Quality-adjusted labour input (QALI) QMI

Quality and methodology information for quality-adjusted labour input (QALI), detailing the strengths and limitations of the data, methods used and data uses and users.

Contact:
Giovanni Sgaravatti
productivity@ons.gov.uk
+44 (0)8465 6013034

Release date:
13 March 2020

Next release:
To be announced

Table of contents

1. Output information

2. About this Quality and Methodology Information report

3. Important points

4. Quality summary

5. Quality characteristics of quality-adjusted labour input data

6. Methods used to produce quality-adjusted labour input data

7. Other information

1 . Output information

National Statistic	Experimental Statistics
Frequency	Quarterly
How compiled	Combined from survey data from households and businesses
Geographic coverage	UK
Related publications	Multi-factor productivity

2 . About this Quality and Methodology Information report

This Quality and Methodology Information (QMI) report contains information on the quality characteristics of the data (including the European Statistical System's five dimensions of quality) as well as the methods used to create it.

The information in this report will help you to:

- understand the strengths and limitations of the data
- learn about existing uses and users of the data
- understand the methods used to create the data
- decide suitable uses for the data
- reduce the risk of misusing the data

3 . Important points

- Quality-adjusted labour input (QALI) is an input into estimating multi-factor productivity (MFP). QALI accounts for changes in the composition (or "quality") of the employed workforce as well as changes in hours worked.
- QALI weights hours worked by different types of workers by their relative income share (reflecting their contribution to economic production).
- The two main sources of data for QALI are the Labour force survey (LFS) and the Annual survey of hours and earnings (ASHE).

4 . Quality summary

Overview

We calculate quality-adjusted labour input (QALI) by categorising workers by identifiable characteristics (age, gender, industry of employment and level of education), and weighting changes in the hours worked of each worker type by their share of total labour income.

The rationale for this approach is that, under competitive markets, economic theory suggests that different factors of production (different categories of workers and different types of capital assets) will be remunerated according to their productivity. Consequently, relative shares of labour income provide a proxy for the relative productivity or “quality” of different types of workers.

We take quarterly time series of hours and earnings by age, gender, industry of employment and level of education from the Labour Force Survey (LFS). Total hours and earnings are then benchmarked against those obtained through the Annual Survey of Hours and Earnings (ASHE) for each worker type. This benchmarking improves accuracy as the estimates rely on two data sources. Finally, hours are weighted by their share of total income, where weights are based on the geometric mean over two consecutive quarters. This allows us to construct Törnqvist indexes for hours worked by each group. We compute whole economy and market sector QALI indices for the different age groups, industries, genders and education groups.

For a further explanation of the underlying framework of QALI, please refer to the Quality-adjusted labour input section in our A simple guide to multi-factor productivity.

Uses and users of QALI

QALI provides a volume series of labour input that can be used in a growth accounting framework, such as for multi-factor productivity (MFP) estimates. QALI estimates measure changes in the volume of services from labour, rather than just changes in hours worked.

For an example of the informative nature of QALI estimates, please refer to the most recent Analysis of compositional changes in hours worked in the UK, where it is revealed how the growth in hours worked following the 2008 economic downturn has been disproportionately driven by workers who are 50 years or older, and by workers with degrees.

At the Office for National Statistics (ONS), QALI is used, along with the volume index of capital services (VICS), as an input into the MFP framework. In simple terms, this allows changes in economic output to be decomposed into changes in services from labour, changes in services from capital, and for the unaccounted growth to be multi-factor productivity (also known as “disembodied technical change”, or the “Solow residual”).

Strengths and limitations of QALI

There is no universally agreed method of accounting for different types of labour input into production, and the method used in QALI is subject to continuous development. The theoretical framework behind QALI, being based on the concept of services flowing from labour, is therefore open to criticism.

Nonetheless, QALI is computed according to a widely recognised growth-accounting framework (PDF, 993.47KB) put together by the Organisation for Economic Co-operation and Development (OECD). Its nature allows a breakdown of the labour input by different characteristics, making QALI informative at a multidimensional level.

