems are known to use a highly specialised and trained workforce, increasingly high-technology medical



equipment and increasing volumes of drugs which are adding to costs relative to the cost of a wider mix of goods and services purchased in the whole economy. Phelps (2009) describes these types of measures in more detail and discusses alternative comparator measures of changing prices and costs in the economy.

ONS would like to extend the analysis of this section using the latest healthcare estimates, as resources allow. Any future publications will be announced on the ONS website and Publication Hub.

## Revisions

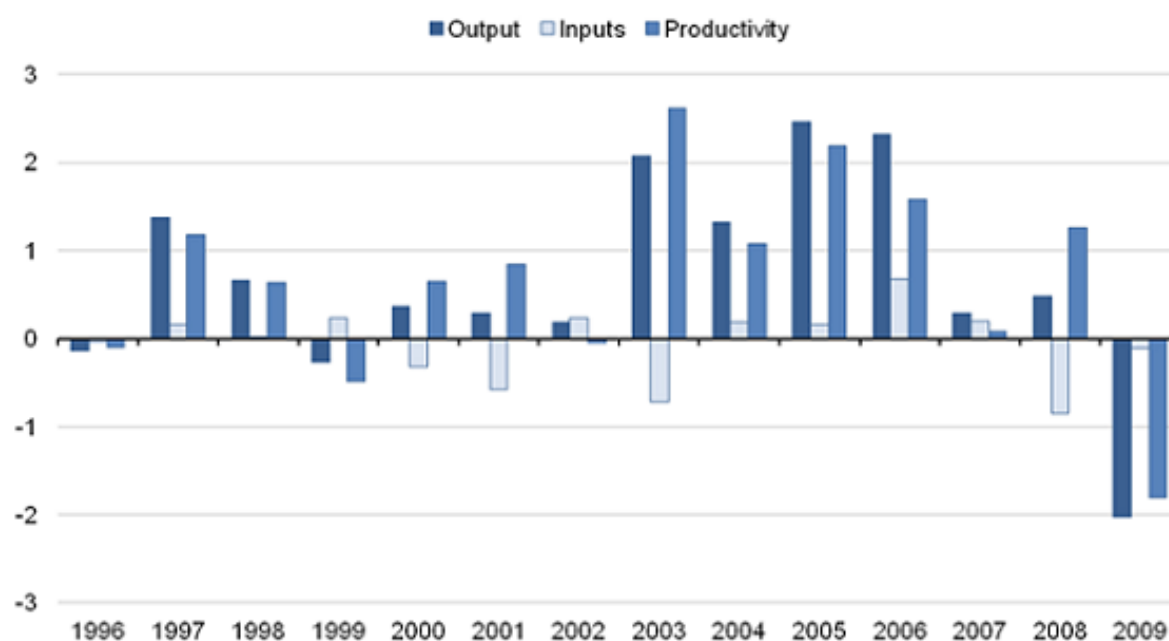
Revisions to previously published estimates have arisen in this release because:

- Historical administrative data has been revised by providers throughout the time series. This is particularly the case for English healthcare activity in some patient settings.
- Improvements have been made to the estimation methodology – as explained in *Methods changes in public service productivity estimates: Healthcare 2010* (ONS 2012a). The most significant effect has been the introduction of an indirectly measured component of activity representing provision by non-NHS organisations.
- More consistent data sources and processing techniques have been implemented in the historic series from 2002-03 onwards. This is the period from which data is available from all four health administrations and from which the quality-adjustment factor is applied. The checking and quality assurance processing has also uncovered a small number of calculation errors that have been corrected in the estimates contained in this release.

Figure 14 shows the difference between the annual growth rates in output, inputs and productivity in this article, compared with the previously published growth rates (ONS 2011a). The output series has been revised upwards by an annual average of +0.7 percentage points between 1995 and 2009.

**Figure 14: Revisions to annual growth rates of healthcare output, inputs and productivity 1996-2009**

UK, Percentage points



Source: Office for National Statistics

### Download chart

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(19.5 Kb)

The inputs index, allowing for rounding, has changed by less than -0.1 percentage points per annum so annual average growth rates in the latest estimates are identical (to 1 decimal place) to that published in 2011 at 4.6% per year. There has been little discernable effect brought about by the changes to methodology of converting to calendar years later in the data processing, and the improvements in geographic coverage to include Scotland and Northern Ireland data for the first time.

The productivity index has therefore been revised upwards (allowing for rounding) by an annual average of +0.7 percentage points from an annual average of -0.2% to +0.5% over the comparison period 1995-2009.

Reference Tables 3, 4 and 5 provide additional detail of revisions to the main estimates, by component, in index form.

