Article

International comparisons of labour productivity by industry: 2014

Uses new production-side PPPs to present estimates of labour productivity for 29 European countries across 10 industries on a GVA per hour worked basis.

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1 . Acknowledgements

2 . Main points

- New, experimental production-side purchasing power parity (PPP) exchange rates have been published by Eurostat, which enable a more detailed analysis of the UK's "productivity gap" with other leading economies by industry.

- UK labour productivity was 15.4% below the average for the other G7 advanced economies on an output per worker basis in 2016, and 15.1% below on an output per hour worked basis.

- The UK's aggregate productivity gap to other leading European economies is replicated at the industry level in 2014 – although the size of the gap varies.

- While the UK's level of labour productivity by industry is weak relative to the other large European economies according to these estimates, it experienced relatively strong growth in labour productivity between 2014 and 2016.

3 . Introduction

The persistent weakness of UK labour productivity relative to other countries is one of the key features of the UK economy. This gap is the subject of the International comparisons of productivity release, which indicates that UK labour productivity was 15.4% below the average for the other G7 advanced economies on an output per worker basis in 2016, and 15.1% below on an output per hour worked basis. While the size of this gap has varied through time, it is remarkably persistent. In 1997, for instance, the UK's gap to the G7 was 14.5% and 11.7% on an output per worker and per hour basis respectively. More analysis of these headline results can be found in the main release.

The long-standing nature of this productivity gap has generated significant policy interest, but analysis to explain it depends on the availability of comparable data across countries and appropriate exchange rates. Policy-maker and researcher interest in productivity differentials is motivated by the potential for "catch-up", as the stronger (or weaker) productivity performance of one economy may suggest policy lessons for another. Typically, work carried out in this area uses data on gross domestic product (GDP) or gross value added (GVA) – the measurement of which is governed by international statistical regulation – adjusted using purchasing power parity (PPP) exchange rates, and a comparable measure of labour input to estimate labour productivity across countries at either the whole economy or industry level.

Among the principal challenges of this work is the use of PPP exchange rates. These are typically derived for the "expenditure side" of GDP, and consequently relate the power of a unit of one currency to purchase final demand in terms of another. While this is appropriate for analysis at the whole economy level, an alternative formulation – building PPPs from the "production side" – is recognised as being more appropriate for analysis of labour productivity at the industry level (Eurostat-OECD, 2012). Although work in this area is limited, new, experimental production-side PPPs for 2014 have recently been published by Eurostat in Olislager and Konijn (2016) [1].

This short article uses these new production-side PPPs to present annual estimates of labour productivity for 29 European countries on a nine-industry breakdown. These estimates are principally for 2014 as this is the year for which the new PPPs are calculated, but there is also some limited analysis of growth rates between 2014 and 2016 by industry and country. Comparability is achieved using estimates of gross value added (GVA) and labour inputs by industry from a common source (Eurostat) and by converting Euro-based GVA using price level indices (PLIs) from Olislager and Konijn (2016). The estimates presented here are experimental, and we welcome user feedback on their use and usefulness.

Notes for: Introduction

1. Olislager, L. and Konijn, P. 2016. '[Eurostat Review on National Accounts and Macroeconomic Indicators](#)'

4 . Methods and data

Work to compare the levels of labour productivity in different countries typically uses data on gross domestic product (GDP) or gross value added (GVA), a set of purchasing power parity (PPP) exchange rates and multi-country information about labour input. To ensure comparability, data are usually extracted from international sources – often from the Organisation for Economic Co-operation and Development (OECD) or Eurostat databases which contain these variables. The GDP or GVA estimates are converted to a single currency using the PPP exchange rate, and then divided through by a comparable labour measure – usually hours, jobs or workers. In the Office for National Statistics' (ONS') headline International comparisons of productivity release, these data are drawn from the OECD and this methodology is applied to estimate whole economy labour productivity in a range of countries.

Purchasing power parities

With notable exceptions (see EU KLEMS 2007, Timmer, Ympa and van Ark 2007, Mason, O'Leary, O'Mahoney and Robinson 2008, Inklaar and Timmer 2012), researchers typically use PPP exchange rates which are based on the "expenditure side". The methodology for the calculation of these PPPs is set out in Eurostat-OECD (2012). This involves comparing the prices of similar products in each bilateral pair of economies, before weighting these product-level PPPs by their respective shares of total expenditure. Further adjustments are made to ensure that these bilateral indices are internally consistent at the multi-lateral level. The resulting PPP exchange rates capture the amount of each currency which is required to purchase a common basket of goods and services, which in turn enables the conversion of the total expenditure of an economy in domestic currency units into a common international currency[1].

