Quality-adjusted labour input: estimates to 2010

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Abstract

Quality-adjusted labour input (QALI) is a measure of labour input to economic production which takes account of the composition of the workforce as well as volume of hours worked. It provides a more complete picture of the input of labour to the production process than traditional measures, which focus only on the quantity of labour input, and therefore provides a broader perspective in assessing productivity performance. This article presents new estimates of QALI for 1993 to 2010. Key methodological changes are the change to the SIC (2007) industrial breakdown and an improved treatment of self employed labour income.

Summary

In seeking to explain productivity dispersions across industries, the quality of labour input plays an important role. This is unsurprising as two types of worker may not make the same contribution to output. Analysis of the quality of the labour force can arguably shine new light on the recent weak labour productivity statistics on the UK economy.

Quality-adjusted labour input (QALI) is a measure of labour input to economic production which takes account of the composition of the workforce as well as volume of hours worked. It provides a more complete picture of the input of labour to the production process than traditional measures, which focus only on the quantity of labour input, and therefore provides a broader perspective in assessing productivity performance. Along with the volume index of capital services (VICS), QALI is a key input to multi-factor productivity (MFP) and growth accounting analyses.

This article presents new estimates of QALI for 1993 to 2010. The series has been extended by an additional year since the previous release (Acheson 2011a). Key methodological changes are the change to the SIC (2007) industrial breakdown and an improved treatment of self employed labour income. Data are presented for the whole economy, the market sector, and by QALI category (industry, education, age and gender).

Whole economy QALI increased by 1.3 per cent in 2010, compared with a fall of 1.5 per cent in 2009 (Figure 1). This turnaround almost entirely reflects a change in hours worked, which fell by around 3 per cent in 2009 but were virtually unchanged in 2010. The contribution of labour quality to QALI was little changed in 2010 compared with 2009, at around 1.5 index points in each
Labour quality is the difference (measured in index points) between the QALI series and an index of hours worked. It refers to the pure quality effect of labour input. It is also known as labour composition but will be referred to as labour quality throughout this article.

**Figure 1: the whole economy, 1993 Q1 to 2010 Q4**

![Figure 1](chart_url)

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Figure 2 gives a snapshot of industry level results for 2010. The contribution of labour quality was highest in industries J (information and communication), K (financial and insurance) and LMN (real estate and business activities), with the latter contributing more strongly to the whole economy result through its high share of hours worked in the whole economy.

**Figure 2: summary of labour input at industry level, 2010**

![Figure 2](chart_url)
Introduction

Standard labour productivity measures express growth in output with respect to the volume of labour input, either in terms of employment, jobs or hours worked.\(^1\) The implicit assumption underlying this approach is that labour is homogeneous, as it does not take into account the composition, or quality, of the workforce.

‘As a result an hour worked by a highly experienced surgeon and an hour worked by a newly hired teenager at a fast food restaurant are treated as equal amounts of labour’. OECD (2001)

However, labour is far from homogeneous, and the ‘value’ of an hour worked, or marginal productivity, varies significantly between workers. The quality-adjusted labour input (QALI) series attempts to address this, providing a measure which explicitly recognises the heterogeneity of labour by weighting the volume of hours worked according to certain characteristics – qualifications, age, gender and industry – which may be indicative of a worker’s quality i.e. QALI is a weighted index of hours worked where the weights reflect marginal productivity of different categories of labour based on income shares.

QALI is a conceptually stronger method for use in productivity and growth accounting analyses, and is a useful tool for assessing the evolution of human capital over time. It is used alongside experimental estimates of capital services to produce multi-factor productivity (MFP) estimates (Acheson, 2011b).

The outline of this paper is as follows. The next section briefly reviews methodological changes since the last release. More detail on these changes, and on the QALI methodology in general, is provided in a series of appendices. The following section provides guidance on interpretation, noting that movements in labour quality can reflect changes in the shares of hours between QALI categories (e.g. an increase in the share of those with higher levels of qualification), and/or movements in average remuneration of different QALI categories (e.g. a reduction in gender pay differentials).

An outline of the main results follows, including results by industry, qualification, gender and age. More detailed results are available by contacting productivity@ons.gsi.gov.uk.

Notes

1. Employment is a head-count of all participants in the labour market. A jobs measure differs from head-count measures like employment as it takes account of workers with second jobs.
Changes since the last release

This year’s publication includes two changes to the QALI methodology. These are the change from the SIC (2003) to the SIC (2007) industrial breakdown and the treatment of self employed labour income.¹

1) SIC (2007)

The first methodological change is the change to SIC (2007). All other compositional categories (i.e. the breakdown by age, education and gender) remain the same.² More detail on the SIC conversion is provided in Appendix 2. The change in industrial classification is the main cause of changes to this year’s QALI results compared with last year.

The overall growth pattern of whole economy QALI under SIC (2007) is similar to that under SIC (2003) (Figure A1), although the level of QALI is a little higher under SIC (2007). Since the hours data are virtually unchanged, this implies that the contribution of labour quality to QALI is also a little higher under SIC (2007). This year’s results also show more volatility compared to last year’s. Further details on the comparison with SIC (2003) are available in Appendix 2.

2) Treatment of the self employed

Another change in the methodology was to the treatment of the labour income of the self-employed. The treatment now replicates the methodology behind the calculation of unit labour costs in the Labour Productivity Statistical Bulletin. The new methodology scales the pay of the self employed and employees, as calculated from the LFS micro data, to the sum of compensation of employees and the labour share of mixed income.³ Full details on the methodology change are available in Appendix 3.⁴

Notes

1. The Standard Industrial Classifications (SIC) is an internationally agreed system of classifying firms into different industries. From October 2011, all ONS data are published on a SIC (2007) basis.

