Office for National Statistics

Information Note

New developments in ONS labour productivity estimates

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This note updates users with recent development work on (i) seasonal adjustment of hours worked at the industry level and (ii) decompositions of movements in labour productivity. The industry component series for hours worked (known as “productivity hours”) are ONS’s preferred measure of hours worked at industry level and feed into ONS estimates of labour productivity as measured by output per hour. Productivity decompositions allow movements in aggregate productivity to be broken down into contributions from “within” industry movements in productivity and the effects on the aggregate of changes in labour shares “between” different industries.

1. Seasonal Adjustment of Productivity Hours

Background

The source for hours worked by industry of employment is the Labour Force Survey (LFS), which records average hours worked in first and second jobs by employees and the self-employed. The ONS productivity system combines this information with jobs estimates derived from LFS, short-term employment surveys of businesses and administrative sources[1]. Aggregate hours worked are then scaled to the non-seasonally adjusted total from LFS. Industry level components are then seasonally adjusted and the resulting estimates are used as denominators in compiling industry level estimates of output per hour.

A survey period in the LFS is 13 weeks long and headline results are reported as rolling 3-month average. Each 3-month period operates on a '4-4-5' basis (a repeating pattern consisting of a four-week-long reference month, followed by another four-week-long reference month, followed by a five-week-long reference month) leading to a reference year of 364 days. Therefore, the survey periods do not align exactly to calendar months or quarters and this non-alignment shifts by one or two days per year. This evolving disparity is known as a 'phase shift'.

[1] Administrative sources relate to data which is obtained by government departments, outside the Office for National Statistics, in their day-to-day operations.

So, for example, the survey period for October-December could include the end of September and exclude the end of December, or could exclude early October and include early January. Once every five or six years, when the disparity has evolved by a whole week, a one-week-long survey break is inserted in order to arrest the phase shift. Referred to as a 'leap weeks'; these are built in to the calendar to realign the survey periods and calendar periods. In October 2010 the LFS was subject to an additional leap week in order to align its reporting periods with those of the rest of the European Union and the survey periods were effectively moved forward one week.

The non-alignment of survey periods and calendar periods create issues for seasonal adjustment of hours worked. A direct effect is due to the fact that the composition of each survey period, in terms of the number of days from each calendar month that form the given period, changes between successive years. Indirect effects are related to holiday periods in the UK and, more specifically, those holidays that 'move' between reference months and quarters from year to year due to the phase shift. As an intuitive example, many workers take time off over Christmas and so report lower hours worked to LFS.

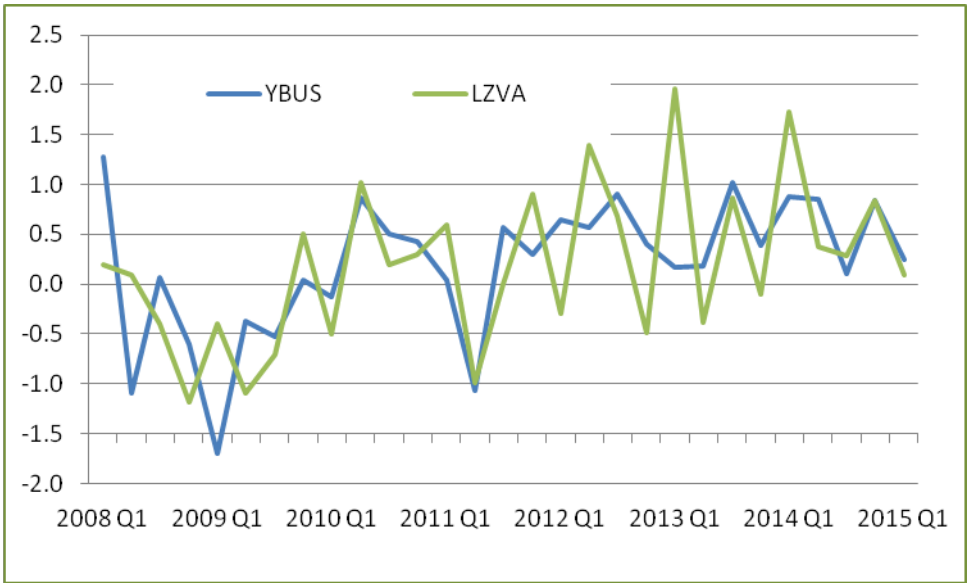
Prior to October 2010 part of the Christmas period could occur in calendar quarter 4 (October – December) or calendar quarter 1 (January-March) depending on the year and the extent of non-alignment. Post October 2010 Christmas will always fall in the LFS reporting period for quarter 4, although the New Year holiday may now fall in quarter 4 or quarter 1. These moving effects need to be accounted for in the seasonal adjustment as they are systematic and depend on the organisation of the survey calendar. This is a form of ‘calendarisation’. Seasonal adjustment of jobs (or employment) is not affected to the same extent because most workers remain in a job over a holiday period before returning to a regular working pattern.