The theoretical framework of QALI relies on the economic assumption that workers receive their marginal products. That is, earnings can be used to accurately represent different workers’ relative contributions (or their marginal additions) to output (the product). This may not always hold true. For example, in non-market sector industries such as non-profit institutions or the public sector, this assumption may be broken (there are no market prices for non-market outputs).

Because of this theoretical difference, users should not try to calculate non-market sector estimates as a residual between the estimates for the whole economy and those for the market sector. On the other hand, whole economy and market sector estimates are comparable for industries that are wholly market sector.

Another point where this economic assumption may not hold is around the gender variable. If the persistent pay gap that exists between males and females reflects discrimination, then the assumption that workers are paid their marginal product is violated, resulting in hours growth being weighted incorrectly and the quality adjustment carrying a downward bias.

Given the innovative nature of growth accounting, QALI estimates are still labelled as Experimental Statistics, therefore lacking the badging of National Statistics. Experimental Statistics are newly developed or innovative statistics. These are published so that users and stakeholders can be involved in the assessment of their suitability and quality at an early stage.

QALI provides additional information on top of the ONS's labour productivity statistics. The main strength of QALI is that of accounting for different types of workers. Differentiating among hours worked within the framework of growth accounting makes the labour index more informative and precise.

For a detailed explanation of the QALI framework and its more informative nature when compared with other methods, please refer to our A simple guide to multi-factor productivity.

In an effort to tackle the limited level of detail that QALI estimates were providing, and to make them more informative at the industry level, since April 2018 we have been using market sector QALI estimates as an input into an expanded 19-industry MFP release. In our current MFP publication, QALI estimates are provided at both the 10 and 19 industry-level. However, for the 19-industry split we only publish quarterly estimates for growth rates, while relative hourly remuneration and shares of hours worked estimates are published as annual estimates.

Furthermore, we have recently started to publish two-digit SIC-code estimates for selected subsections within three major industries in the UK: [C] manufacturing, [G] wholesale and retail trade; repair of motor vehicles and motorcycles and [M] professional, scientific and technical activities.[1]

Notes for: Quality summary

1. Given sample constraints, at the current stage we are not yet able to publish the whole 64-industry split. Please refer to this article for a detailed explanation.

5 . Quality characteristics of quality-adjusted labour input data

This section provides a range of information that describes the quality and characteristics of the data and identifies issues that should be noted when using the output.

Relevance

(The degree to which statistical outputs meet users' needs.)

Outside the Office for National Statistics (ONS), external researchers, including academics, non-governmental bodies and other government departments, have used quality-adjusted labour input (QALI) as an input into their own growth accounting estimates. Other researchers have used QALI for broader purposes such as analysis of the productivity puzzle by using QALI for labour productivity estimates.

Those users have indicated that they find QALI useful and have offered suggestions for its development. To promote engagement, we organise an annual user forum where we discuss recent developments in the computation of our estimates and gather users' feedback and suggestions on ways to move forward. Moreover, we work alongside the Economic Statistics Centre of Excellence (ESCOE) to make sure our estimates and the methods to obtain them are at the frontier of economics and statistics research.

QALI estimates can also shed some light on the productivity puzzle. Labour composition has been the only component within the multi-factor productivity (MFP) framework to have made a consistently positive contribution to productivity growth since the 2008 economic downturn. Please refer to the Quality-adjusted labour input section of our Quarter 3 (July to Sept) 2019 MFP release for a better overview over the possible uses of QALI within the analytical framework of productivity growth.

Accuracy and reliability

(Accuracy is the degree of closeness between an estimate and the true value. Reliability is the closeness of the initial value to the subsequent estimated measure.)

As QALI estimates represent changes in an intangible concept, their accuracy is somewhat unobservable. Nonetheless, we can evaluate the degree of accuracy for QALI through the comparison with labour productivity estimates, where accuracy relies on labour productivity and QALI telling an economically coherent story. That said, QALI and its use in a growth accounting framework are subject to various theoretical assumptions regarding the operation of employment markets and corporate behaviour.

It is reasonable to conclude that the degree of accuracy has increased with improved methodologies and data sources. For example, implementing the benchmarking process of the Labour Force Survey (LFS) to the Annual Survey of Hours and Earnings (ASHE). These are two very different surveys addressed to different respondent categories; the LFS is the largest household study in the UK, while ASHE collects data from UK employers.