2. Table A1 shows the full breakdown of compositional categories used in the quality adjustment.

3. Mixed income is defined in the National Accounts as the total income earned by the self-employed. It includes both the return to labour and the return to capital, as the self-employed do not specifically remunerate themselves for labour input.

4. A refined methodology was possible this year due to improved data availability after the publication of Blue Book 2011.
Interpreting the statistics

Table 1 gives an indication of the relative remuneration per hour in 2010 of the compositional categories recorded in Table A1 in the Appendices. Within QALI, labour input is categorised by industry (10 sub-categories), education (6 sub-categories), gender (2 sub-categories), and age (3 sub-categories), giving a total of 360 QALI sub-categories. Table 1 collapses the LFS micro data along the breakdown within each compositional category. It provides a simple means of summarising the distribution of relative remuneration.

The table highlights the variance in pay across the quality adjustment categories. Not surprisingly, some QALI categories, like working in financial and insurance activities or having a higher degree, provide more return to labour input than others, on average.

Comparing Table 1 with the equivalent table in last year’s QALI update, the pattern of relative remuneration between 2009 and 2010:

• Has changed significantly across QALI industries, reflecting the transition from SIC (2003) to SIC (2007). For example, average remuneration across manufacturing was significantly above the average for all industries in 2010, whereas it was below average in 2009;
• Shows a narrowing of the gap between average remuneration by gender;
• Shows little change in average remuneration by age – with the middle age category (30-49 years) at the top and young workers trailing well behind;
• And shows a small but significant narrowing of average remuneration by education.

Table 1 shows the importance of accounting for different compositional differences when calculating quality-adjusted labour inputs. It does not necessarily foreshadow the QALI results, which also depend on movements in the shares of hours worked by the different QALI categories. For example, an increase in the share of hours worked by those with higher educational qualifications, or from females to males, will tend to increase labour quality as long as these QALI categories enjoy relatively higher remuneration. And of course, volume and relative price movements are not independent of one another. In particular, movements in the shares of hours worked by QALI categories that reflect supply factors (such as an increase in the share of the workforce with higher levels of education due to an expansion of higher education) are likely to be a factor contributing to changes in relative remuneration.
Table 1: relative remuneration per hour in 2010, whole economy = 100

<table>
<thead>
<tr>
<th>Quality Adjustment Categories</th>
<th>Relative remuneration per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry</strong></td>
<td></td>
</tr>
<tr>
<td>Agriculture, forestry and fishing; mining and quarrying; utilities (ABDE)</td>
<td>71.7</td>
</tr>
<tr>
<td>Manufacturing (C)</td>
<td>115.3</td>
</tr>
<tr>
<td>Construction (F)</td>
<td>95.6</td>
</tr>
<tr>
<td>Wholesale and retail trade; accommodation and food services (GI)</td>
<td>82.2</td>
</tr>
<tr>
<td>Transportation and storage (H)</td>
<td>82.2</td>
</tr>
<tr>
<td>Information and communication (J)</td>
<td>133.7</td>
</tr>
<tr>
<td>Financial and insurance activities (K)</td>
<td>176.6</td>
</tr>
<tr>
<td>Real estate activities; professional and scientific activities; administrative and support activities (LMN)</td>
<td>88.0</td>
</tr>
<tr>
<td>Public administration and defence; education; health and social work (OPQ)</td>
<td>109.5</td>
</tr>
<tr>
<td>Arts and entertainment; other services (RSTU)</td>
<td>84.8</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>91.4</td>
</tr>
<tr>
<td>Males</td>
<td>105.4</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>16-29 years</td>
<td>71.0</td>
</tr>
<tr>
<td>30-49 years</td>
<td>111.1</td>
</tr>
<tr>
<td>50+</td>
<td>104.5</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
</tr>
<tr>
<td>Masters and doctorates</td>
<td>152.2</td>
</tr>
<tr>
<td>First and other degrees</td>
<td>129.2</td>
</tr>
<tr>
<td>Certificates of education or equivalent</td>
<td>107.2</td>
</tr>
<tr>
<td>A – levels or trade apprenticeships</td>
<td>91.5</td>
</tr>
<tr>
<td>GCSEs or equivalent</td>
<td>78.8</td>
</tr>
<tr>
<td>No qualifications</td>
<td>64.2</td>
</tr>
</tbody>
</table>
Results - whole economy and market sector

Whole economy

As shown in Figure 1 whole economy QALI had returned to its pre-recession level by the end of 2010, while the index of hours was some three percentage points lower than the peak in 2008Q1. Most of the reduction in hours occurred in 2009, with a miniscule recovery in 2010. By contrast, the contribution of labour quality, which has broadly offset the reduction in hours, was similar in 2009 and 2010 at around 1.5 index points in each year.¹

Although this article only traces the evolution of employed persons in the economy, the increase in labour quality throughout the recession and beyond implies that the quality gap between the employed and the unemployed is growing. For example, a recent ONS article found that amongst young people (18-24 year olds) claiming Jobseeker’s Allowance in January 2012 approximately 6 in every 10 were looking for a job in sales or ‘elementary occupations’, with the latter classed as the lowest skilled jobs in the economy.