While these expenditure-based PPPs are suitable for cross-country comparisons, they are limited in their usefulness for productivity analysis. Expenditure-side PPPs enable the estimation of comparable whole-economy GDP or GVA in a common currency, and therefore allow researchers to calculate the relative levels of whole economy labour productivity. The price base of expenditure-side PPPs is purchaser prices which include imports, exclude exports, and include trade and transport margins and net taxes – that is they are appropriate for the conversion of GDP at market prices. However, industry-level GVA is calculated at basic prices. Therefore, traditional expenditure-side PPPs are not the appropriate exchange rates for the conversion of industry-level output: for this, production-side PPPs – which compare the relative prices of the output of different industries – are required. The expenditure-side PPP exchange rates strictly enable a comparison of the purchasing power of the value generated by the whole economy and have no industry dimension. By contrast production-side PPPs enable a comparison of the relative levels of output generated by an industry across countries in a common currency.

Production-side PPPs have historically proved considerably more difficult to construct, partly owing to data availability. Olislager and Konijn (2016) describe the method by which they have calculated PPPs for the production side of GDP. Their estimates are generated solely using official European Datasets. In particular, they draw detailed estimates of product-level prices from the production industries using the Production of the European Community (PRODCOM) survey (based on unit values – see limitations section); they use data from the established PPP programme for a number of products and draw GVA weights by industry from Eurostat's national accounts and structural business survey statistics. This mixture of consumer prices and producer prices allows for a high coverage of activities contributing to GDP, enabling an extensive industry breakdown. Estimates of PPPs in this work cover 31 European countries: the EU28[2], Switzerland, Iceland and Norway.

These PPPs enable analysis of productivity differences across countries at the industry level, and can therefore identify whether the UK's productivity gap affects all industries equally, or if it varies across industries. Consistent with the original paper, we use price level indices (PLIs) to create comparable GVA measures across countries. PLIs are the ratios of PPPs to market exchange rates and provide a comparison of countries' price levels relative to the EU average. For a more detailed description of the methodology underlying the estimation of these PPPs, refer to Olislager and Konijn (2016).

Output and total hours

In an effort to minimise the risk of introducing other inconsistencies, we follow the original authors and use GVA and hours worked data from Eurostat. GVA in current prices is the measure used for the calculation of productivity in 2014, which is drawn from Eurostat's 'Gross value added and income by A10 industry breakdowns' dataset. In light of the recent updates to the UK National Accounts, which at the time of release were not yet reflected in Eurostat datasets, we have used ONS GVA data for the UK appropriately adjusted using the market exchange rate[4]. The companion labour metric for the calculation of output per hour is total hours, which comes from Eurostat's 'Employment by A10 industry breakdown dataset. For the calculation of growth rates between 2014 and 2016 we use chain linked volume (constant price) GVA, from the same dataset as current price GVA. Differences in the methods and data employed in this article limit the comparability of these results with our headline International comparisons of productivity release: see the limitations section.

The operation used to calculate our output per hour measures across countries can be detailed formally as below:

$$\frac{(GVA\,national\,currencies\,/\,market\,ex\,rate)\;*\;(market\,ex\,rate\,/PPP)}{total\,hours}$$

Country and industry breakdown

Estimates are presented for 29 European countries – the EU28 excluding Malta and with the addition of Norway and Switzerland. As PLIs for non-European countries are not available the non-European G7 (Japan, Canada and the USA) have not been included in this analysis. These PLIs are available at the A64, A21 and A10 categories of industries. However, given the experimental nature of these estimates we have focused on the high level industry groups (A10[3]). It is worth noting that the picture underneath some of these industry groupings may be substantially more variable.

Notes for: Methods and data

1. This is a considerable simplification and users interested in acquiring a more detailed understanding are urged to review Eurostat-OECD (2012). In overview, the process involves several steps. Firstly, the prices of products which are deemed "representative" of a defined product group – known as Basic Headings – within an economy are averaged and then compared across countries. The Basic Heading group is defined as the level below which product-specific weights are not computable. Consequently, Laspeyres, Paasche and Fisher-type indices are calculated for each bilateral Basic Heading comparison, which form the inputs to subsequent stages. Second, the PPPs are adjusted to be internally consistent at the multilateral level to ensure they are complete and transitive across countries. Third, the resulting Basic Heading PPPs are separately aggregated using shares of total expenditure in both countries and averaged. Fourth, a further set of adjustments are made at the headline level to ensure their transitivity.

