Office for National Statistics

Article

Improving estimates of labour productivity and international comparisons

Analysis of how the methodologies, data sources and adjustments used internationally to estimate the number of persons, jobs and hours worked affect our international comparisons of UK productivity statistics.

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1 . Introduction

Office for National Statistics (ONS) has been producing the International comparison of UK productivity (ICP) National Statistics bulletin since October 2001, allowing domestic users to compare the labour productivity of the UK against that of the other members of the G7. We compare how much labour input is used (in hours worked and number of people) to produce the outputs (goods and services) in our economy. We express this in output per hour and output per worker.

In our previous publication of these data, for the year 2016, the UK's gross domestic product (GDP) per hour worked was:

- 26.2% lower than Germany

- 22.8% lower than France

- 22.6% lower than the US

- 10.5% lower than Italy

- 0.6% higher than Canada

- 8.7% higher than Japan

These were significant differences in productivity between the UK and most other G7 countries. Output for every hour worked in the UK was proportionally lower than both the European countries in the G7 and the US. This implied output was very low for the number of hours worked or the hours worked were very high for the output that was being produced. This has been a long-standing trend in these data. Whilst there may be structural differences across the economies (depending on whether they are production or service oriented), the magnitude of the differences in the levels meant that we had to refresh our productivity statistics to review these data and test the results.

This was particularly stimulated in 2014 when the Organisation for Economic Co-operation and Development (OECD) discontinued their Annual Labour Force Statistics (ALFS) database total employment measure, which was historically used for estimating the employment measure in the ICP bulletin. For a limited period, we replaced the periods post-2014 with the total employment series from Eurostat, for the European countries – France, Germany and Italy – and used an alternative OECD employment series to estimate the values for the non-European countries – the US, Canada and Japan. However, this did not appear to be a sustainable strategy and in October 2018 we suspended the publication of ICP to review the current methods and explore potential new data sources to produce these statistics.

In doing this review, and following initial discussions with the OECD, we identified that an important step to be undertaken was to better understand how different countries assemble their estimates of workers and hours worked. We discussed the scope of the work with the OECD and partly funded the research, which resulted in the OECD's working paper International productivity gaps: Are labour input measures comparable? (PDF 3.33MB) . The work initiated a joint OECD and Eurostat questionnaire on understanding labour inputs recorded by countries. There was broad international participation across 41 countries from the EU, the OECD and even countries outside the OECD. The questionnaire sought information on the methodologies used to compile labour inputs, the main and secondary sources used; for example, labour force survey, business statistics, population statistics or administrative data. It also asked which adjustments were applied to the labour inputs by each country to bring them in line with national accounts concepts and the production boundary.

The results showed that the methodologies, data sources and adjustments used to estimate the number of persons, jobs and hours worked varied significantly across countries. In particular, the actual hours worked across countries were significantly affected by the method used to estimate labour inputs. In fact, countries that calculated hours worked using the Labour Force Survey recorded systematically higher values than those using the component method, which captured a series of sources including administrative data.

In this article we explore these differences and the impact on our ICP statistics.

2 . Labour inputs

When estimating labour productivity, it is important to align the labour inputs with the national accounts concepts of output. The concept of productivity aims to show how many labour inputs, in the form of hours worked or persons employed or jobs, contributed to create the value added that was generated in the production process. Labour productivity is derived using growth rates for gross value added (GVA) and labour inputs in line with the following equation:

$$\Delta \text{Labourproductivity} \; = \; \Delta \left(\frac{\text{Output in Gross Value Added (GVA) terms}}{\text{Labour Input (hours, workers or jobs)}} \right) \; \approx \; \Delta \text{GVA} \; - \; \Delta \text{Labour Input}$$

Hence, we need to apply these three core concepts when estimating productivity:

1. The unit of measurement used in employment (persons employed or jobs) should match those persons and hours worked to generate the value added in the domestic economy.

2. A distinction should be made between actual hours worked and other concepts of hours worked. When estimating labour inputs we want to understand the "actual hours" that were worked to produce the output.

3. Labour inputs should align with the national accounts production boundary on which gross value added (GVA) is measured.

3 . Common sources used to estimate labour inputs internationally

Unlike the gross domestic product (GDP) estimate, which forms the numerator in the labour productivity equation, the labour inputs, which form the denominator, do not have a formal international verification process. GDP is reviewed, particularly in the EU, in the gross national income (GNI) own resource verification process.