The whole economy result underlines the importance of analysing labour inputs by more than just their volume characteristic. A volume analysis alone, as conducted in the quarterly Labour Productivity Statistical Bulletin, is important for its timeliness but omits the impact and dynamics of quality. Standard measures of labour productivity will underestimate the contribution of labour to economic growth if labour quality is improving. The picture painted by the latest quarters of quality-adjusted data show the employed workforce is on average moving toward higher remunerated QALI categories and this in turn suggests that the quality of UK labour input has increased in this recession and its aftermath.²

This trend of rising labour quality over 2009 and 2010 could be seen to accentuate the ‘productivity puzzle’, which is usually couched in terms of the failure of conventional measures of labour productivity to recover as quickly from the 2008-09 recession as from previous downturns. This is because a growing contribution from labour quality means that measures of productivity that used QALI as the measure of labour input would display an even worse performance.³

Market sector

The market sector results in 2010 show a more pronounced recovery in hours worked in 2010 compared with the whole economy results (Figure 3).⁴ However, this is not sufficient to bring the market sector QALI index back to its level before the recession, in part because market sector hours fell more steeply in 2009, and in part because the improvement in labour quality has not been as pronounced as for the whole economy (about one index point in each of 2009 and 2010, compared with 1.5 index points). These differences may be partly explained by job shedding in the public
sector and by the effect of quality adjusting hours worked in industry OPQ (public administration and defence, education, health and social work), which are mainly in the non-market sector.

**Figure 3: the market sector, 1994 Q1 to 2010 Q4**

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**Notes**

1. These time series has been seasonally adjusted using the ONS standard software package (X-12-ARIMA). They have not gone through the same methodological checks that, for example, seasonally adjusted series in the Labour Productivity Statistical Bulletin go through. This note applies to all series presented in this article.

2. In general, however, there is mixed evidence for the counter-cyclicality of labour quality (Schwerdt and Turunen, 2006).

3. The debate over the slowdown in the UK’s productivity is not conclusive and incorporates both supply-side analysis such as Dale (2011) and demand-side analysis such as Martin (2011).

4. The market sector of the economy is that sector where output is sold at economically meaningful prices.
Results - the 2008-2009 recession and its aftermath

Table 2 shows the change in labour quality, QALI and hours during the recession by QALI industry category. Between 2008Q1 and 2009Q2, QALI saw the steepest decline in LMN and C and the greatest increase - discounting ABDE which is highly volatile – in OPQ. Labour quality increased in all QALI categories other than H, with particularly pronounced increases in J and RSTU. This indicates that the compositional mix in these industries moved, on average, to higher remunerated categories over the recession. Moreover, since hours declined in all QALI categories other than ABDE and OPQ, it is likely that this compositional effect reflects greater reductions in hours among ‘lower quality’ categories of labour.

Table 2: peak to trough changes

<table>
<thead>
<tr>
<th>QALI (index points)</th>
<th>Hours (index points)</th>
<th>Labour Quality (index points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole economy</td>
<td>-1.8</td>
<td>-3.5</td>
</tr>
<tr>
<td>Market sector</td>
<td>-4.1</td>
<td>-5.2</td>
</tr>
<tr>
<td>ABDE</td>
<td>5.1</td>
<td>2.4</td>
</tr>
<tr>
<td>C</td>
<td>-9.7</td>
<td>-10.9</td>
</tr>
<tr>
<td>F</td>
<td>-3.7</td>
<td>-6.1</td>
</tr>
<tr>
<td>G1</td>
<td>-4.7</td>
<td>-7.0</td>
</tr>
<tr>
<td>H</td>
<td>-3.9</td>
<td>-3.8</td>
</tr>
<tr>
<td>J</td>
<td>-1.6</td>
<td>-5.7</td>
</tr>
<tr>
<td>K</td>
<td>-1.2</td>
<td>-1.9</td>
</tr>
<tr>
<td>LMN</td>
<td>-4.4</td>
<td>-5.8</td>
</tr>
<tr>
<td>OPQ</td>
<td>4.8</td>
<td>3.5</td>
</tr>
<tr>
<td>RSTU</td>
<td>0.3</td>
<td>-4.3</td>
</tr>
</tbody>
</table>

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<tbody>
<tr>
<td></td>
<td>(18 Kb)</td>
</tr>
</tbody>
</table>

Table 3 shows the evolution of the series after the recession. The change in labour quality for the whole economy is identical to the change during the recession, although the composition across industries has changed, with large increases in K and LMN. One interesting feature of the hours data is that in industries H and K, hours have declined more since the 2008-2009 recession than during it.
Table 3: the trough and its aftermath

<table>
<thead>
<tr>
<th></th>
<th>QALI (index points)</th>
<th>Hours (index points)</th>
<th>Labour Quality (index points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole economy</td>
<td>1.9</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Market sector</td>
<td>2.5</td>
<td>1.9</td>
<td>0.6</td>
</tr>
<tr>
<td>ABDE</td>
<td>15.0</td>
<td>12.6</td>
<td>2.4</td>
</tr>
<tr>
<td>C</td>
<td>0.4</td>
<td>-0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>F</td>
<td>-6.8</td>
<td>-5.5</td>
<td>-1.3</td>
</tr>
<tr>
<td>GI</td>
<td>2.0</td>
<td>0.1</td>
<td>1.9</td>
</tr>
<tr>
<td>H</td>
<td>-3.7</td>
<td>-4.8</td>
<td>1.1</td>
</tr>
<tr>
<td>J</td>
<td>3.9</td>
<td>-0.5</td>
<td>4.4</td>
</tr>
<tr>
<td>K</td>
<td>2.2</td>
<td>-2.1</td>
<td>4.3</td>
</tr>
<tr>
<td>LMN</td>
<td>4.9</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>OPQ</td>
<td>1.8</td>
<td>0.7</td>
<td>1.1</td>
</tr>
<tr>
<td>RSTU</td>
<td>2.4</td>
<td>0.8</td>
<td>1.6</td>
</tr>
</tbody>
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Results - by industry

The following sections look at QALI by industry i.e. each industrial category is decomposed by education, age and gender (36 cells). In these analyses, movements in labour quality reflect compositional and relative price movements within a single industry, between workers with different educational qualifications, different age classes and the gender balance.

