

Article

Multi-factor productivity estimates: Experimental estimates to 2013

Estimates of growth for the whole economy, the market sector and 10 industry groups.

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1. Abstract

This article presents multi-factor productivity (MFP) estimates to 2013. MFP estimates use experimental measures of quality adjusted labour inputs and capital services and a growth accounting framework to decompose output growth into the relative contributions of growth of labour and capital inputs and a residual component variously described as disembodied technical change, the 'Solow residual', total factor productivity (TFP) or, in this article, MFP. This approach complements traditional measures of productivity, which focus only on one input – labour – and take account only of the volume of hours and not changes in the composition of labour over time. Capital input to production is measured by capital services which similarly take account of changes in the composition of the productive stock of capital over time. New estimates of capital services to 2013 are presented in an accompanying article (Murphy and Franklin, 2015). These estimates of MFP show that in 2013, MFP made a negative contribution to growth. This was the fourth negative contribution of MFP - albeit the smallest - since 2008, while new historical estimates presented in this article show that MFP growth was positive in every year between 1991 and 2007. There are revisions to growth accounting estimates over the whole period since the previous MFP article in January 2014. These revisions principally reflect the impact of National Accounts revisions (methodological and data-driven) which affect growth rates of economic output and - particularly - estimates of capital services.

2. Acknowledgements

The authors would like to thank Joe Murphy of ONS for research support in preparing this article.

3. Introduction

About this release

This is the latest in a series of MFP releases, containing estimates of MFP growth for 1970 to 2013 consistent with [Blue Book 2014](#). The previous edition was published in January 2014 (Field and Franklin, 2014). Estimates are presented for the whole economy, the market sector and ten industry groups. MFP measures the change in real (inflation adjusted) economic output that cannot be accounted for by changes in measured inputs of labour and capital. Importantly, the measurement of labour and capital attempts to adjust for compositional changes as well as pure volume movements. This is most apparent in the case of labour inputs, where the MFP framework distinguishes between changes in hours worked and a “labour composition” component. For more information on measurement of labour inputs, see Franklin and Murphy (2014).

Within an MFP growth accounting framework, movements in capital inputs are captured by capital services. Conceptually this is analogous to the treatment of labour input insofar as weights are given to different forms of capital to reflect their estimated contribution to the production process, although unlike labour there is no equivalent of a pure volume measure of capital. The weights used in this capital services framework differ from those used in measuring the value of the stock of capital in the ONS National Accounts. Intuitively this is because the monetary value of an asset can differ from its contribution to the production process. For more information on the derivation of the capital services estimates used in this release, see Murphy and Franklin (2015).

Layout of article

The following section describes what's new in this edition. There have been extensive revisions to source data, and major revisions to estimates of capital services which are covered in depth in Murphy and Franklin (2015). An innovation of this edition is the inclusion of long time series of MFP decompositions for the whole economy and for manufacturing. Next is a short section on interpreting MFP statistics. A key point to note is that output is here measured net of intermediate consumption. At the present time ONS is not able to provide the conceptually preferable breakdown of gross output (including intermediates as one of the inputs to production) because ONS systems do not currently support real measures of gross output and intermediate consumption.

The following results section includes time series decompositions of output growth and labour productivity growth for the whole economy, including the long time series noted above. MFP decompositions for individual industries are (a) volatile from year to year and (b) conceptually inferior to decompositions based on real gross output. For these reasons, the article provides only period average decompositions, to highlight differences across industries.

The article concludes with short sections on revisions to MFP since the previous estimates published in Field & Franklin (2014), and on next steps, setting out priorities for future development and inviting feedback from users.

Further information on data sources and methodology is provided in Appendix 1.

4. What's new?

Blue Book 2014 (BB14) introduced sweeping changes to the UK National Accounts reflecting the adoption of the European System of Accounts 2010 (ESA 2010) as well as a raft of other changes. Prominent among the changes is the identification of new forms of capital assets, including R&D and weapons systems. This has obvious implications for the estimation of capital services. In addition, since the last MFP article ONS has resumed publication of the '[Capital Stocks and Consumption of Fixed Capital](#)' release, which makes use of some of the same data sources as capital services. Incorporation of these common data sources (principally time series of industry shares of asset accumulation by asset) has led to significant revisions to estimates of capital services compared with the modelled distribution of asset accumulation used in the previous indicative estimates of MFP, quite apart from the impact of new asset categories in BB14. The impact of these changes on capital services is described further in the accompanying article (Murphy and Franklin, 2015).

Capitalisation also affects economic output, since it reclassifies expenditure from intermediate consumption (hence netted out of gross value added) to final expenditure. However, the impact of such changes is normally more significant in terms of the level of output rather than year-on-year growth rates, which is what matters for MFP. That said, GVA growth was significantly revised in BB14, primarily reflecting other changes including non-ESA 2010 related changes to GFCF and to inventories. Further information is available in a series of [articles](#) published on the ONS website.

As far as labour inputs are concerned, the estimates in this article are substantively identical to those published in July 2014 (Franklin and Murphy, 2014). The only differences are that hours estimates used in this release are benchmarked in line with latest estimates of hours worked by broad industry, taking account of revised Labour Force Survey weights to reflect the results of the 2011 Census. For further information, see ONS (2014). Revisions to weights can also be expected to have some second-order impact on labour composition which will be picked up in the next release of Quality Adjusted Labour Inputs, scheduled for later in 2015. We have also incorporated updated labour income benchmarks (again, by broad industry) consistent with BB14.

These updates imply some small revisions to growth of hours worked and of labour composition. For more information, see the revisions section below.

This release includes long time series (back to 1970) of MFP breakdowns for the whole economy and (in the [Reference Table \(90 Kb Excel sheet\)](#)) manufacturing. Pre-1994 estimates should be considered to be of inferior reliability as the labour input components have been estimated using the [EU KLEMS](#) dataset, using a simple mapping between two different industry taxonomies.

5. Interpreting these statistics

Using a growth accounting framework, as first developed by Solow (1957), growth in output can be decomposed into contributions from growth in labour inputs (in terms of both its quantity and composition) and from growth in capital services. The residual output growth that cannot be accounted for by growth in labour and capital inputs is hence an estimate of multi-factor productivity (MFP). This term is sometimes referred to as the 'Solow residual' or total factor productivity (TFP).