The Labour Force Survey provides information about personal characteristics of the labour force, such as educational attainment and the occurrence of multiple job holding, which are missing in ASHE. Because of the importance of self-employment in the UK economy, the ONS takes the view that the LFS provides the best estimate of overall labour input into the economy. Moreover, the LFS is considered to be more reliable for variables such as age, and actual hours worked.

Analysis shows that household surveys, in which individuals define for themselves the industries in which they work, are less reliable for detailed industry analysis than business surveys. ASHE data is considered to avoid the problem of inaccurate industry categorisation and to provide more accurate data on pay (such as employers' contributions) and contracted hours.

For a more detailed explanation on the quality of LFS and ASHE data and the methodologies used for their collection, please refer to the Labour Force Survey (LFS) QMI and Annual Survey of Hours and Earnings (ASHE) QMI.

Combining data from these two data sources increases the accuracy of the resulting estimates. Furthermore, using ASHE data alongside LFS data helps achieve more granular industry splits because of the augmented size of the datasets. Please refer to the article, Developing improved estimates of quality adjusted labour inputs using the Annual Survey of Hours and Earnings: a progress report for a more thorough explanation on the implementation of ASHE data for QALI estimates.

In terms of reliability, QALI estimates are normally subject to minor variations because of revisions in the data sources. Users should keep in mind that such small variations are expected, especially during the first and the third quarters (when ASHE data are published along with LFS data).

Changes to benchmarks used can also cause revisions to published series. Any major revisions or reclassifications brought about by national accounts changes (normally with Blue Book [1] publications) or from other sources are referenced and explained in the MFP bulletin.

The ONS has various procedures in place to ensure that errors are minimised. The data go through thorough quality assurance processes, and outputs are peer reviewed before being published. If errors are found in the data after publication, a notice will be attached to the publication to inform users, and datasets will be revised in line with the Code of Practice for Statistics.

Coherence and comparability

(Coherence is the degree to which data that are derived from different sources or methods, but refer to the same topic, are similar. Comparability is the degree to which data can be compared over time and domain, for example geographic level.)

For comparability, the methods of calculation used for QALI are based upon those in the OECD Productivity Manual (PDF, 993.47KB) and were first outlined in the first publication of QALI. The OECD Productivity Manual describes how labour input into production should be weighted by income shares for productivity measurement.

QALI is coherent with other ONS productivity statistics, as the sources used to aggregate QALI hours and earnings estimates are those used elsewhere in productivity systems. For example, productivity hours, used to scale the hours results from the QALI systems to industry totals, are used in the Labour productivity statistical bulletin.

QALI estimates are compiled using UK Standard Industrial Classification 2007:SIC 2007, used for the first time in Blue Book 2011. For further information on the introduction of SIC 2007 see Implementation of Standard Industrial Classification 2007: December 2009 update, Economic and Labour Market Review, December 2009, Volume 3, No. 12.

Concepts and definitions

(Concepts and definitions describe the legislation governing the output, and a description of the classifications used in the output.)

QALI concepts and definitions are produced in line with international standards, most notably those laid down by the Organisation for Economic Co-operation and Development (OECD). The industry classification used to compile QALI estimates is the Standard Industrial Classification 2007: SIC 2007.

Accessibility and clarity

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

QALI statistics are published each quarter as part of the MFP release. All datasets are available at the ONS website free of charge. One section of the MFP release is solely dedicated to QALI and it is published alongside three datasets for each release: “QALI00 - Quality adjusted labour input, descriptive statistics”, “QALI01 - Quality adjusted labour input, summary data”, “QALI02 – Quality adjusted labour input, underlying data”.

The QALI00 dataset reports relative hourly remuneration and shares of hours worked by industry, education, age and gender. The QALI01 aggregates QALI estimates by industry, education, age and gender, presented in logarithmic changes. Finally, QALI02 includes data on hours worked, jobs and income weights for the 360 worker types (created from the intersection of the various worker characteristics measured) used in quality-adjusted labour input.

All QALI datasets report experimental estimates.