Q1 2015 Labour Productivity Release

Seasonal adjustment parameters for all ONS series are reviewed periodically. Seasonal adjustment parameters in the ONS productivity system were reviewed earlier in 2015 and introduced in the Q1 (January – March) Labour Productivity release published on 1 July 2015. The review of seasonality of industry level hours worked had two features that were different from the previous specification. First, the review took explicit account of the ‘calendarisation’ issue noted above. That is, the raw LFS estimates were adjusted to align them with calendar quarters, prior to estimating the impact of seasonality. Second, seasonality was estimated over the whole time period, whereas previously, seasonality had only been estimated up to Q3 2010. This allowed us to replace a work-around which had been in place from Q4 2010, under which movements in aggregate productivity hours were constrained to align with movements in LFS seasonally adjusted total hours worked (Central Database IDentifier (CDID): YBUS).

Although we are confident that the revised seasonally adjusted hours estimates published in the Q1 release are methodologically superior to the previous estimates, some users queried the result that the recent evolution of total hours worked – i.e. the sum of the seasonally adjusted industry components (CDID: LZVA) differed from YBUS, as shown in Figure 1.

FIGURE 1: Total hours worked, LFS (YBUS) and Productivity Hours (LZVA)
Seasonally adjusted, quarter on quarter percentage changes



Although there are some periods where productivity hours and LFS total hours worked exhibit similar rates of change, for example from 2010 to 2011 and in more recent quarters, it is notable from Figure 1 that the former measure is far more volatile. Additionally, there are some quarters in which YBUS fell (grew), while LZVA moved in the opposite direction.

In fact it has always been a feature of the ONS compilation method that the sum of seasonally adjusted industry level estimates of hours worked can differ from YBUS. Historically these differences have been trivial, and as noted above, until the Q1 2015 release there was a work-around in place to deal with the structural break in the LFS hours series in October 2010.

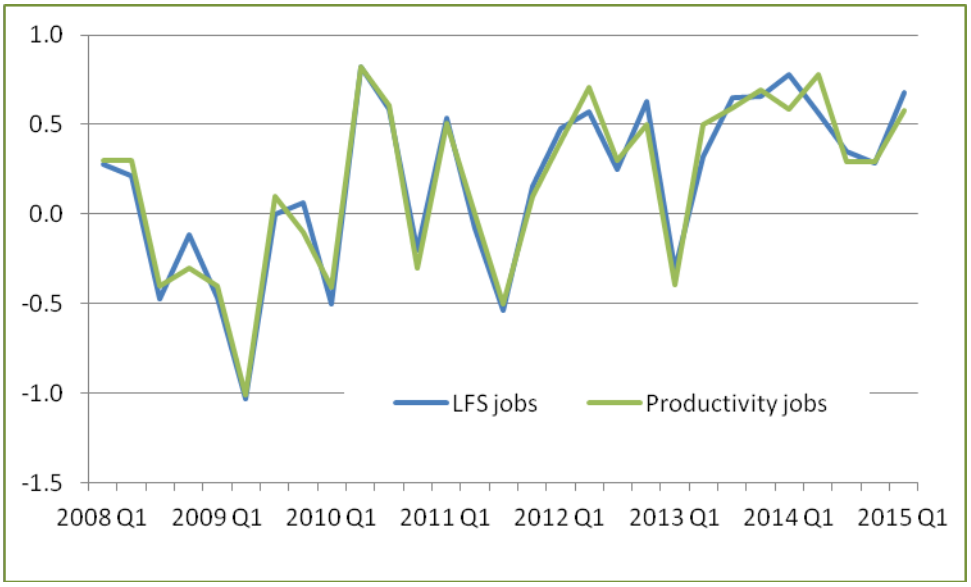
The disparity between the two measures is a result of three differences in the seasonal adjustment methods applied to each data set.