Alternatively, the growth accounting framework can be expressed as a decomposition of labour productivity growth, by dividing all of the elements by the volume of labour input (actual hours worked in this case) into the contributions of weighted labour composition (the difference between the growth of quality adjusted and unadjusted labour inputs), capital deepening (defined as the weighted growth in capital inputs per hour worked) and MFP.

Conceptually the MFP residual can be thought of as capturing technological progress, including the effect of changes in management techniques and business processes or more efficient use of factor inputs. It is important to note that improvements in the quality of capital are examples of 'embodied technical change'. In principle, such quality changes are captured in the measurement of capital services and are not included in MFP. MFP is linked, therefore, not to an increase in the quantity or quality of measured factor inputs but rather to how they are employed.

In practice the MFP residual may also capture a number of other effects such as adjustment costs, economies of scale and measurement error in inputs and outputs. For example an improvement in the quality of the labour force not captured by the quality adjusted labour inputs or returns from expenditures that are not currently treated as capital formation within the national accounts framework, such as workplace based training, design and branding, will be incorporated into the MFP residual.

The formal growth accounting methodology was set out in Appendix 2 of the 2012 MFP article (Appleton and Franklin, 2012) and is not repeated here. More information on data sources is set out in Appendix 1 of this release.

Note that due to the volatility of year on year MFP growth, some of the results are presented as averages over the periods. The results by year are presented in the [Reference Table \(90 Kb Excel sheet\)](#) component of this release.

6. Results

Whole economy

This section presents growth accounting results over the period 2000 to 2013 for the whole economy.

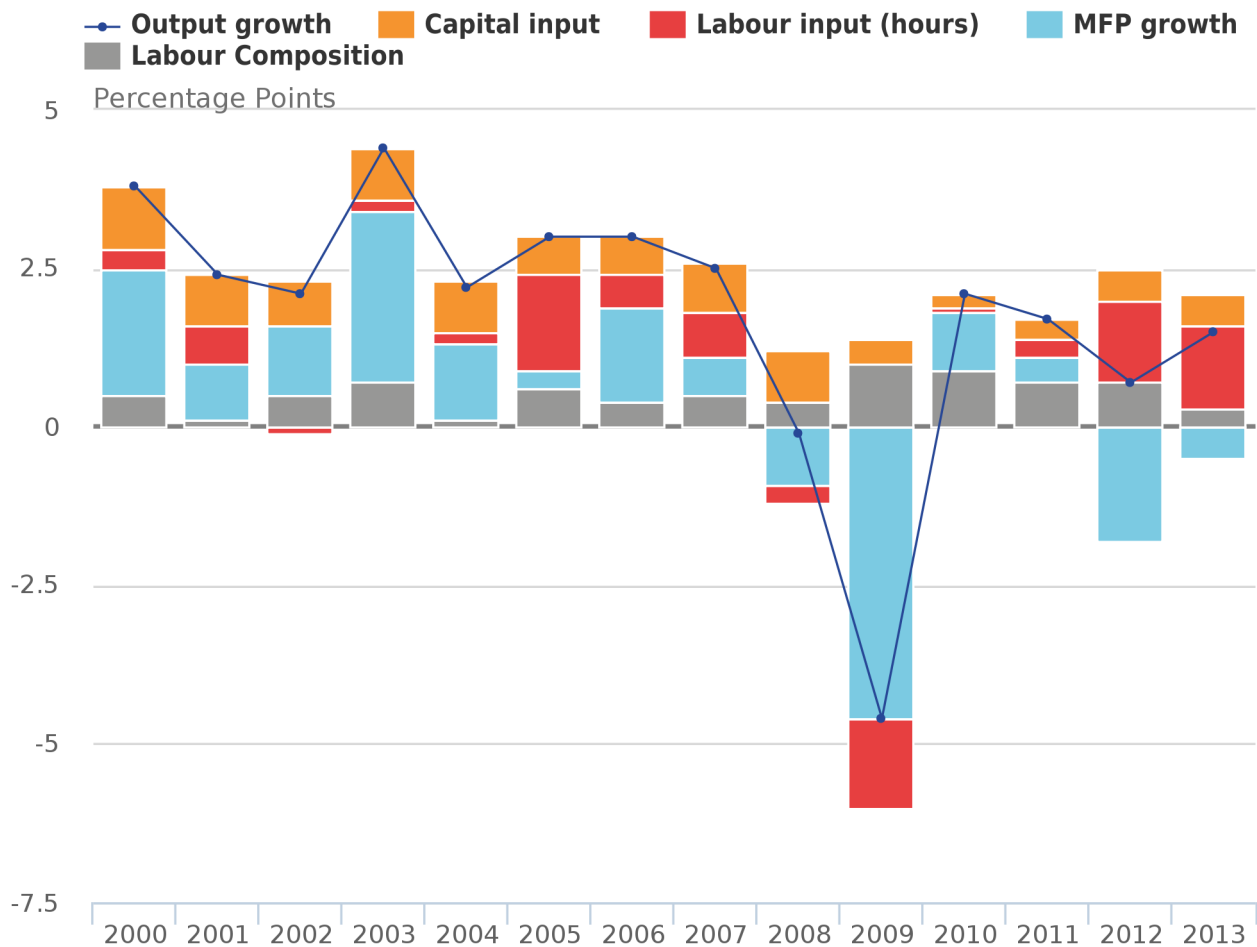
Figure 1 decomposes annual output growth from 2000 to 2013 into contributions from capital and labour input growth (the latter separated into contributions from hours and labour composition) and the residual MFP contribution. MFP made a small negative contribution to output growth in 2013 (-0.5 percentage points), this is less than the negative contribution made in 2012 (-1.8 percentage points). The main driver of increased output growth in 2013 was an increase in labour input, or hours (1.3 percentage points). Capital input and labour composition also made positive contributions in 2013 (0.5 and 0.3 percentage points respectively).

Labour composition has made positive contributions to output growth in every year since 2000, but notably since 2008. As noted in Franklin and Murphy (2014), the positive contributions since 2008 have exacerbated the 'productivity puzzle' as it implies labour input to production has been even stronger than implied by a non-weighted measure of hours worked. Alternatively, it also implies that the average productive potential of each hour worked has improved over this period, reflecting – on average- a shift towards labour market attributes that are associated with higher productivity such as educational attainment and experience.