Our recommended format for accessible content is a combination of HTML web pages for narrative, charts and graphs, with data provided in usable formats such as CSV and Excel. Our website also offers users the option of downloading the text in PDF format. In some instances, other software may be used throughout the computation of the estimates, and such files may be available on request. For further information please email productivity@ons.gov.uk.

Timeliness and punctuality

(Timeliness refers to the lapse of time between publication and the period to which the data refer. Punctuality refers to the gap between planned and actual publication dates.)

QALI data are published within the growth accounting framework of our MFP quarterly publication. We now publish releases on labour productivity, multi-factor productivity and public service productivity for the same time period on the same date.

The main constraint of QALI production is the publication of the GDP quarterly national accounts, from which the QALI income constraints are constructed. As a result, QALI is usually published one week after the publication of the quarterly national accounts and around 14 weeks after the reference quarter.

For more details on related releases, the GOV.UK Research and statistics page is available and provides 12 months' advance notice of release dates. In the unlikely event of a change to the pre-announced release schedule, the ONS will publicly announce and explain the reasons for the change, as set out in the Code of Practice for Statistics.

Notes for: Quality characteristics of quality-adjusted labour input data

1. The Blue Book is an annual publication presenting a full set of economic accounts (national accounts) for the UK. These accounts are compiled by the Office for National Statistics (ONS). They record and describe economic activity in the UK and are used to support the formulation and monitoring of economic and social policies.

6 . Methods used to produce quality-adjusted labour input data

How we collect the data, main data sources and accuracy

The two main data sources for quality-adjusted labour input (QALI) are the Labour Force Survey (LFS) and the Annual Survey of Hours and Earnings (ASHE). The LFS sample is made up of approximately 40,000 responding UK households containing about 65,000 persons in the age group 16 to 74 years (2019 quarterly dataset). Respondents are interviewed for five successive waves at three-monthly intervals, and 20% of the sample is replaced every quarter.

ASHE is based on a 1% sample of employee jobs (around 180,000) taken from HM Revenue and Customs' (HMRC) Pay As You Earn (PAYE) records. Information on earnings and hours is obtained from employers and treated confidentially.

The LFS provides us with quarterly datasets for hours and corresponding earnings of different worker types. LFS data are then benchmarked to ASHE estimates both to add an extra level of reliability on LFS-derived estimates and to allow for a higher level of detail. This is particularly important for pay estimates because employers are considered to be more reliable in reporting gross pay figures.

Hours estimates are further benchmarked to productivity hours, which are computed from a combination of LFS and Short-Term Employment Survey data. The final source used in the process is the national accounts labour income data, which form the income constraints on employee and self-employed compensation levels. These are derived from Blue Book income data and quarterly national accounts data.

How we process the data

First stage: construction of LFS hours and earnings time series

The raw datasets are coded to stratify the workforce in four ways whose combination results into 360 categories. These are three age groups, two genders, six educational classifications, and 10 industry groups. These characteristics are shown in Table 1.

Table 1: QALI worker characteristics

Gender	Age groups	Educational attainment	Industry
Female	16 to 29 years	Masters and doctorates	ABDE
Male	30 to 49 years	First and other degrees	C
	50 years and over	Certificates of education or equivalent	F
		A-levels or apprenticeships	GI
		GCSEs or equivalent	H
		No qualifications	J
			K
			LMN
			OPQ
			RSTU

Source: Office for National Statistics

Industry classification is indicated according to the Standard Industrial Classification 2007: SIC 2007. Average hours and earnings are computed for each of these categories in each time period, and these are formatted as time series. Separate series are produced for first and second jobs, and for employees and self-employed.

Labour characteristics

The choice of labour characteristics involves a trade–off between comprehensiveness and data availability. None of the following characteristics represents labour quality in and of themselves, but only as dimensions of the income–share weights.

Age

Age is included as a proxy for work experience. Although imperfect, as it takes no account of periods of unemployment or inactivity, the assumption is that older workers tend be more productive because of their greater experience and therefore receive greater compensation for their labour.