Agriculture, forestry and fishing; mining and quarrying; utilities (ABDE)

While this industry group is quite similar to the group in previous QALI articles (see Acheson (2011a) for details), the SIC (2007) change means that sewerage and waste management activities are now included here (they were grouped in ‘other services’ previously). The growth in both QALI and hours is very pronounced in 2010. This reflects particularly strong growth in measured hours worked in agriculture, forestry and fishing (A), which makes up the majority of labour input in this industry grouping. By the end of 2010, QALI exceeded its 1993 level for the first time in the entire time series. The contribution of labour quality also saw a noticeable increase in 2010.
Figure 4: agriculture, forestry and fishing; mining and quarrying; utilities (ABDE), 1993 Q1 to 2010 Q4

Manufacturing (C)

The impact of the recession on labour input is particularly pronounced in manufacturing. The peak to trough fall in both QALI and hours was the second steepest of all industry categories. Labour quality did not change over that period (see Table 2). Hours continued to decline in 2010, albeit at a much slower rate, but this was offset by an improvement in labour quality. Since 2005, labour quality (i.e. the difference between the QALI and hours series) has hovered between 7 and 9 index points. Given the high-technology bias of UK manufacturing and its labour productivity growth since 2005, this small and constant labour quality result is surprising. However, looking at the composition in detail, the share of income earned by different worker types in manufacturing has remained steadier over time than in other industries. For example, men earned 82 per cent of manufacturing income in the last quarter of 2000.

The same result applies to both the last quarter of 2005 and of 2010. Taking information and communication (J) as a counter example, the same quarters yield income shares of 73, 78 and 82 per cent respectively. This can explain the constancy of labour quality, but not the scale. This may be related to the education mix in manufacturing, where the income share of workers with university degrees or higher is much lower than in services. Again taking information and communication as a counter example, workers with university degrees earned 57 per cent of all income earned in this industry in 2010Q4 compared with a 27 per cent share for workers with similar characteristics in manufacturing.
Construction (F)

QALI fell further in 2010 to a level that is some 12 percentage points below that of 2007. As noted above, labour quality also declined in this category, more than reversing a large improvement in labour quality in 2009. Over the whole period since 1993, construction has experienced easily the least improvement in labour quality of any QALI industry category, perhaps reflecting limited scope to substitute towards higher skilled workers in the construction sector.
Wholesale and retail trade; accommodation and food services (GI)

In order to draw out new aspects of the economy under SIC (2007), some trade-offs had to be made to ensure that the number of industries analysed did not exceed the capability of the LFS micro data to provide accurate detail for results. Therefore, in this year’s publication wholesale and retail trade (SIC (2007) section G) and accommodation and food services (SIC (2007) section I) were joined together.

The results for this industry are similar to those for the whole economy, which is unsurprising as approximately 20 per cent of all hours worked in the economy are worked in these two industries (see Figure 2). After a decline in 2009, both QALI and LFS hours increased over 2010, although both remain below their previous peaks. This industry experienced a sharp fall in hours, down by 7.9 per cent from peak to trough, with QALI falling by 5.6 per cent. However, after flat-lining in 2008, labour quality increased by around 1.5 index points in each of 2009 and 2010.
Transportation and storage (H)

Transportation and storage was the only services industry to experience a fall in QALI in 2010. This mainly reflected a surprisingly large reduction in hours; labour quality actually improved in 2010. As shown in Table 2, this was the only industry to experience a fall in labour quality over the recession (albeit a minor one of 0.3 per cent).

In the years before the recession, transportation and storage was one of the biggest contributors to aggregate labour productivity (Martin, 2011), but its low labour quality relative to other service industries hints that this strong productivity growth in the past was due to capital intensity more than labour quality (see the growth accounting exercise in Acheson (2011b) for further evidence of this).
Figure 8: transportation and storage (H), 1993 Q1 to 2010 Q4

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**Information and communication (J)**

This industry is new to the SIC 2007 classification of industrial activity. It gathers together the activities of newspaper and music publishers, software programmers, broadcasting activities, IT services and telecommunications. As such, it is a good example of what policy makers call the ‘knowledge economy’ and an industry that has developed because of and along with the permeation of ICT across the broader economy. Growth in labour quality in the activities defined by this industry is particularly important if the productivity gains from the use and diffusion of ICT capital services are to be realised, as labour quality can be viewed as a complementary asset to aid ICT diffusion i.e. the more skilled a worker is the better he or she is at using ICT (O’Mahony et al., 2005). In fact, growth in QALI has been very strong throughout the entire period. Since 2001, hours worked in this industry have remained relatively flat, but QALI continued to grow.