2. The 28 EU member states known as the EU28 consist of: Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK.

3. The 10 industries in this section are: Agriculture, forestry and fishing (A), Production (B-E), Construction (F), Wholesale and retail trade, transport, accommodation and food service activities (G-I), Information and communication (J), Financial and insurance activities (K), Professional, scientific and technical activities; administrative and support service activities (M-N), Public administration, defence, education, human health and social work activities (O-Q), and Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies (R-U). Real Estate (L) is excluded as the numerator (GVA) includes the imputed rentals of owner-occupiers – which has no equivalent labour input metric.

4. In order to ensure this methodology would be appropriate we tested it using the previous vintage of ONS data. Converting the previous vintage of ONS pound sterling (£) figures into Euros (€) using the market exchange rate – as calculated by the ratio of GVA (£) to GVA(€) in the Eurostat dataset – we were able to replicate the Eurostat GVA (€) figures.

5 . Limitations

The experimental nature of these data means that caution is advised when interpreting the results. This is set out in Olislager and Konijn (2016), who argue that while their results are promising, more work remains to be done. Several limitations should be considered by users.

Firstly, the experimental nature of the methods and data used in this research note limits the consistency of these data with those published elsewhere. In particular, the use of production-side purchasing power parity (PPP) exchange rates, an alternative source for hours; and gross value added (GVA) in place of gross domestic product (GDP) mean that the results presented here may differ from those in the headline ONS International comparisons of productivity release. The use of alternative data sources means that the industry-level productivity data published here are not directly comparable with ONS' headline measures of labour productivity. The results in this release also differ slightly for some countries from those published in Olislager and Konijn's (2016) paper as a consequence of revisions to Eurostat's total hours and GVA data.

Secondly, there are a number of limitations which concern the manner in which the production-side PPPs have been constructed. These are reported at length in Olislager and Konijn (2016), but briefly include:

1. As is often the case in PPP calculations, the source data required to compute these production-side PPPs was incomplete for some countries. In these cases – and in cases where there was a limited number of price quotes for some products – some imputation was used to ensure a complete set of data. The extent of this imputation varies across industries and countries.

2. Expenditure-side PPPs were used directly as proxies for production PPPs for some activities. These included construction, health and collective government services, as well as energy production and distribution, real estate and social work activities.

3. For some goods, Olislager and Konijn (2016) make use of unit values which are calculated using data on values and quantities from the Products of the European Community (PRODCOM) survey. While the authors argue that the detail of the product classification which they use, combined with a cleaning mechanism for censoring outliers, should limit the well-known adverse effects of using unit values [1], this may have an impact on their results.

4. The use of output price measures and weights which are based on value added shares in each industry. Equivalently, these production-side PPPs are "single deflation" measures, rather than a more complete, double-deflated set which would require more granular information on intermediate consumption than is available currently (see Bean 2016).

These issues notwithstanding, Olislager and Konijn (2016) present data which suggests that the aggregate PPPs developed from their procedure differ relatively slightly – if systematically – from the expenditure-side PPPs. They argue that this indicates that their methodology does not produce wildly different results from established methods.

Finally, the price level indices (PLIs) which Olislager and Konijn (2016) develop are for 2014, and as a result they will be less applicable if they are applied to data from different periods – in particular to periods a long time before or after the period for which they are constructed. We have consequently limited our time series analysis to just a three-year window: 2014, 2015 and 2016.

Notes for: Limitations

1. There are various issues surrounding the use of unit values for these purposes including the lack of accounting for changes in quality through time. This may cause problems for relatively complex products.

6 . Results

The results of this research indicate that the UK's productivity gap to other leading European economies is replicated at the industry level – although the size of that gap varies. Figure 1 shows level of output per hour in 2014 for the European G7 economies across nine industries (the A10 industries, excluding real estate [1]), ranked from the lowest to the highest level of UK labour productivity. It shows that the UK has the lowest labour productivity of this group of countries in five industries; and that it is third in the remaining four categories. Even among the UK's most productive industries measured on this basis – including Production (B-E) and Financial and Insurance Activities (K) – the UK ranks relatively poorly, and there is a substantial gap between the UK and the most productive economy in this group.