Capital services are also estimated to have made small positive contributions to growth since 2008, which could be surprising given the weakness of investment over this time period. However, it should be recalled that capital services flow from productive capital stocks which, for some long-lived assets such as buildings and structures, depend on investments over many prior years.

Figure 1: Decomposition of annual output growth, 2000-2013

Whole economy

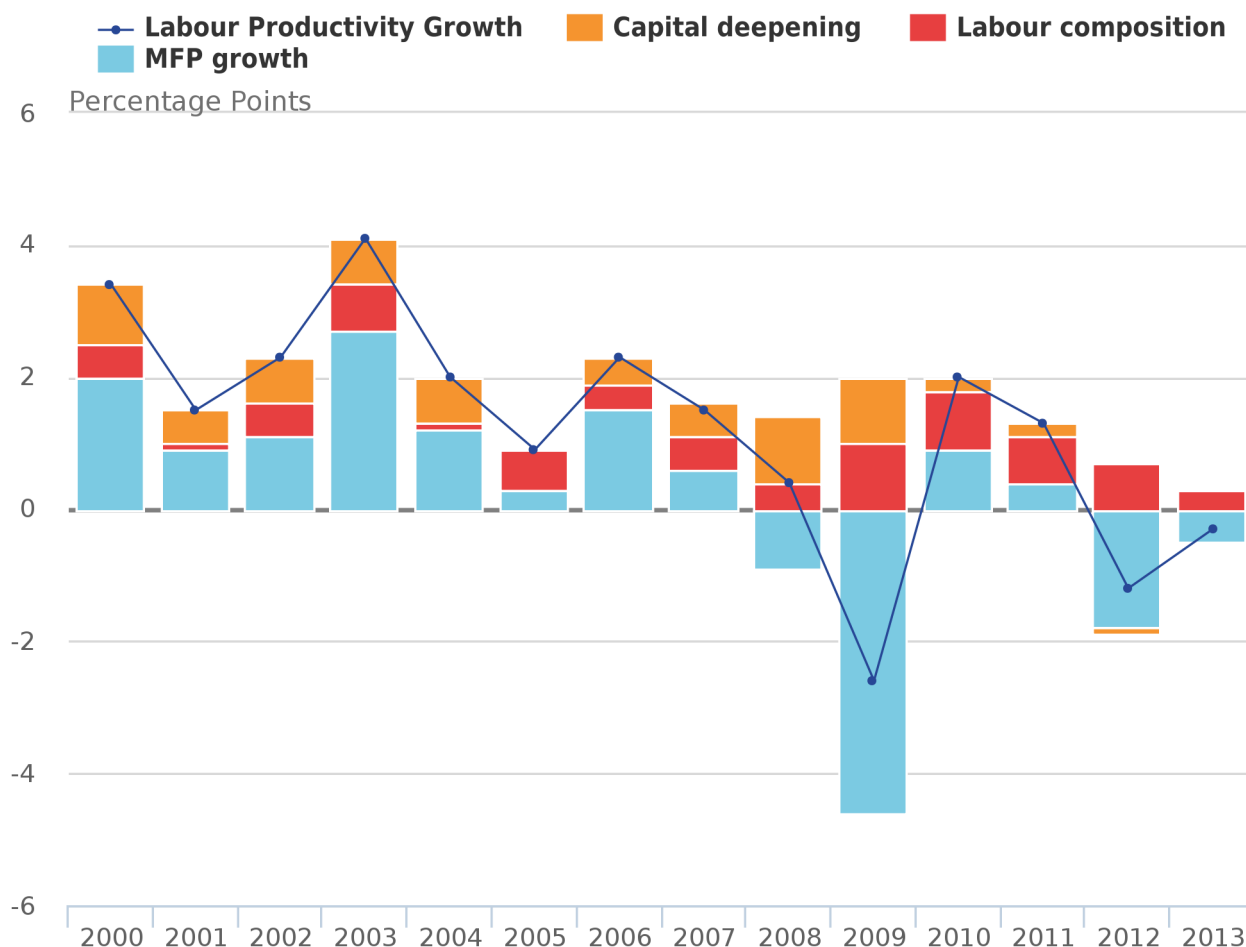


Source: Office for National Statistics

The growth accounting framework can be re-arranged to provide a breakdown of movements in labour productivity measured by output per hour, as shown in Figure 2. In this presentation the capital contribution reflects changes in capital services per hour worked (known as capital deepening). The difference between capital input (Figure 1) and capital deepening (Figure 2) can be seen in 2012 and 2013, where aggregate capital input increased slightly but the volume of capital services per hour worked did not change, reflecting the increase in hours worked. The reverse is seen in 2009, when a fall in hours was reflected in a larger contribution in capital deepening than overall capital services. Labour composition and MFP are identical in Figures 1 and 2.

Figure 2: Decomposition of labour productivity growth, 2000-2013

Whole economy



Source: Office for National Statistics

Historical perspective

Figure 3 looks at the long run trend in the decomposition of labour productivity for the whole economy, carrying the series in Figure 2 back to 1971. There is clear evidence of economic downturns coinciding with periods of negative MFP, in the mid-1970s, the early 1980s and early 1990s as well as 2008-09 and 2012.