The contribution of labour quality to QALI from before the recession (2008 Q1) to the latest quarter of data (2010 Q4) has almost doubled, as can be seen from the widening of the gap between the two series in Figure 9a. Labour quality in this industry is dominated by men with university degrees in their 30s and 40s. By the end of 2010, such workers accounted for almost a quarter of all income earned in this industry. In addition their share of hours worked was also the highest for all worker types in information and communication.
Looking at the income shares and hours shares of the compositional categories shows how the drivers of QALI change over time. Figures 9b and 9c look at the educational sub-categories. The income shares of the two most qualified sub-categories (those with degrees or masters) have been increasing over the time series. Looking at the hours shares, however, suggests that in the case of those with first or other degrees, there is an oversupply of labour as their hours share has increased by far more than their income share. Hours shares for those with masters or doctorates, on the other hand, have increased in line with income shares over time.

The different share trends for the higher educated could also be due to the evolution of this industry: the composition of the workforce changed with the need for less advanced human capital as the industry changed from more ‘creative’ activities demanding highly qualified and remunerated staff into more ‘production’ activities.
Figure 9b: income shares for educational sub-categories in information and communication (J)

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Financial and insurance activities (K)

Labour quality improved sufficiently in 2010 for QALI in this industry to recover its pre-recession level despite hours falling by 1.4 per cent. Considering the importance of this industry to the wider economy, the absence of any significant growth in hours since 1993 is a notable feature. Equally, it is perhaps surprising that hours have not fallen by more over the recession, given the drop in output in this industry. Over the entire period, the improvement in labour quality has been among the most of any industry. And the proportion of QALI that is accounted for by labour quality is easily the highest of any industry. This should be borne in mind when interpreting productivity trends across different service sectors.
Labour quality improved sharply in this industry in 2010, continuing the trend observed from 2005, before which there was little net contribution from labour quality. This recent quality effect is due to compositional change in industry M (professional, scientific and technical activities) toward more highly remunerated QALI categories. For real estate activities (L) and administrative and support activities (N) there has been little change in labour quality.
Public administration and defence; education; health and social work (OPQ)

This industry grouping captures a lot of government activity, but also includes parts of education and health, for example, which are provided by private enterprises. Labour quality improved by 1.4 index points in 2010, following an improvement of 1.8 index points in 2009. The composition of this industry grouping differs from others in that it is the only one where female income and hour shares exceed male shares. In 2010, females worked 64 per cent of hours in this industry and they earned 59 per cent of all income.

However, despite the notable impact of female labour input in this industry, average pay is still lower than for males and indeed the industry average, as shown by the relative remuneration chart in Figure 12b. Changes in relative remuneration across time are less varied in this industry than in all other service industries.
Figure 12a: public administration and defence; education; health and social work (OPQ), 1993 Q1 to 2010 Q4

Figure 12b: relative remuneration for males and females in OPQ
Arts and entertainment; other services (RSTU)

The most notable change to this industry under SIC (2007) is the removal of waste activities to ABDE. In this industry, along with J and K, movements in labour quality have made very substantial contributions to QALI over the whole period. Labour quality in this industry, along with J, increased by most over the recession but, unlike J, its growth has declined since (see Table 3). The contribution of labour quality to QALI in 2010 (2.1 index points) was only around half the contribution in each of 2008 and 2009 (Figure 13).

Figure 13: arts and entertainment; other services (RSTU), 1993 Q1 to 2010 Q4

Notes

1. As the measurement of labour input in agriculture, forestry and fishing is particularly difficult, the Labour Productivity Statistical Bulletin only publishes estimates on an annual basis.
Results - by other compositional categories

The following results subsections examine QALI from other dimensions of education, age and gender. In these analyses, labour quality movements reflect movements between the other QALI dimensions, including movements between different industries.

Education

Education is a key element of human capital and this directly affects productivity by raising the quality of labour input. Modern growth theory assumes human capital facilitates innovation, and therefore that higher levels of education can move the economy onto a permanently higher growth path.

When the labour force is broken down by education qualification it is clear that the share of hours worked by those with higher education qualifications has increased very strongly (see Figure 14a for QALI results). However, in the case of those with university degrees or masters and doctorates, labour quality has generally been declining, and fell for both of these educational categories in 2010 (79 Kb Excel sheet). Between 2003 and 2010, the share of whole economy hours worked by those with university degrees or higher grew by 33 per cent (see Figure 14b) yet their share of whole economy income over the same period only grew by 26 per cent (see Figure 14c). One intuitive explanation is that workers with these levels of qualification have increasingly found employment in industries with lower levels of relative remuneration.

The relative remuneration of the highly qualified (Table 1) suggests that, on average, their income does reflect the quality of their labour input, but with such high growth in the volume of labour it is inevitable that at the margin there will be some workers earning less, particularly if this cohort has a young age profile or increasingly works in low-paying industries.

The rapid increase in the volume of labour taken with the overall fall in labour quality for this group indicates an over-qualification of labour input for these workers. This suggests rigidities in the labour market (e.g. skill mismatches). According to a recent ONS short story, Earnings by qualification in the UK, those with degrees are now more likely to work in lower-skilled jobs. According to the analysis, which used the Standard Occupational Classification (2000) rather than education variables to infer skills, 68 per cent of workers with a degree were employed in a job in the highest skill group in 1993. In 2010 this fell to 57 per cent, and there was a higher percentage of workers with a minimum of a degree in the lower-skill occupations.