Figure 1: Output per hour €, 2014

selected industries and countries
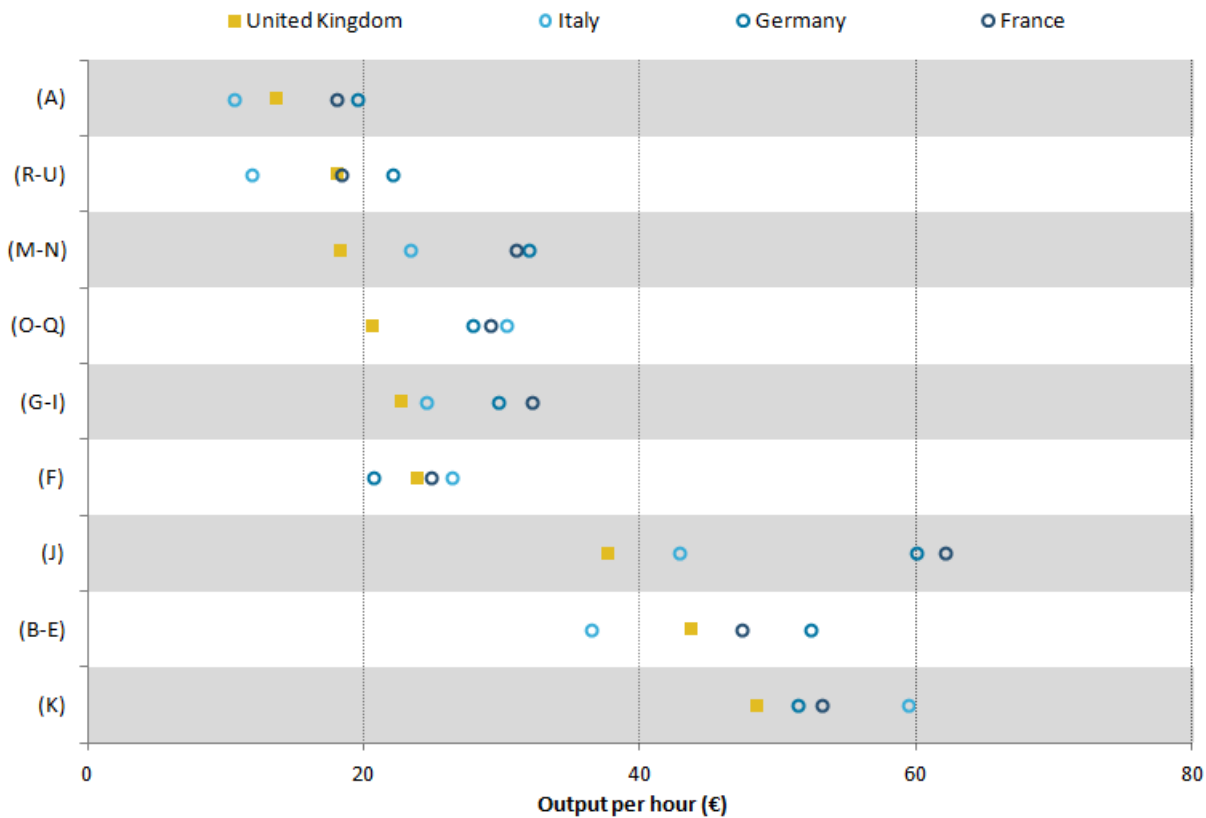
Expanding the analysis to encompass all of the available European economies, there is often a considerable gap between the UK and the European "frontier economy" – the most productive economy in that industry. Figure 2 shows the output per hour level of the UK and the most and least productive countries for which we have data as well as the average (mean). It shows that in most industries, UK productivity lies within the middle of the European economies with an average position of 18th of the 29 nations included. The UK's productivity performance is largely close to the average for this sample of countries; notable exceptions include relative weakness in the information and communication industry (J) and financial and insurance activities (K), as well as relative strength in the production industries (B-E).