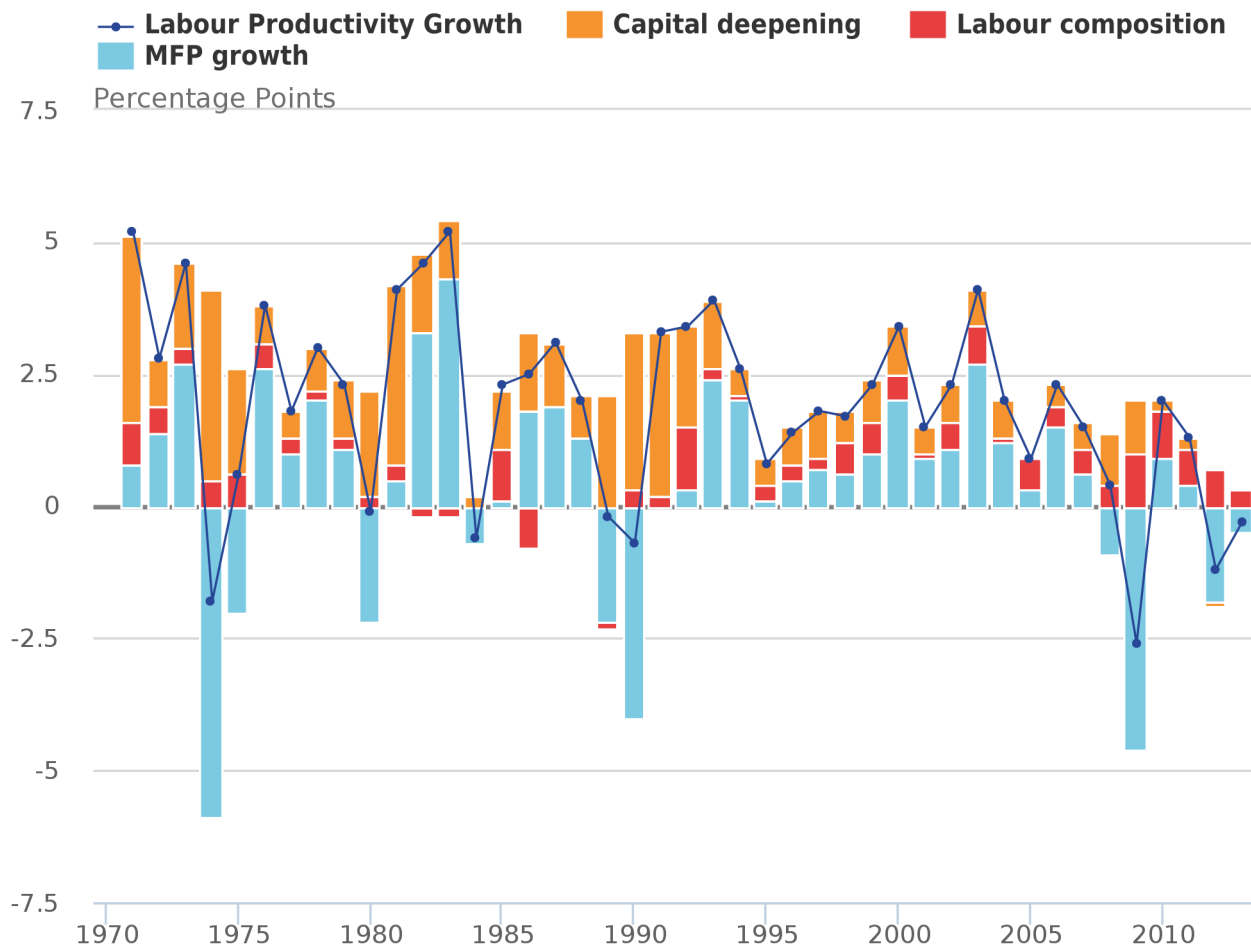
Perhaps as striking is the evidence of a trend decline in capital deepening. Between 1971 and 1997, capital deepening contributed, on average, 1.5 percentage points (pps) a year to labour productivity growth. Since 1997, this has fallen to 0.5 pps per year on average, and since 2010 the average contribution of capital deepening has been close to zero.

Long-term movements in labour composition have been in the opposite direction and have acted to partly offset the declining contribution of capital deepening on growth of labour productivity. At the whole economy level, the average contribution of labour composition has increased from around 0.2 pps per year prior to 1997 to around 0.5 pps per year since 1997.

On average, MFP growth has been lower since 1997 (+0.3 pps per year) than prior to 1997 (+0.5 pps per year). This means that the combined average contributions of MFP and labour composition are little changed pre- and post-1997, such that essentially all of the reduction in growth of labour productivity between these periods can be accounted for by the decline in the rate of capital deepening.

Figure 3: Decomposition of labour productivity growth, 1970-2013

Whole economy



Source: Office for National Statistics

Results by industry

This section decomposes labour productivity growth (GVA per head) by industry. Categories on the X-axis for figures 4, 5 and 6 refer to the industry groupings set out in Table 1. WE is the whole economy and MS is the market sector.

Table 1: Industry descriptions

Industry (1)	Industry Description
ABDE	Agriculture; Forestry & fishing; Mining & quarrying; Utilities
C	Manufacturing
F	Construction
GI	Wholesale & retail trade; Accommodation & food services
H	Transportation & Storage
J	Information & communication
K	Financial & insurance activities
LMN	Real estate activities; Professional & scientific activities; Administrative & support activities

OPQ Public administration & defence; Education; Health & social work

RSTU Arts & entertainment; Other services

Source: Office for National Statistics

Notes:

1. Standard Industrial Classification (2007)

Figure 4 presents the decomposition of labour productivity growth by industry, expressed as annual averages over the period 1998 to 2013. It can be seen from the chart that average MFP contributions over the last 16 years have varied substantially. Industry J (information & communication) has seen by far the largest positive contribution of MFP (3.8 percentage points), whilst industries ABDE (agriculture; forestry & fishing; mining & quarrying; utilities) has seen the largest negative contribution (-2.5 percentage points).