1. The LFS team use two sets of seasonal adjustment parameters, one for data prior to the extra 2010 leap week (mentioned above) and one for data post October 2010. The two seasonally adjusted series are then combined. Productivity hours use one set of seasonal adjustment parameters for the whole series.

2. These seasonal adjustment parameters include different regressors to account for periods where holiday effects are shifted into a different 3-month period to that of calendar quarters.
3. The LFS total hours worked series is seasonally adjusted at the aggregate level, whereas productivity hours are seasonally adjusted at the industry level then aggregated.

Discrepancies between LFS jobs and productivity jobs are not as large as those observed in hours data, as seen in Figure 2. Intuitively, this is because the seasonality of jobs is less affected by factors such as the timing of holiday periods and changes in the weather.

FIGURE 2: Total jobs, LFS and Productivity Jobs
Seasonally adjusted, quarter on quarter percentage changes



Despite both measures exhibiting similar quarterly changes, there are periods where they differ slightly. Additionally, there are periods where the two measures move in different directions, such as in Q4 2009 where LFS jobs grew by 0.1% while productivity jobs fell by 0.1%.

Latest developments

In response to feedback from users we have looked again at the seasonal adjustment parameters for industry level hours worked. As a result of this exercise we are proposing to make two changes in future Labour Productivity releases, with effect from the next release on 1 October 2015:

(i) To introduce further methodological improvements to seasonal adjustment parameters in order to take full account of the phase shift between the LFS schedule and calendar quarters. The effect is to reduce the volatility of hours series and, in aggregate terms, to move productivity hours

closer to YBUS. However, our analysis shows that there would still be occasions when the short-term profile of the two aggregate series diverged.

(ii) Additionally, we propose to benchmark our aggregate seasonally adjusted hours series to YBUS, in order to present a single aggregate time series for total hours across ONS. The effect of this is to re-introduce a little more volatility in some component level series than would be the case from (i) alone, although the resulting series are in general less volatile than either those in the Q1 release or earlier estimates.

The effects of these changes to output per hour figures for the whole economy and for industry level data series can be seen in the Excel tables that accompany this information note. The tables show that the proposed seasonal adjustment parameters generally have a positive effect on output per hour for the whole economy, though that effect tends be get weaker over time.

The effect on the industry-level data is greater in the manufacturing sector than in services. The volatility of some manufacturing industries, some of which exhibit large differences quarter-on-quarter changes between the seasonal adjustment parameters used in the Q1 release and those being proposed, could be due to the relatively small size of those industries.

The effect on service industries is also notable when comparing the differences between quarter-on-quarter changes, although the differences between quarterly and annual data are negligible.

As noted above, there are sometimes slight differences between LFS jobs and productivity jobs. Users have not raised any issues with these differences, but since we are proposing to benchmark productivity hours data to YBUS, we are open to considering whether we should benchmark seasonally adjusted productivity jobs to LFS jobs in order to maintain consistency.

We would welcome user feedback on this matter and comments can be emailed to productivity@ons.gsi.gov.uk or please call Stuart Newman on 01633 651824.

Future developments

Separation of ‘calendar’ effects from seasonality in LFS estimates of hours worked removes an obstacle to the development of ‘end of pipe’ seasonal adjustment of labour productivity estimates, as proposed in this article published in August 2013. We will update users on this development in due course.

2. Productivity decompositions

Background

Recent editions of the ONS Labour Productivity quarterly release have contained simple de-compositions of movements in labour productivity which are additive (that is, the components add to the movement in the aggregate measure) and which are operationally straightforward to compile. This framework does not, however, lend itself to identification of 're-allocation', that is, the effect of movement of resources (that is, shares of overall hours worked) from one industry to another. Re-allocation is of interest to users because *levels* of labour productivity vary considerably between industries (reflecting different levels of capital intensity among other factors). For example, a shift of labour and capital resources from a low productivity industry (such as hotels and catering) to a high productivity industry (such as oil and gas extraction) would be expected to raise aggregate productivity, other things equal. Economic theory suggests that re-allocation is an important mechanism through which productivity growth occurs over time.

An alternative de-composition of labour productivity was used in the April 2014 edition of the ONS Economic Review. This identified an allocation effect, but using this method the industry-components do not add up to the aggregative level of productivity, and the size of the allocation effect depends on the weighting system used, for example, whether industries are weighted by labour shares or shares in nominal GVA.