**Figure 2: Most and least productive countries per hour alongside the UK, 2014, selected industries**

2014, selected industries
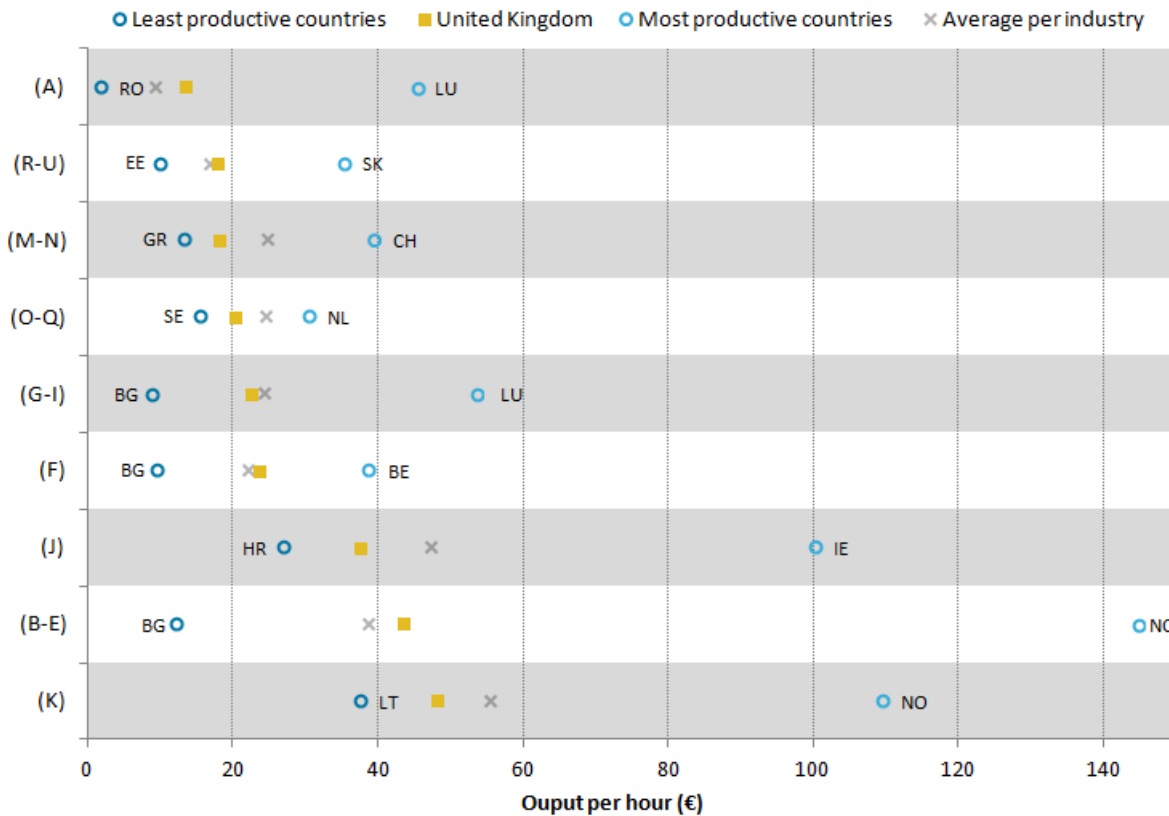
While the UK lags substantially behind the other European economies in level terms, it has experienced stronger productivity growth in recent years relative to the European G7 economies on these measures. Figure 3 shows growth in real output per hour between 2014 and 2016 for the UK and the other European G7 economies by industry – taking data on real GVA growth and total hours for a longer period from Eurostat. The UK has seen its level of output per hour rise in every industry between 2014 and 2016, with the exception of Financial and Insurance activities (K) which showed a slight fall of 0.2%. This can be seen most notably in the Information and Communication industries (J) at 10.1%, Wholesale, Retail, Transport, Accommodation and Food Services industry group (G-I) at 3.5%, and the Agricultural industry (A) at 4.8%. These results are mostly consistent with the main International comparisons of productivity release, which indicates that across this period the UK was towards the front of the pack – ahead of both Italy and Germany, but some distance behind France in growth terms.