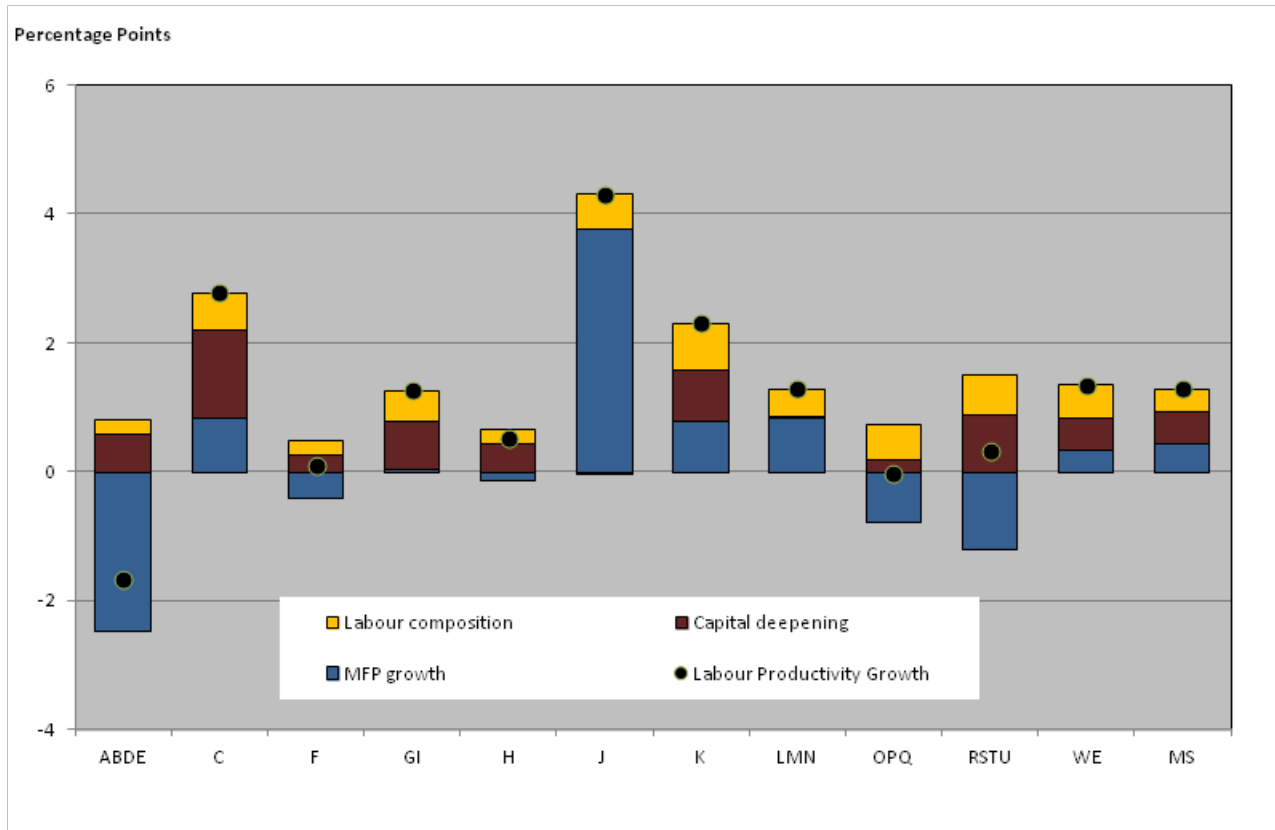
By contrast, capital deepening made positive contributions in all but one of the industries, industry J. Capital deepening is estimated to have made the largest contribution in industry C (manufacturing) and industries RSTU (arts & entertainment and other services). The smallest contributions from capital deepening, other than in industry J, were in LMN (real estate activities; professional & scientific activities; administrative & support activities) and OPQ (public services).

Labour composition generally varies less by industry, but is less pronounced in industries ABDE, F (construction) and H (transportation & Storage), and more pronounced in industries C, K (financial & insurance activities) and RSTU.

Variations in MFP account for much of the variation in labour productivity growth across industries. MFP contributions for the market sector (0.4 percentage points) were slightly higher than for the whole economy (0.3 percentage points). The varying contributions of MFP across industries may reflect differences in the diffusion of disembodied technological change, or perhaps measurement error. Measurement error can vary by industry as, for example, it is generally more difficult to differentiate between volume and price movements in service industries than in production industries. Moreover, as noted above, decomposition of productivity movements below the whole economy level should ideally take account of contributions of (real) intermediate inputs.