Generalised Exactly Additive Decompostion (GEAD)

This Information Note introduces a revised decomposition of labour productivity using the GEAD approach (Tang and Wang, 2004). As the name suggests, GEAD generates an exactly additive decomposition which is unambiguous in terms of total contributions of each component, although, as shown by Reinsdorf (2015), for an individual component industry the split between the within industry component of productivity growth (hereafter called the 'pure' productivity movement) and the re-allocation component depends on the exact specification of the GEAD model. Here we use the simplest form of the GEAD specification, in which the pure productivity component of industry *i* is simply the growth of productivity in *i* weighted by its share in nominal GVA in the base period. In this specification the allocation component is comprised mainly of a relative size change effect, where changes in relative size can reflect changes in shares of labour input or changes in relative output prices, or both.

Points to note

(i) GEAD total contributions are similar, but not exactly equal to those calculated using the methodology in previous Labour Productivity releases. For example, in terms of contributions to annual changes in whole economy output per hour, both methodologies show the largest

contributions from non-financial services. However, the GEAD framework shows that the contributions of manufacturing have generally been negative whereas the previous methodology shows generally positive contributions from manufacturing.

(ii) Decompositions between pure productivity movements and allocation components depend on the boundary under review (for example, whole economy versus a specific industry) and the granularity of the components. This is because the pure and re-allocation components are not separately additive (although the combined contributions are additive) and because for any given aggregate, the re-allocation component is zero by definition.

So for example, whole economy output per hour can be affected by re-allocation of resources between, say, manufacturing and other industries, and manufacturing output per hour can similarly be affected by re-allocation between, say, textiles and pharmaceuticals. But a decomposition of whole economy output per hour growth into manufacturing and other components will include only the former within its re-allocation component, since the effect of re-allocation between sub-components of manufacturing will already be reflected in the growth of manufacturing output per hour.

(iii) For any given aggregate, net re-allocation components are generally small, although this can disguise larger positive and negative re-allocation effects for individual components. Re-allocation is computed as the change in relative size of the industry weighted by its relative productivity in the base period. It follows that re-allocation effects will be larger when there is more variance in relative productivity between components. Thus re-allocation tends to be larger within services than within manufacturing, partly because there are more components in the breakdown (7 in services compared with 4 in manufacturing in the breakdowns used in the Labour Productivity release, although more detailed de-compositions can be calculated) and partly due to the impact of imputed rent[2].

Results

Data in this section are based on labour productivity estimates as published on 1 July 2015, prior to revisions to seasonal adjustment parameters detailed above and prior to revisions to national accounts due to be published at the end of September 2015.

[2] Imputed rent relates to the value property owners derive from owner-occupation, and is included in the National Accounts to improve consistency between countries with different levels of owner-occupation. Since there is no equivalent labour input, imputed rent has the effect of increasing the level of labour productivity in the real estate industry.

Table 1: Whole Economy
Decompositions of Labour Productivity Growth, 1997-2014
(annual averages)

Industries	Labour Productivity Growth	Contributions		
		Total	Pure	Re-allocation
ABDE*	-1.89%	-0.02%	-0.09%	0.07%
Manufacturing	2.91%	-0.35%	0.40%	-0.75%
Construction	0.52%	0.14%	0.03%	0.11%
Financial Services	2.24%	0.19%	0.13%	0.06%
Other Services	1.32%	1.34%	0.89%	0.45%
TOTAL	1.31%	1.31%	1.36%	-0.05%

Source: ONS

* ABDE is Agriculture, Extractive Industries and Utilities

Table 1 shows a high-level decomposition of annual labour productivity growth over the period 1997 to 2014, expressed in terms of annual averages. The first column simply shows the growth of labour productivity, while the remaining columns show contributions in percentage points. Labour productivity growth is not additive, but the contributions are additive, both vertically and horizontally. On this basis, average productivity growth was 1.3% per annum, the whole of which was accounted for by non-financial services. Although labour productivity grew fastest in manufacturing, the total contribution (pure plus re-allocation) of this sector was actually negative because the negative re-allocation component (as the relative size of manufacturing has shrunk over this period) outweighed the effect of pure productivity growth. The average effect of re-allocation over this period was to reduce productivity growth by 0.05% per annum. This largely reflects the difference between a negative re-allocation effect in manufacturing and an offsetting positive re-allocation effect in non-financial services. The net effect is small because the level of productivity is broadly similar in manufacturing and non-financial services.

Breakdowns of productivity contributions from manufacturing and services are available in an Excel table published alongside this Information Note.