Figure 3: Growth in Output per hour €

2014 to 2016, selected industries and countries
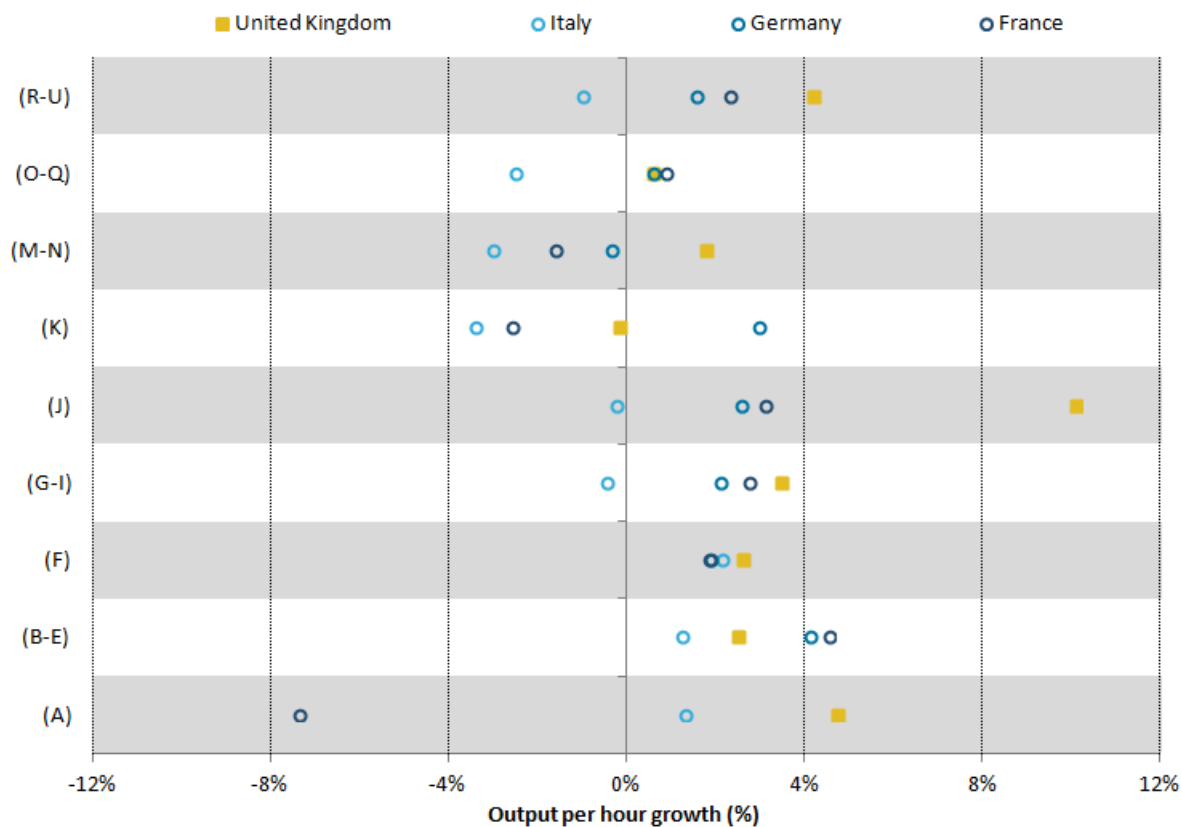
The UK has partly achieved this stronger aggregate productivity growth through an employment structure geared towards those industries which have had faster productivity growth in recent times[2].

Figure 4 shows the share of total hours worked in each industry group for the European G7 economies. In particular, the share of hours accounted for by the group of industries J, K, L, M to N, and R to U is largest in the UK, at 31.1%. This group comprised some of the fastest productivity growth industries over this period: Labour productivity in the UK information and communication (J) industry grew by 10.1% between 2014 and 2016 and arts, entertainment and recreation and other service activities (R to U) grew by 4.2%. These are some of the highest growth rates experienced in the European G7 countries between 2014 and 2016, highlighting the UK's employment structure as one which is weighted towards those industries experiencing the fastest growth.

These industries also hold a larger share as a percentage of total hours in the UK than the other four countries. For example, the information and communication industry (J), accounts for 5% of total hours in the UK compared to 3% for the other European G7 countries in 2014.