Figure 4: Decomposition of annual average labour productivity growth, 1998-2013

By industry



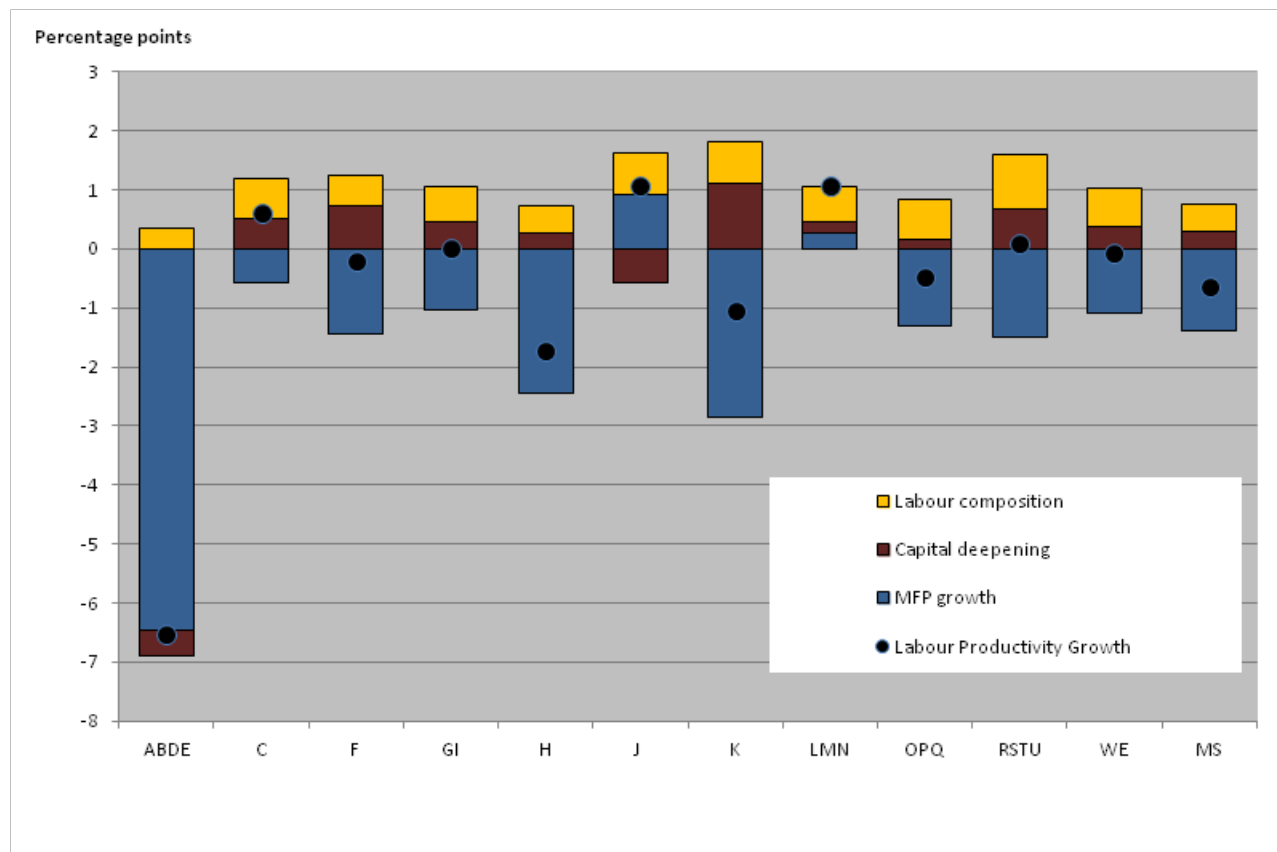
Source: Office for National Statistics

Focusing on the period since the economic downturn, the pro cyclical nature of MFP is highlighted when looking at the decomposition of average annual labour productivity since 2008 (figure 5). MFP is estimated to have made a negative contributions to growth in output per hour in eight of the ten industries, while all bar two industries have experienced positive contributions from capital deepening and productivity in all industries has benefited from improvements in labour composition. Two industries, J and LMN, saw positive MFP contributions in this period although much less than seen in Figure 4.

Over this period, MFP contributions for the market sector (-1.4 percentage points) were more negative than across the whole economy (-1.1 percentage points), accounting for about half of the difference in growth of labour productivity.

Figure 5: Decomposition of annual average labour productivity growth, 2008-2013

By industry

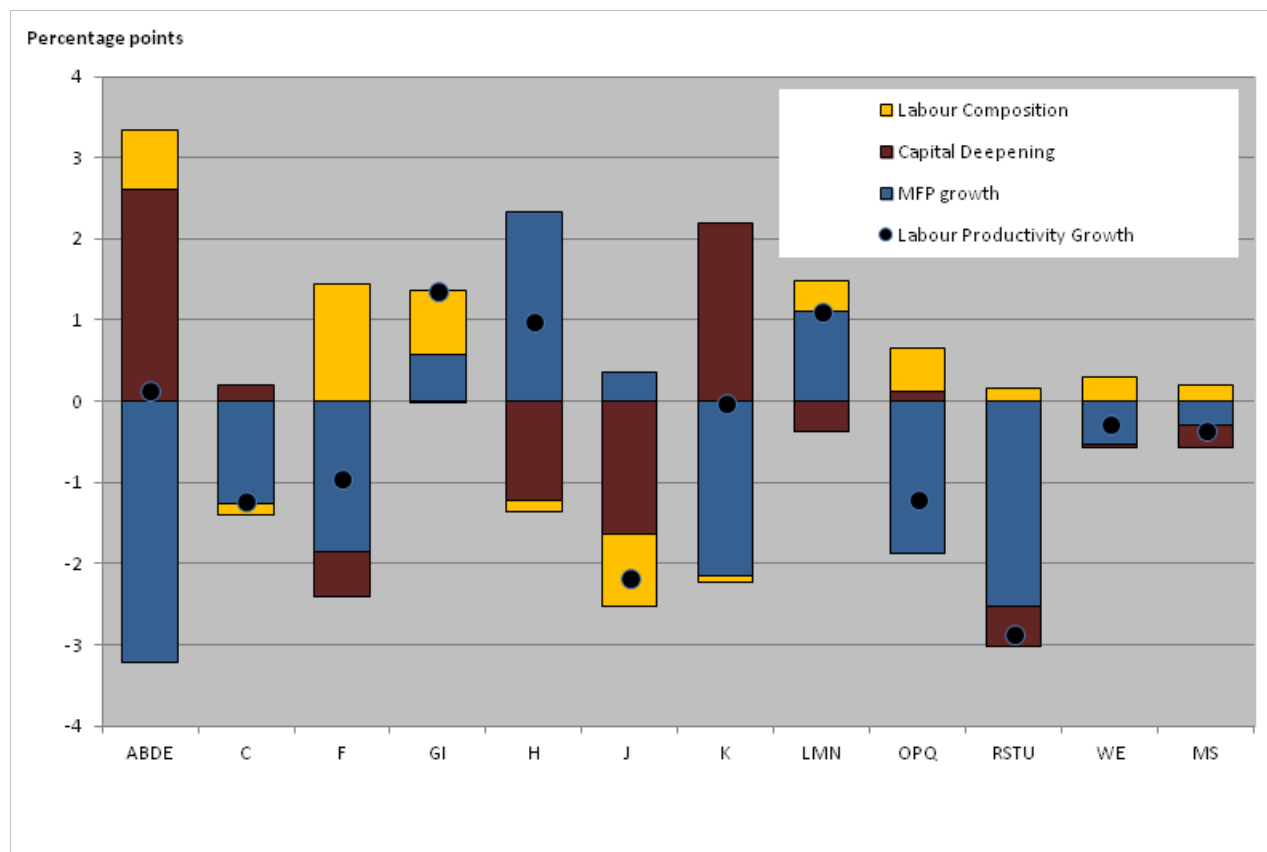


Source: Office for National Statistics

A decomposition of labour productivity in 2013 (Figure 6) shows how much MFP, labour composition and capital deepening can differ across industries in a single year. Yearly estimates of MFP are quite volatile and figure 6 should mainly be used as a tool to highlight further the divergences in productivity across industries.