The evidence is not conclusive on whether there has been a deterioration in the quality of graduates, as indicated by their remuneration, or that graduates are simply moving into lower skilled jobs.
Figure 14a: QALI by education level, 1993 Q1 to 2010 Q4

Download chart

XLS format (24.5 Kb)
Figure 14b: share of hours worked in whole economy, by education level

Download chart

XLS XLS format
(17.5 Kb)

Figure 14c: share of income earned in whole economy, by education level
Gender

The gender variable is included in QALI in order to compensate for the fact that age is only a rough proxy for experience; using a gender variable compensates for this as empirically men and women have different working patterns, with women showing a greater tendency for career breaks and part-time work.

The hours index recovered marginally more for men than for women in 2010. One reason for this is that more women than men work in public services (OPQ) and this saw a drop in hours in the final quarter of 2010. The contribution of labour quality grew for women in 2010, but remained fairly constant for men.

Looking at labour quality over time, growth for women compared to men is striking. One reason for the difference is the improving educational attainment for women relative to men. It is also possible that it picks up some effects of equal pay legislation mandating a convergence between male and female compensation.

Figure 15: males, 1993 Q1 to 2010 Q4
Age

Age is included in the QALI matrix in order to account for experience. It is expected that the more experienced a worker is, the higher the quality of an hour worked by them. This intuition is borne out by comparing labour quality across age groups. Since 2002, there has been a notable divergence between different aged workers. The results for 2010 show some flattening off for younger or middle-aged cohorts by the end of the year, whilst it continued to grow strongly for the over-50s. Expanded results for the age category are in the Reference Tables (79 Kb Excel sheet).
Figure 17: labour quality by age cohort, 1993 Q1 to 2010 Q4

Download chart

**XLS**  XLS format

(27 Kb)

Notes

1. The Standard Occupational Classification (SOC) is a common classification of occupational information for the United Kingdom. Within the context of the classification jobs are classified in terms of their skill level and skill content.

Background notes

1. 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

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References


Appendix 1 - Methodology, data sources, scaling and data issues

a) Methodology

QALI is a weighted index of hours worked, where the categories of hours worked in the index are based on measured characteristics (such as age and qualifications) and the weights reflect marginal productivity based on income shares. For further detail on the intuition for the characteristics analysed and on the methodology, see last year’s article (225.3 Kb Pdf). This methodology is the standard approach to measuring labour quality and has been practiced since at least Jorgenson and Griliches (1967).

The growth in quality-adjusted hours is represented as a Törnqvist index:

\[
\Delta \ln L_t = \ln \left( \frac{L_t}{L_{t-1}} \right) = \sum_i \left[ \left( \frac{w_{i,t} + w_{i,t-1}}{2} \right) \ln \left( \frac{h_{i,t}}{h_{i,t-1}} \right) \right]
\]

The description for this equation is currently unavailable. ONS apologises for any inconvenience caused.

(1)

where \( w_{i,t} \) is the share of total labour income paid to group \( i \) in period \( t \), the weight used is the average of \( w_{i,t} \) and \( w_{i,t-1} \), and the income shares sum to one. The logged changes are then used to create an index where the first quarter of the time series, 1993 Q1, equals 100. The use of data from the current and previous period to weight the change in hours is a feature of Törnqvist indices, making them more current or representative measures.

The difference between the Törnqvist index (1) and an unadjusted index of hours is referred to throughout the article as ‘labour quality’ and is the pure quality effect of labour input.

The main objective in choosing labour characteristics is to capture significant developments in labour inputs to production as indicated by human capital theory. When performing the quality adjustment there is an inevitable trade-off between the different characteristics due to constraints imposed by the sample size of the Labour Force Survey (LFS). In particular, a judgement needs to be made whether to prioritise the main compositional categories (education, age and gender) or focus on the industrial breakdown. The industrial breakdown is, for the first time, on a SIC 2007 basis.\(^1\) This article uses the same compositional breakdown for education, age and gender as the previous release (Acheson 2011).

By producing results for ten industries, other compositional categories are necessarily more limited. For example, there are only three age categories. Despite the expected pay differential between, say, workers aged 16-19 and workers aged 26-29, this limitation is necessary if enhanced industrial detail is sought (particularly for growth accounting analysis).

None of the following characteristics represent labour quality in and of themselves, but only as dimensions of the income–share weights. The choice of characteristics and their level of detail are
not fixed, but ONS’s design matrix follows best practice internationally.² If users have comments about the current dimensions, please contact productivity@ons.gsi.gov.uk.
## Table 1: quality adjustment categories

<table>
<thead>
<tr>
<th>Education</th>
<th>Age</th>
<th>Gender</th>
<th>Industry (SIC 2007)</th>
<th>Industry description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masters and doctorates</td>
<td>16 – 29</td>
<td>Male</td>
<td>ABDE</td>
<td>Agriculture, forestry and fishing; mining and quarrying; utilities</td>
</tr>
<tr>
<td>First and other degrees</td>
<td>30 – 49</td>
<td>Female</td>
<td>C</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>Certificates of education or</td>
<td>50 +</td>
<td></td>
<td>F</td>
<td>Construction</td>
</tr>
<tr>
<td>equivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A – levels or trade apprenticeships</td>
<td></td>
<td></td>
<td>GI</td>
<td>Wholesale and retail trade; accommodation and food services</td>
</tr>
<tr>
<td>GCSEs or equivalent</td>
<td></td>
<td></td>
<td>H</td>
<td>Transportation and storage</td>
</tr>
<tr>
<td>No qualifications</td>
<td></td>
<td></td>
<td>J</td>
<td>Information and communication</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K</td>
<td>Financial and insurance activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LMN</td>
<td>Real estate activities; professional and scientific activities; administrative and support activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OPQ</td>
<td>Public administration and defence; education; health and social work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RSTU</td>
<td>Arts and entertainment; other services</td>
</tr>
</tbody>
</table>