Figure 4: Shares of total hours worked by industry group

2014,selected countries and industry

Figure 4: Shares of total hours worked by industry group

2014,selected countries and industry

Legend: J,K,L,M-N,R-U | O-Q | G-I | F | A-E
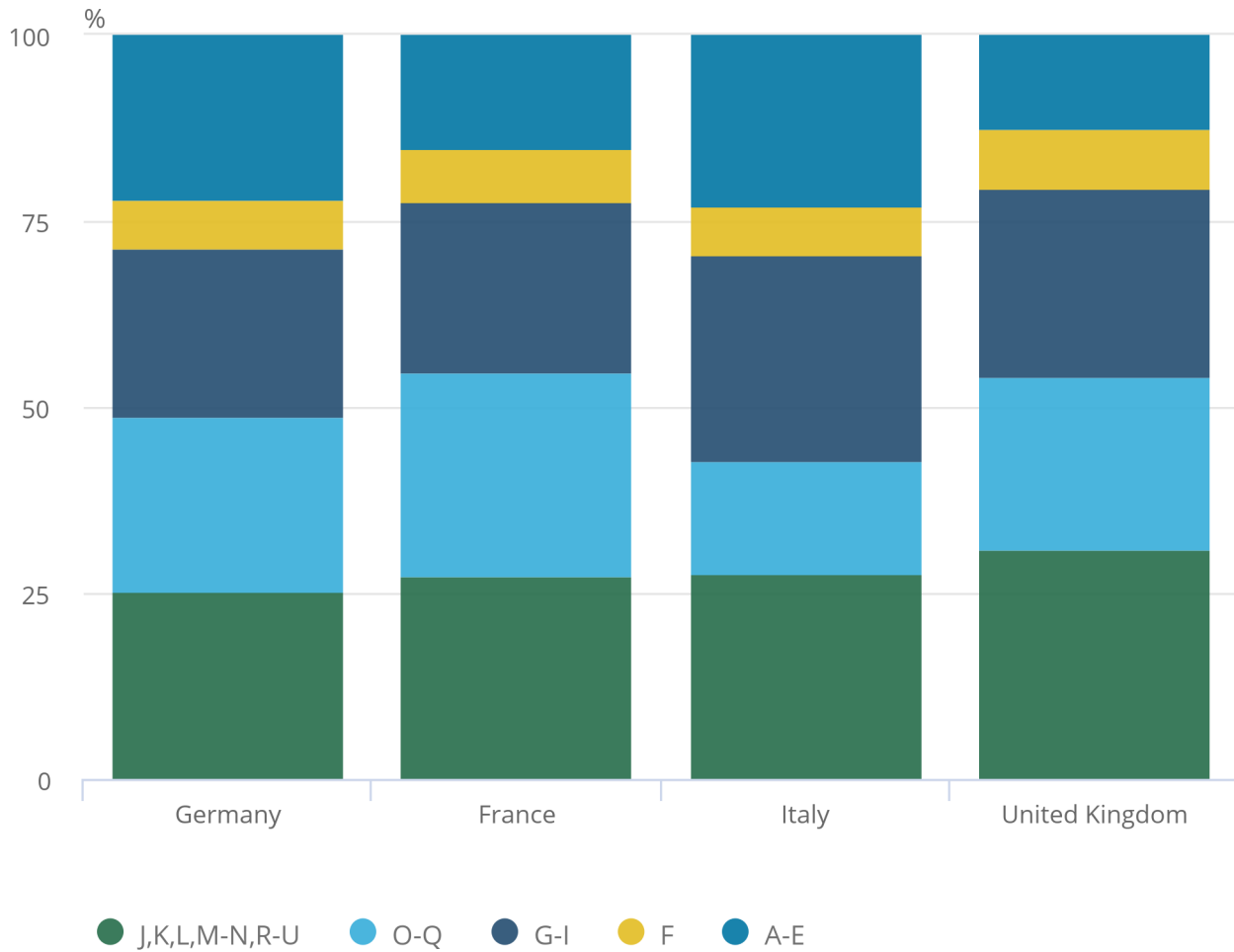
Source: Office for National Statistics, Eurostat

Source: Office for National Statistics, Eurostat

Notes:

1. Industry key:

Agriculture, forestry and fishing (A);

Industry (except construction) (B-E);

Construction (F);

Wholesale and retail trade, transport, accommodation and food service activities (G-I);

Information and communication (J);

Financial and insurance activities (K);

Professional, scientific and technical activities; administrative and support service activities (M-N);

Public administration, defence, education, human health and social work activities (O-Q);

Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies (R-U)

Notes for: Results

1. We exclude real estate activities (L) as a significant driver of GVA for this industry is imputed rentals – rentals projected to accrue to owner occupied housing – which constitute output but have no accompanying labour input.

2. The aggregate rate of productivity growth in an economy is determined by (a) the rate of productivity growth within industries and (b) movements of resources and market share towards industries which have a relatively high level of labour productivity. Analysis using ONS' headline labour productivity release suggests that the latter effect has been an unusually strong drag on UK productivity growth in recent times, emphasising the relative importance of within industry productivity growth.