### Revisions to the healthcare output series in more detail

As outlined in *Methods changes in Public Service Productivity Estimates: Healthcare 2010* (ONS 2012a), several changes have been introduced to the estimates of healthcare quantity and output

compared to the previous article, Public service output, input and productivity: Healthcare (ONS 2011a).

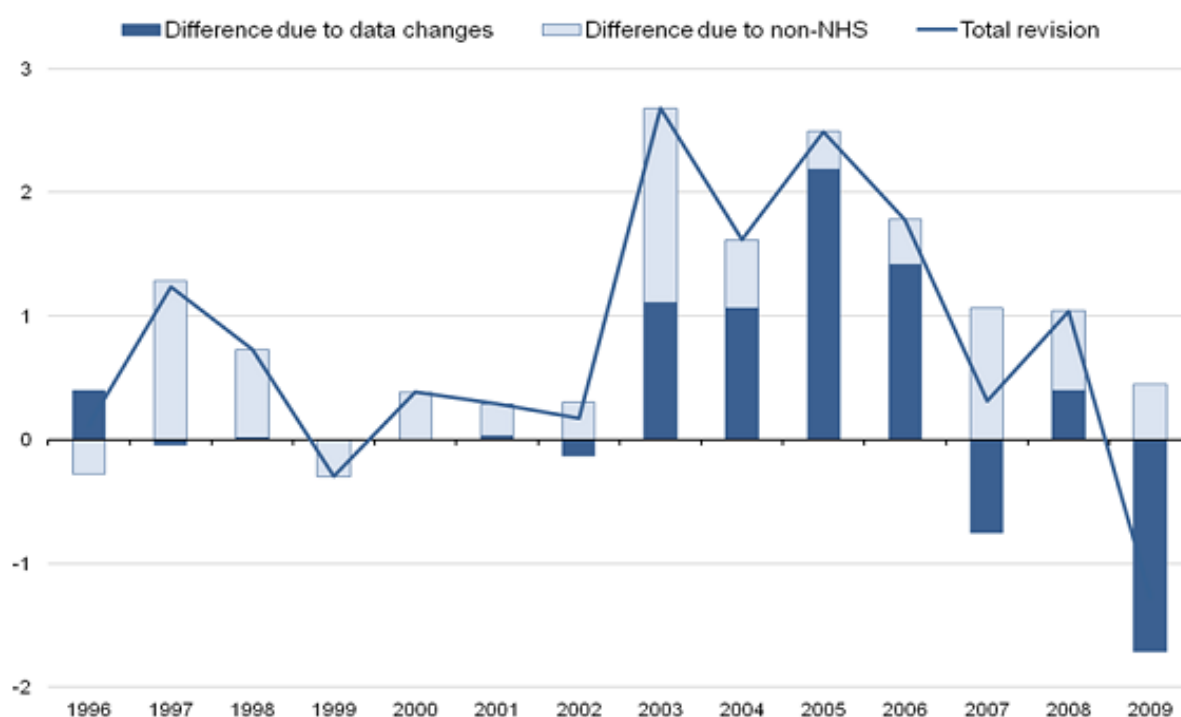
The most significant of these is extension of coverage to include an inputs=outputs treatment of previously unmeasured non-NHS expenditure. Alongside this change, ONS has undertaken a review of the historical output series back to 2003-04. As revisions to the quality-adjustment factor are relatively small, the changes to healthcare output are driven by changes to the underlying healthcare quantity index. Compared to ONS (2011a), the combined effect of the changes is to raise the annual average growth rate of healthcare quantity between 1995 and 2009 from 4.0% to 4.8%.

As a result, the quantity of delivered healthcare is 19.6 percentage points higher in 2009 than was previously estimated in ONS (2011a), with a new index value of 191.8 compared to the previous estimate of 172.2.

Figure 15 shows the revisions to the annual growth rates of the UK quantity series, divided between the effects of (a) the new treatment of non-NHS expenditure and (b) the effect of other new data, revisions and changes. Over the full period, the main cause of these revisions is the new treatment of non-NHS expenditure. Between 1995 and 2009, the average annual growth rate of UK healthcare quantity is revised upwards by 0.8 percentage points, of which 0.5 percentage points is accounted for by the introduction of non-NHS expenditure.

**Figure 15: Contribution to change in annual healthcare quantity growth 1995-2009 compared to previously published estimates**

UK, Percentage points



Source: Office for National Statistics

## Download chart

**XLS** [XLS format](#)

(29 Kb)

However, while non-NHS expenditure has an effect on healthcare quantity throughout the time series, the impact of new data, revisions and changes is concentrated in the period between 2002 and 2009. Between 1995 and 2002, the average annual growth rate of healthcare quantity is revised upwards by 0.4 percentage points, the vast majority of which is accounted for by non-NHS expenditure. However, between 2002 and 2009, the annual average growth rate is revised up by 1.2 percentage points. 0.5 percentage points are derived from non-NHS expenditure and 0.7 percentage points from other new data, revisions and changes.