**Table notes:**
1. SIC stands for Standard Industrial Classification
b) Data Sources

The main data source for QALI is the Labour Force Survey (LFS). The LFS is a continuous household survey that covers approximately 53,000 households every quarter. It provides data on the volume of hours worked, and contains series for educational attainment, industry, gender and age, plus pay data, which are used to carry out the quality adjustment. Although the LFS became quarterly in 1992, questions about the respondent's income were not asked until 1993, so the QALI series begins in the first quarter of 1993.

c) Scaling

QALI’s consistency with other data series, particularly the National Accounts and ONS headline productivity measures, is important for its use in other types of productivity calculation such as growth accounting. To achieve this external consistency, various components of QALI are scaled to ONS aggregates. Specifically:

• gross weekly pay for employees plus the (imputed) gross weekly pay for the self-employed is scaled to National Accounts industry level ‘Compensation of Employees’ (CoE) plus the imputed labour element of the National Accounts industry level ‘Mixed Income’ series. Appendix 3 explains this in greater detail.
• actual hours worked are scaled to industry level productivity hours
• total jobs are scaled to industry level productivity jobs

The first adjustment improves the consistency of the LFS-based data with National Accounts income measures. While the LFS only provides information on wages and salaries, CoE also includes bonuses and income-in-kind and, as such, is a more complete indicator of total remuneration. Additionally, as with other household surveys, LFS micro data include proxy responses, missing responses and inaccurate data. Respondents have particular difficulty recalling their pre-tax income or bonuses accurately; scaling the data helps overcome these issues. It should be noted that the scaling up of gross weekly pay does not impact on QALI for individual industries, but the relative weights of industries will change and so will whole economy and market sector QALI as a result.

CoE only covers remuneration of employees; the earnings of the self-employed are recorded as mixed income, which accounts for both the returns to capital and labour. As of this publication, the QALI methodology now splits mixed income to give labour compensation for the self-employed. Appendix 3 explains this in greater detail.

Scaling the jobs and hours data to the headline labour productivity jobs and hours series, which use superior business survey-based industry breakdowns, improves consistency and also helps to partly overcome the inaccuracies in the LFS industrial breakdown.

d) Data issues
The inclusion of the self-employed poses an issue, as highlighted above, as wages for the self-employed are not recorded in the LFS, or any other survey. This is because self-employed people remunerate themselves for a combination of labour and entrepreneurial effort, without distinguishing between the two.

To measure labour's true input to production as accurately as possible, no restrictions have been placed on outliers, and actual hours rather than usual hours are used because, conceptually, it is the former that need to be measured.

**Notes**

1. Standard Industrial Classifications (SIC) are an internationally agreed system of classifying firms into different industries. From October 2011, all ONS data are published on a SIC 2007 basis.

2. The leader in this area is the EU KLEMS project, which ran from 2003 to 2008. It created a database on measures of economic growth, productivity, capital formation and technological change at industry level for all European Union member states from 1970 onward. Its equivalent of QALI is referred to as ‘labour services'. Further details available at the [EU KLEMS website](https://euklems.net).  

3. Productivity hours and productivity jobs are series used in the calculation of headline ONS labour productivity measures. They provide conceptually consistent measures of the volume of labour input for productivity purposes as they are produced using more reliable industry breakdowns, from both short-term and annual business surveys, which are constrained to LFS aggregates.

4. Productivity jobs and productivity hours were both extracted from the Q4 2011 Labour Productivity Statistical Bulletin for use in this article.

**Appendix 2 - Conversion of LFS micro data to SIC (2007)**

Since 2009 Q1, the Labour Force Survey (LFS) has been dual coded on both SIC (2003) and SIC (2007). For quarters prior to that, it was necessary to convert the data using a conversion tool provided by the LFS team in ONS. The conversion was done at the lowest level of industry coding (the class level) and then industry sections were aggregated up from these classes. For the four quarters of 1993, which was classified on SIC (1982), the conversion could not be performed using this tool. Instead, SIC (1982) classes were mapped to SIC (2003) classes and these were then mapped to SIC (2007) classes. This double conversion results in the 1993 estimates being less reliable than the later quarters.

Table A2 below shows the differences in industry breakdown as a result of the industrial classification change. Broadly speaking, it remains the same. Two industries are merged in this article which were treated separately previously, but this allows the emergence of a new industry, information and communication.
When performing the quality adjustment there is an inevitable trade-off between the different categories due to constraints imposed by the sample size of the LFS. This is why the industry detail was not expanded by more.