Productivity de-compositions since the financial crisis

The GEAD framework is designed for annual decompositions, reflecting annual re-basing of the national accounts, but can be adapted to decompose quarterly movements in productivity with negligible loss of additivity.

FIGURE 3: Cumulative contributions to quarter on quarter growth of whole economy output per hour

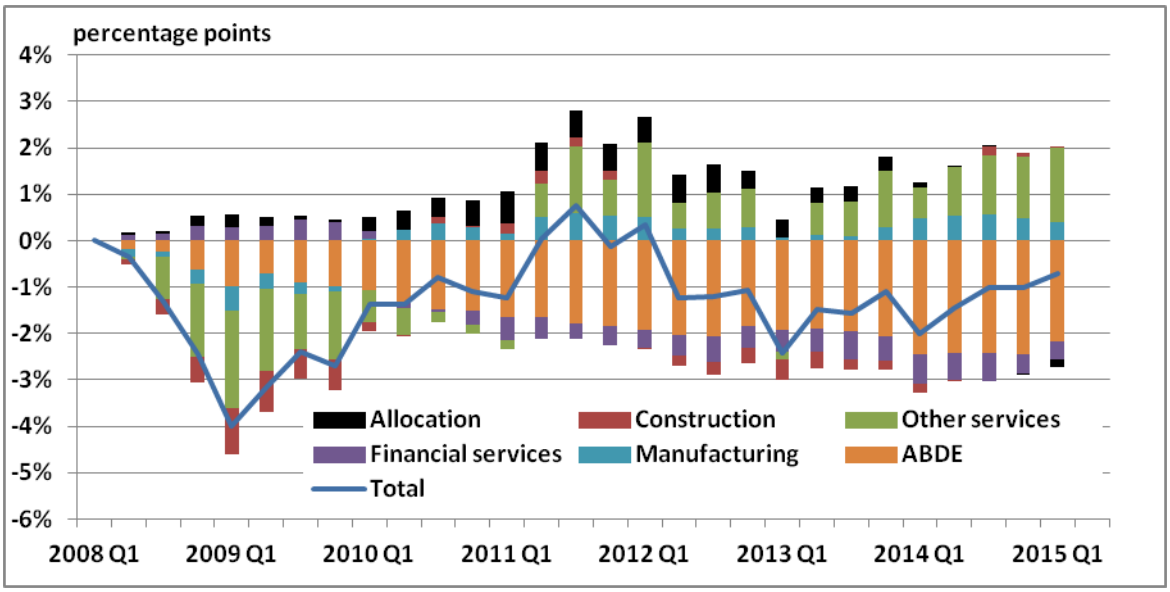


Figure 3 shows the pure contribution of each component industry to the evolution of output per hour since Q1 2008, together with the net allocation component. Individual components over the period Q1 2008 to Q1 2015 are shown in Table 2 below. One interesting feature is that the net allocation component made a notable positive contribution to productivity growth up to 2012, before tailing off (and hence pulling down overall productivity) and indeed turning negative in the most recent quarter.

Table 2: Whole Economy
Decompositions of Labour Productivity Growth, Q1 2008 - Q1 2015
(cumulative quarterly growth and contributions)

		Contributions		
Industries	Labour Productivity Growth	Total	Pure	Re-allocation
ABDE*	-41.01%	-0.98%	-2.18%	1.20%
Manufacturing	4.08%	-1.53%	0.39%	-1.92%
Construction	1.91%	-0.32%	0.01%	-0.33%
Financial Services	-4.01%	0.57%	-0.38%	0.95%
Other Services	2.28%	1.56%	1.61%	-0.04%
TOTAL	-0.70%	-0.70%	-0.55%	-0.15%

Source: ONS

* ABDE is Agriculture, Extractive Industries and Utilities

Another observation is that, while the pure contribution of ABDE has been to reduce overall productivity by more than 2 percentage points (reflecting the precipitous fall in productivity shown in the first column of Table 2), this has been partially offset by a positive re-allocation component for this industry of 1.2 percentage points. This reflects a combination of an increase in the relative size of this industry and high relative productivity.

References

Reinsdorf M (2015) 'Measuring Industry Contributions to Labour Productivity Change: A New Formula in a Chained Fisher Index Framework', International Productivity Monitor, Number 28, Spring 2015

Tang J and Wang W (2004) 'Sources of aggregate labour productivity growth in Canada and the United States', Canadian Journal of Economics, Volume 37, Number 2

For further information please contact productivity@ons.gsi.gov.uk or call Stuart Newman on 01633 651824.