Figure 6: Decomposition of labour productivity growth, 2013

By industry



Source: Office for National Statistics

7. Revisions

Revisions to MFP estimates since Field and Franklin (2014) arise from revisions to the component series, capital services and quality-adjusted labour input, and can be categorised into three broad groups:

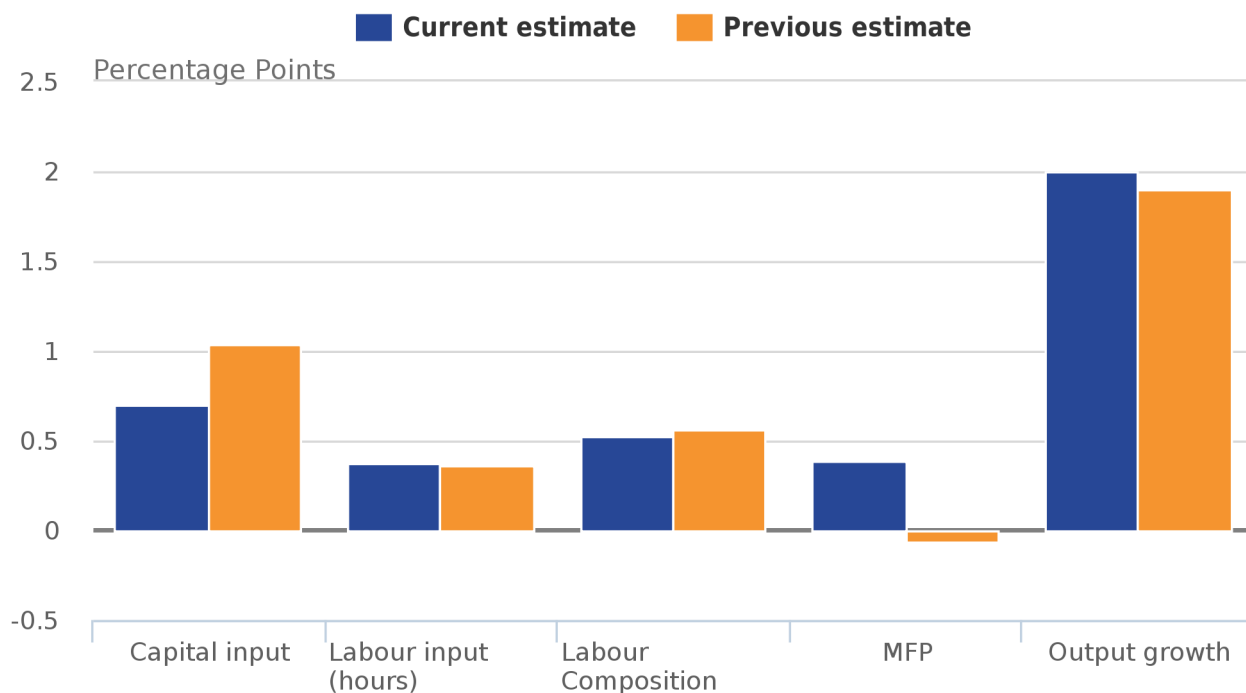
- Revisions to output growth rates arising from changes to the UK National Accounts introduced in Blue Book 2014
- Revisions to capital services source data, including revisions to asset categories (and new asset categories), to deflators, and to detailed estimates of asset accumulation by industry
- Labour Force Survey (LFS) reweighting for Census 2011

To give an indication of the drivers of revisions to output growth, Figure 7 plots the average contributions at the whole economy level for the most recent and previous estimates. The data cover the period 1998 to 2012, over which comparable data are available.

Average output growth has been revised up slightly over this period, while the contribution of capital has been revised down significantly. Since revisions to labour hours and composition are trivial, it follows that this has led to upward revisions to average MFP growth.

Figure 7: Contributions to whole economy annual average output growth, 1998-2012

Current and previous estimates



Source: Office for National Statistics

Revisions to capital inputs are discussed further in an accompanying article (Murphy and Franklin, 2015). In summary, incorporation of new estimates of capital formation across industries and assets has led to large downward revisions to growth of capital services for the whole economy and for most industries. These revisions are not primarily due to the inclusion of new asset classes (including R&D and weapons systems), which mainly affect levels of asset accumulation rather than growth rates. A priori, one would expect the identification of new assets in Blue Book 2014 to reduce the MFP residual, by widening the capture of capital inputs into production. However, as discussed further in Murphy and Franklin (2015), inclusion of R&D and other new assets makes almost no difference to the growth of capital inputs or to capital services. In other words, it is other revisions to GFCF (and to GVA) which account for the increase in the MFP component.

Since capital services depend on gross fixed capital formation (GFCF), and GFCF is a major component of final expenditure, it might be expected that the pattern of revisions to output growth would mirror the pattern of revisions to capital services. But in fact this is not the case: capital services growth has been revised down, while output growth has been revised up, albeit only marginally. The resolution of this apparent paradox is that revisions to growth of capital services since 1997 reflect revisions to historic GFCF series as well as revisions to flows of GFCF in the post-1997 period.

8. Next steps

This section describes forthcoming development work on the ONS growth accounting measures. ONS welcomes feedback on all aspects of the statistics produced. For information on how you can communicate this to us see the Background Notes of this release.

Updating Labour force Survey (LFS) micro-data for use in Quality Adjusted Labour Input (QALI)

As mentioned in the Revisions section of this publication, the LFS has been reweighted for Census 2011 resulting in LFS data revisions back to the third quarter of 2001. The extent of the revisions have meant it has not been

possible to update QALI estimates with reweighted data in time for this publication, so previous published QALI estimates have simply been constrained at the industry level to the latest LFS aggregate estimates. The next step for labour input is to update the micro-data with LFS Census reweighted revisions. The results of this exercise will be included in the next QALI publication later in 2015.

Historical MFP growth by industry

This release provides new historical estimates of MFP growth for the whole economy back to 1970. Historical MFP growth estimates for manufacturing are available in the [Reference Table \(90 Kb Excel sheet\)](#) component of this release, as well as historical estimates for both capital services and adjusted and unadjusted labour input measures by industry. Other than manufacturing, industry estimates of MFP before 1991 are not provided in this release. This is because GVA estimates prior to 1990 are only available for the whole economy and manufacturing. The next steps in producing a full historical MFP dataset are, firstly, to develop consistent measures of GVA by industry prior to 1990, and secondly, to review the mapping of labour input estimates from the KLEMS dataset to the SIC07 industry taxonomy.

Quarterly growth accounting estimates

Another objective is to shorten the time lag between publication of the UK national accounts and publication of growth accounting estimates, with the medium term aim of moving towards a quarterly framework for growth accounting. Considerable progress has already been made in developing a quarterly process for quality adjusted labour inputs. One application of this work is the development of consistent measures of unit labour costs below the whole economy level, see ONS (2012).

Measurement of capital services on a quarterly basis is conceptually feasible but is some way off in practical terms. For example, detailed GFCF estimates by asset and industry are not currently available on a quarterly frequency.