Table A2: industry categories under SIC (2003) and SIC (2007)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ABDE</td>
<td>Agriculture, forestry and fishing; mining and quarrying;</td>
<td>ABCE</td>
<td>Agriculture, hunting and forestry; fishing; mining and</td>
</tr>
<tr>
<td></td>
<td>utilities</td>
<td></td>
<td>quarrying; utilities</td>
</tr>
<tr>
<td>C</td>
<td>Manufacturing</td>
<td>D</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>F</td>
<td>Construction</td>
<td>F</td>
<td>Construction</td>
</tr>
<tr>
<td>GI</td>
<td>Wholesale and retail trade; accommodation and food</td>
<td>G</td>
<td>Wholesale and retail trade</td>
</tr>
<tr>
<td></td>
<td>services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Transportation and storage</td>
<td>H</td>
<td>Hotels and restaurants</td>
</tr>
<tr>
<td>J</td>
<td>Information and communication</td>
<td>I</td>
<td>Transport, storage and communications</td>
</tr>
<tr>
<td>K</td>
<td>Financial and insurance activities</td>
<td>J</td>
<td>Financial intermediation</td>
</tr>
<tr>
<td>LMN</td>
<td>Real estate activities; professional and scientific</td>
<td>K</td>
<td>Real estate, renting and business activities</td>
</tr>
<tr>
<td></td>
<td>activities; administrative and support activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPQ</td>
<td>Public administration and defence; education; health</td>
<td>LMN</td>
<td>Public administration and defence; education; health</td>
</tr>
<tr>
<td></td>
<td>and social work</td>
<td></td>
<td>and social work</td>
</tr>
<tr>
<td>RSTU</td>
<td>Arts and entertainment; other services</td>
<td>OPQ</td>
<td>Other social and personal services</td>
</tr>
</tbody>
</table>

It is not possible to make like-with-like comparisons with last year’s results for all industries as although certain industry headings are the same, for example manufacturing, some of the detailed activities have changed due to the classification change. However, comparing whole economy results shows how changes in QALI compositional categories change the income share weights and therefore the aggregate whole economy result.
Figure A1 compares this year’s results to last year at the whole economy level, where the only difference in this year’s methodology is the industrial classification change. The overall growth pattern of QALI is very similar, although the level of QALI (and therefore labour quality) is higher under SIC (2007). The differences in the two QALI series arise principally due to a level shift in 1993 (if the base quarter was changed to 1994 Q1, for example, the level differences would effectively disappear). This is because the LFS was on a SIC (1982) basis in 1993 and the conversion to SIC (2007) is less exact as a result. This year’s results also show slightly more volatility compared to last year’s, as evidenced by the spikiness of the blue line.

**Figure A1: comparison of whole economy QALI and hours results**

When looking at an industry-level comparison, such as manufacturing, changes to its classification detail caused a greater decline in QALI under SIC (2007). This is the result of the reassignment of activities such as publishing and recycling to other non-manufacturing sectors of the economy. The change in detail in SIC (2007) manufacturing results in a change in income shares and hours shares in this industry such that the QALI index now grows more slowly over time.
Appendix 3 - Methodology change to the treatment of the self-employed

The QALI methodology assumes that the hourly pay of a self-employed person with specific characteristics is the same as that of an employee with identical characteristics. This assumption is common in the growth accounting literature (see, for example, Jorgenson, Ho and Samuels (2010)). Considering the data constraints (no survey currently gives information on the labour income of the self-employed) and the nature of the QALI matrix (which captures key worker characteristics which impact on income levels such as age, education and industry of employment) this assumption is both practical and plausible.¹

However, the previous methodology also scaled the micro data to National Accounts and Labour Productivity Statistical Bulletins aggregate data in order to maintain consistency with other published estimates (namely productivity jobs, productivity hours and compensation of employees). This means that income for each type of worker, e.g. a young male working in government services (OPQ) with a higher degree, is scaled such that the sum of income for all worker types in industry

¹
OPQ equals compensation of employees for that industry. The Törnqvist income shares are then calculated from this scaled data. This scaling does not affect the income shares derived for industry results (the share is a ratio, and the numerator and denominator are being scaled by the same amount at industry level) but will affect the whole economy result and results by gender, age and education.

The assumption of equal hourly (or marginal) pay for self-employed and employed workers with the same characteristics is acceptable, given the data constraints. However, it is erroneous to scale total pay thus calculated to compensation of employees - as this assumes that the self-employed receive the same absolute compensation for their labour as the employed, when this is unlikely to be the case. Instead the total pay of employees and the self-employed should be scaled to the sum of compensation of employees and the labour element of mixed income. The labour element of mixed income is implied by multiplying mixed income by a factor share ratio, given by:

$$\frac{\text{Compensation of Employees}}{\text{Compensation of Employees} + \text{Gross Operating Surplus}}$$

The intuition behind this ratio is that the relative returns to each factor (labour and capital) are the same for the self-employed as for the employed. Although not a perfect assumption, treating the self-employed in this way is conceptually preferable to the previous practice, and has the advantage of aligning with the methodology used in both the calculation of unit labour costs in the Labour Productivity Statistical Bulletin and the calculation of total labour income in the experimental Multi-factor Productivity articles.

Figure A3 shows the impact of the methodology change at whole economy level. From 2000, the QALI index under the new methodology grows slightly faster as the share of self-employed income in total labour income grew faster from this period.
An alternative approach to accounting for the labour income of the self-employed is to separately scale their imputed pay to the labour share of mixed income and add this to employee pay scaled to compensation of employees. This alternative approach produces very different results to Figure A3 as the relative income weights of employees and the self employed change over time, which would have a bigger impact on the results. This alternative approach, graphed in Figure A4, was not implemented as the employee/self-employed split in the LFS is quite different from the employee/self-employed split in National Accounts income data (i.e. compensation of employees and mixed income). In particular, it is likely that the LFS over-records self-employment as some respondents claim to be self-employed when they are actually counted as employees for the purposes of calculating compensation of employees. Therefore the scaling change was applied to the sum of all workers instead.
Figure A4: alternative scaling methodology (separate scaling of employees and self-employed), whole economy QALI

Notes

1. Note that self-employed people do not remunerate themselves specifically for their labour input, but for a service which also includes capital input embodied in their entrepreneurial effort. In the National Accounts, this series is known as mixed income.