The changes from 2002 onwards reflect the impact of revised data and a more consistent application of processing techniques, as well as the correction of two errors in the healthcare data. The three largest revisions by magnitude – in 2005, 2006 and 2009 – reflect changes in several different components of healthcare quantity. In addition to relatively small revisions in Scotland, Wales and Northern Ireland, the changes in 2005 and 2006 include upward revisions to HCHS, FHS and Prescription drugs in England.

In 2009 and to a lesser extent in 2008, the bulk of the revision arises from the correction of an error in the processing of HCHS data from England. The revised healthcare quantity series, excluding the new treatment of non-NHS expenditure, will be reflected in forthcoming Blue Book publications as revisions policy allows.

See Reference table 6 for additional data.

## Reference tables

The following reference tables are available to download.

[Reference Table 1 \(20.5 Kb Excel sheet\)](#) Healthcare quantity expenditure shares by component 1994-95 to 2009-10

[Reference Table 2 \(20 Kb Excel sheet\)](#) Input expenditure shares by component 1995-2010

[Reference Table 3 \(21 Kb Excel sheet\)](#) Comparison of output, inputs and productivity indices with previously published estimates (ONS 2011a)

[Reference Table 4 \(23.5 Kb Excel sheet\)](#) Comparison of quantity by component in this article with previously published estimates (ONS 2011a)

[Reference Table 5 \(21.5 Kb Excel sheet\)](#) Comparison of labour, goods and services and capital indices with previously published estimates (ONS 2011a)

[Reference Table 6 \(21 Kb Excel sheet\)](#) Contribution of new assumption on non-NHS provision to healthcare quantity revisions

## User feedback survey

ONS is actively seeking 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 and public debate. The [user survey](#) provides an opportunity for you to tell us about your use of this healthcare productivity release and your perception of the quality of the statistics.

If you would like to be invited to our user consultation sessions, please let us know. Contact details are in the Background Notes.

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## Annex A - Technical note on costs of healthcare output

Using notation in Phelps (2009) the implicit price index for public service output can be found by dividing total expenditure on public service output by the index of total public service output. Let this price index be  $P_t^P$ , where  $t$  is the relevant year. This index is implicit in the calculations of direct output measures already published by ONS, but has not been published since Pritchard (2003).

We also denote the corresponding quantity and price indices for inputs as  $Q_t^i$  and  $P_t^i$ .

As there is no profit in the public sector, the value of inputs is equal to total spending on public services (that is, the value of output). That is:

$$(1) Q_t^P P_t^P = Q_t^i P_t^i \text{ or}$$

$$(2) P_t^P = (Q_t^i / Q_t^P) \times P_t^i$$

The ratio  $(Q_t^i / Q_t^P)$  may be described as the index of the amount of input required to produce a unit of output. We denote this index as  $I_t$ . This is the reciprocal of the already published productivity index.

Equation (2) can be written as:

$$(3) P_t^P = I_t \times P_t^i$$

## Annex B - A user guide to key statistics in this release

[Annex B \(21.6 Kb Pdf\)](#) contains a user guide to the key statistics in this release including the concept of average total costs of output.

## 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 uses this technique to produce estimates of the volume of output and inputs for public service healthcare, and other measures of government services such as education 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 healthcare 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 healthcare, most expenditure is used to fund state providers of health services and its administration. There is, however, a growing component of expenditure on private or voluntarily-provided health services which is now 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 (jobs or hours) used in the production of these goods and services to estimate labour productivity series such as those produced by ONS. Multi-factor productivity estimates include labour and capital services as inputs. See ONS (2012b) for an article on estimates of multifactor productivity for the UK economy.

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 healthcare 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. Papers by ONS (2011b, 2010) describe some of these differences in approach in more detail.

A user guide to the interpretation of the healthcare output, inputs and productivity estimates contained in this article is included at Annex B.

## 3. Quality and Methodology Information (QMI)



An updated QMI describes the intended uses of the statistics presented in this article, their quality and a summary of the methods used to produce them. This will be available on the ONS website.

#### 4. **Pre-release access**

A [list of persons receiving pre-release access to this release \(85.6 Kb Pdf\)](#) is available on the ONS website.

#### 5. **The new ONS website**

The launch of the new ONS website in August 2011 has brought changes to the design and format of statistical bulletins and articles. The article main body is available in html and pdf format with detailed data tables available as Excel spreadsheets. You can follow ONS on [Twitter](#) and [Facebook](#) and watch our videos at [YouTube/onsstats](#).

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

#### 7. 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)

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