One issue for consideration is the value of more frequent publication of quality adjusted labour inputs to users, other than as component of a wider growth accounting framework. ONS welcomes comments from users on this issue. In particular, we welcome feedback from users on the trade-offs between development of more timely indicators of MFP versus development of more robust estimates, focusing for example on improvements to source data and to methodology.

9. Background notes

1. ONS is keen to develop a greater understanding of the use of productivity statistics. If you have any feedback please get in touch via productivity@ons.gsi.gov.uk
2. This release will be discussed at a productivity statistics user group workshop in London on 4th February 2015. For more information email us at productivity@ons.gsi.gov.uk
3. ONS publishes a quarterly [Labour Productivity statistical bulletin](#). This provides more timely and periodic information regarding UK labour productivity, and uses a more disaggregated industry breakdown than this MFP release.

ONS publishes [international comparisons of labour productivity](#) in levels and growth rates for the G7 countries.

More international data on productivity are available from the [OECD](#), [Eurostat](#), and the [Conference Board](#).

ONS also publishes a range of [public sector productivity measures](#) and related articles. These measures define productivity differently from that employed in the ONS Labour Productivity and MFP estimates. Further information can be found in [Phelps \(2010\)](#).

More information on the range of ONS productivity estimates can be found in the [ONS Productivity Handbook](#).

4. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk

10. References

1. Appleton J and Franklin M (2012) 'Multi-factor Productivity, Indicative Estimates to 2010', Office for National Statistics. Available at: <http://www.ons.gov.uk/ons/rel/icp/multi-factor-productivity--experimental-/index.html>
2. Field S and Franklin M (2013) 'Multi-factor Productivity (experimental), Indicative estimates to 2012', Office for National Statistics. Available at: <http://www.ons.gov.uk/ons/rel/icp/multi-factor-productivity--experimental-/indicative-estimates-to-2012/index.html>
3. Franklin M and Murphy J (2014) 'Quality Adjusted Labour Input (experimental), Estimates to 2012 and First Estimates to 2013', Office for National Statistics. Available at: <http://www.ons.gov.uk/ons/rel/icp/quality-adjusted-labour-input--experimental-/estimates-to-2012-and-first-estimates-to-2013/index.html>
4. Murphy J and Franklin M (2015) 'Capital Services, Estimates to 2013', Office for National Statistics. Available at: Volume Index of Capital Services (experimental)
5. OECD (2001) 'Measuring Productivity – OECD Manual', Organisation for Economic Co-operation and Development: Paris.
6. ONS (2012) 'Productivity Measures, Sectional Unit Labour Costs', 28 November 2012, Office for National Statistics. Available at: <http://www.ons.gov.uk/ons/rel/icp/productivity-measures/index.html>
7. ONS (2014) '2011 Census-based reweighting of Labour Force Survey estimates: indicative historical revisions, mid-2001 to end 2013', 23 September 2014, Office for National Statistics. Available at: <http://www.ons.gov.uk/ons/guide-method/method-quality/specific/labour-market/articles-and-reports/revisions-to-labour-force-survey-estimates.pdf>
8. Phelps M (2010) 'Comparing different estimates of productivity produced by the Office for National Statistics', Economic and Labour Market Review, vol. 4, no. 5, May 2010. Available at: <http://www.ons.gov.uk/ons/rel/elmr/economic-and-labour-market-review/no--5--may-2010/comparing-different-estimates-of-productivity-produced-by-the-office-for-national-statistics.pdf>
9. Solow R (1957) 'Technical Change and the Aggregate Production Function', Review of Economics and Statistics, vol. 39, no. 3, pp. 312-320.

11. Appendix 1 - MFP sources and methods

The growth accounting approach taken in this article is relatively undemanding in terms of data requirements. It uses gross value added (GVA) as an output measure and quality-adjusted labour input (QALI) and capital services as its factor inputs. In addition the income share of each factor of production, labour and capital, is required to determine its contribution to output growth.

Quality Adjusted Labour Input (QALI)

The use of QALI allows labour contribution to be attributed to both an increase in the volume of labour, in terms of actual hours worked, and an increase in the quality of labour, in terms of skill composition of the workforce. QALI is mainly derived from quarterly labour force survey (LFS) data, which captures information on the educational, age and gender composition of the workforce.

QALI makes the assumption that workers are paid their marginal product, the hours worked by each of these compositional categories are weighted by their share in total labour outcome. That is, labour input is broken down by industry, age, education and gender and each component is weighted by its income share. The QALI estimates used in this release have been benchmarked to labour income weights consistent with Blue Book 2014 (and specifically the Supply-Use tables of the Blue Book release).

For further information about QALI and the most recent analysis, see Franklin and Murphy (2014).

Capital services

Capital services are akin to QALI in capturing compositional changes in capital inputs more fully than alternative measures of capital input, such as changes in net capital stocks. Capital services differ from National Accounts capital stock measures as they weigh together the growth in the net stock of assets using rental prices rather than purchase prices. Rental prices better reflect the cost of owning an asset over a specific time period, which can differ greatly from the costs of ownership over the whole asset life. Further, using rental prices is conceptually more appropriate for use in growth accounting analysis since, under the assumption that factors receive their marginal products, rental prices better reflect the marginal productivity of a given capital asset.

For further information about capital services and the most recent analysis, see Murphy and Franklin (2015).

Output

Output measures used in MFP analysis are chained volume indices of GVA at basic prices, consistent with the latest [Quarterly National Accounts](#) (QNA) published by ONS in December 2014.

Labour and capital income shares are derived in a consistent fashion from the income presentation of the National Accounts and include a decomposition of the income of the self-employed, which is recorded in the national accounts as mixed income. Mixed income includes returns to both capital and labour. Capital income includes gross operating surplus (GOS) and an imputed element for the non-labour component of mixed income, but excludes that part of GOS attributable to ownership of dwellings, which are not deemed to be part of the productive capital stock.

An alternative approach to growth accounting is to use a gross output measure and calculate the contributions to growth not only from capital and labour inputs but from intermediate inputs as well. An example of this approach is the EUKLEMS project (see www.euklems.net) which additionally apportions output growth to the intermediate inputs of energy, materials and services. Whilst this approach is conceptually preferable, its data requirements are much more onerous. In particular, constant price supply use tables, which are not currently published by the ONS, represent a barrier to adoption of this approach.