Alternatively, it has been suggested that younger workers may be more dynamic and innovative than their older counterparts (Bell et al 2005). However, if this is true in some cases then, provided labour markets are competitive, these workers will be paid their marginal product, and growth in hours will be weighted accordingly.

Gender

Gender is chosen because of the persistent pay differential that exists between males and females, even after holding other factors constant. Although not a driver of quality change itself, it may represent hidden characteristics such as an increased tendency for women to take career breaks for childcare or to fill part–time posts that are not as well paid.

This complements, or improves, the use of age as a proxy for work experience, and helps to explain the pay differential. However, if the pay differential instead reflects discrimination, then the assumption that workers are paid their marginal product is violated resulting in hours growth being weighted incorrectly and the quality adjustment carrying a downward bias.

Education

This is measured as the highest qualification attained and is used as a proxy for skills. Qualifications either act as a signal of ability to employers or they provide the knowledge for specific job requirements. This characteristic is the primary driver of the index. Because of the increasing prevalence of higher degrees and their growing association with higher pay, they are included as a stand–alone category.

Industry

Although primarily included for the observation of industry trends and the use of QALI in industry–level MFP, this category also helps capturing inherent differences in skills and productivity trends that exist between industries.

The industry categories chosen are broad partly because respondents self-report the industry in which they work in the LFS, making this variable less reliable. Nonetheless, since the implementation of the ASHE dataset into QALI estimates, we have been moving to more granular analysis at the 19-industry level.

For the 19-industry split we publish log changes (and therefore growth rates) of QALI, hours and labour composition indices on a quarterly basis. However, at the 19-industry level we only publish annual estimates for relative hourly remuneration and shares of hours worked.

Second stage: constraining total hours and earnings

QALI's consistency with other data series, particularly the national accounts, and ONS headline productivity measures, is important for its use in growth accounting. To achieve this external consistency, various components of QALI are scaled and constrained to ONS aggregates. Specifically:

- gross weekly pay is scaled to national accounts industry level "labour income" (compensation of employees plus the share of labour income from self-employed)
- both hours worked and jobs are scaled to industry level to be consistent with estimates used in labour productivity

For each industry, compensation of employees (CoE) data are added to an estimated value of self-employed labour income from self-employed mixed income, which is taken from quarterly national accounts data. Self-employment labour income is derived by assuming that in mixed income the ratio between the return on capital and the return on labour is the same as the relationship between CoE and gross operating surplus. This produces a component which can be compiled with CoE to give total labour income by industry for scaling.

Third stage: computation of indices

The QALI indices are computed using a Törnqvist index.

A feature of the Törnqvist index is to make use of data from the current and previous period. Weighting the change in hours is a way of making them more current or representative measures. The index is also a widely used form in economic analysis, particularly with regard to quality–adjusted labour measures (Bell et al 2005).

Hours worked by the different worker types contribute to total labour input L through a function g.

$$L = g(h_1, h_2, \ldots, h_n)$$

Then, for each worker type, income weights are calculated as an average of the current and preceding period share in total income

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

where $w_{i,t}$ is the share of total labour income paid to group i in period t, while $h_{i,t}$ is the share of total hours worked by 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 logarithms of the changes are then used to create an index.

Log changes are used in QALI calculations because they are additive, which makes it possible to calculate contributions to growth. Calculating quarter-on-quarter natural log changes also means that the magnitude of change remains the same regardless of which way the quarters are compared. The only thing that changes is the sign. The ONS has published A simple guide to multi-factor productivity, which has an example for calculating QALI estimates and more information on log changes.

The difference between the Törnqvist index and an unadjusted index of hours is referred to as "labour composition".

How we analyse the data

Data are analysed on a continuous basis by the MFP team within the productivity branch. The main focus is to monitor the variation of the QALI index for the different variables and their relations throughout time, making sure that any important change has a coherent interpretation in terms of concepts from economic theory. Ad hoc analysis is conducted for specific categories.

The MFP release always includes one section exclusively devoted to the QALI index and labour composition analysis.

7 . Other information

User needs

We invite user feedback on quality adjusted labour input (QALI) estimates to productivity@ons.gov.uk. Any proposals or comments from QALI users will be considered when deciding upon future development work on QALI outputs.