7 . Conclusion

The development of purchasing power parities (PPPs) from the production side of gross domestic product (GDP) by Olislager and Konijn (2016) has allowed for the analysis of productivity levels by industry across most of the major European economies. On this basis this article presents annual estimates of output per hour for 29 European countries on a nine-industry breakdown, for both 2014 and in terms of 2014 to 2016 growth rates. The results indicate that the UK's weak productivity performance internationally is not an issue in a single industry, but rather a feature of the UK's performance across a range of industries. While the UK lags behind in level terms, recent UK productivity growth across industries has been strong relative to the other large European economies in recent periods. There is further work to do in the investigation and analysis of the presented productivity figures, and we welcome user feedback on the uses and usefulness of these data. The calculation of production PPPs for further years would also provide a useful basis for further research.

8 . Links to related statistics

The following publications on the topic of productivity are also available:

- UK productivity introduction: Apr to June 2017 draws together the headlines of the productivity releases into a single release, providing additional analysis of our productivity statistics (published 6 Oct 2017).

- [Labour productivity: April to June 2017](#) contains the latest estimates of labour productivity for the whole economy and a range of industries, together with estimates of unit labour costs (published 6 Oct 2017).

- [Quarterly UK public service productivity (experimental statistics): April to June 2017](#) contains the latest experimental estimates for quarterly UK total public service productivity, inputs and output (published 6 Oct 2017).

- [International comparisons of UK productivity (ICP), first estimates: 2016](#) presents an international comparison of labour productivity across the G7 nations, in terms of growth in GDP per hour and GDP per worker (published 6 Oct 2017).

- [International comparisons of labour productivity by industry: 2014](#) uses new production-side PPPs to present estimates of labour productivity for 29 European countries across 10 industries on a GVA per hour worked basis (published 6 Oct 2017).

- [Quality adjusted labour input: UK estimates to 2016](#) presents updated estimates of quality adjusted labour input (QALI) for the whole economy and for the market sector (published 6 Oct 2017).

- [Foreign direct investment and labour productivity: a micro-data perspective: 2012 to 2015](#) examines the composition of firms with foreign direct investment (FDI) in Great Britain between 2012 and 2015, and their productivity outcomes compared with firms with no FDI relationships (published 6 Oct 2017).

- [Quality adjustment of public service criminal justice system output: experimental method: 1997 to 2014](#) presents new methodologies to capture changes in quality of outputs of the criminal justice system, expanding ONS's coverage of quality adjustment for public service output (published 6 Oct 2017).

- [Introducing industry-by-region labour metrics and productivity](#) presents new, experimental industry-by-region productivity metrics; this includes measures of hours worked, jobs, and accompanying productivity measures for the SIC letter industries in the NUTS1 regions (published 5 July 2017).

- [Introducing division level labour productivity estimates](#) provides an overview of new and experimental estimates of labour productivity at the two-digit SIC industry level for the UK and provides some initial analysis demonstrating trends in the data (published 5 July 2017).

- [Regional and sub-regional productivity in the UK: Jan 2017](#) provides statistics for several measures of labour productivity; statistics are provided for the NUTS1, NUTS2 and NUTS3 sub-regions of the UK and for selected UK city regions (published 6 January 2017).

- [Understanding firms in the bottom 10% of the labour productivity distribution in Great Britain: "the laggards", 2003 to 2015](#) examines the characteristics of businesses in the bottom 10% of the labour productivity distribution in terms of their size, age, industry and location, between 2003 and 2015 (published 5 July 2017).

- [Multi-factor productivity estimates: Experimental estimates to 2015](#) decomposes output growth into the contributions that can be accounted for by labour and capital inputs; the contribution of labour is further decomposed into quantity (hours worked) and quality dimensions (published 5 April 2017).

- [Developing new measures of infrastructure investment: July 2017](#) is the first in a series of papers on infrastructure statistics, focusing on definitional and data challenges in measuring infrastructure investment (published 5 July 2017).

- [Volume index of UK capital services (experimental): estimates to 2015](#) provides estimates of the contribution of capital inputs to production in the market sector, split by asset and industry (published 6 January 2017).

- [Public service productivity estimates: total public service, UK: 2014](#) presents updated measures of output, inputs and productivity for public services in the UK between 1997 and 2013, in addition to new estimates for 2014; includes service area breakdown, as well as impact of quality adjustment and latest revisions (published 6 January 2017).

- [Public service productivity estimates: healthcare, 2014](#) presents updated estimates of output, inputs and productivity for public service healthcare in the UK between 1995 and 2013, and new estimates for 2014 (published 6 January 2017).

9 . References

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