The Organisation for Economic Co-operation and Development (OECD) survey, carried out as part of their recent work, International productivity gaps: Are labour input measures comparable? (PDF 3.33MB), identified four common sources of data when estimating labour inputs:

- labour force survey

- business statistics

- population statistics

- administrative sources

Although not all of these sources are used to estimate labour inputs within each country, however the OECD drew the conclusion that no individual source was comprehensive and exhaustive enough to capture the three core concepts for aligning labour inputs to output.

A labour force survey is a household survey that asks individuals to record the hours worked during a particular week. Although a good source, particularly for the self-employed, it has some constraints. The study noted that individuals tended to overestimate their actual working time and underestimate the part-week absences, such as illness and holidays. Individuals working in the informal economy or in illegal activities were also likely to under-declare their hours worked.

A labour force survey, like most household surveys, can also exclude the armed forces, communal households and institutions and non-residents working in the domestic economy. These need to be added back in for the labour measure to match the output measure, as defined by the production boundary and the estimates of GDP.

Business statistics were another significant source, particularly for estimating employees. These statistics generally provide detailed data on employment and hours worked, which usually follow a well-defined industrial classification of companies, mainly the NACE Rev.2 (PDF 5.6MB) or SIC 2007 in the UK, which are consistent with the national accounts output and gross value added (GVA) industry breakdowns. However, they can exclude enterprises below a predefined size threshold and certain categories of firms, for example, un-incorporated businesses, self-employed persons and informal labour. Whilst they provide information on hours paid or contractual hours, there is no information on absences from work and unpaid overtime, so hours worked estimates from this source do not align with the hours "actually worked" concept.

Population statistics were also commonly used by countries as they are a comprehensive source covering the whole population of the country and are often a useful tool to benchmark the labour force survey. However, the data are collected infrequently, typically every 5 or 10 years and they were likely to exclude some categories of migrants.

Administrative statistics were the final data group used across countries both as a primary and secondary source for estimating labour inputs. These are data collected by government bodies or regulatory authorities that require their members to submit information on several variables. The information is usually based on some form of statutory or voluntary registration and they can provide information on all persons required to pay income tax or social insurance. However, they may not necessarily align with the actual hours worked concepts and are likely to exclude informal employment.
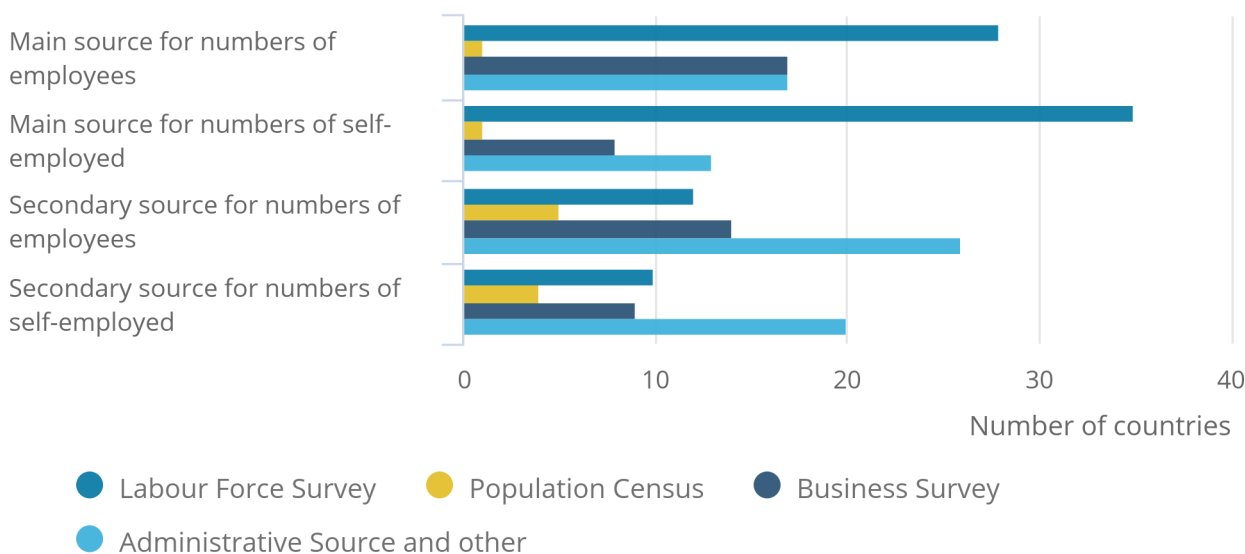
Figure 1 shows the main sources used to estimate employment across the countries that took part in the OECD and Eurostat survey. Most countries used a labour force survey for estimating number of employees and self-employed, though administrative sources were the most popular secondary source, followed by business statistics.

Figure 1: Sources used for employment

The sources used by countries, main original sources, to construct estimates

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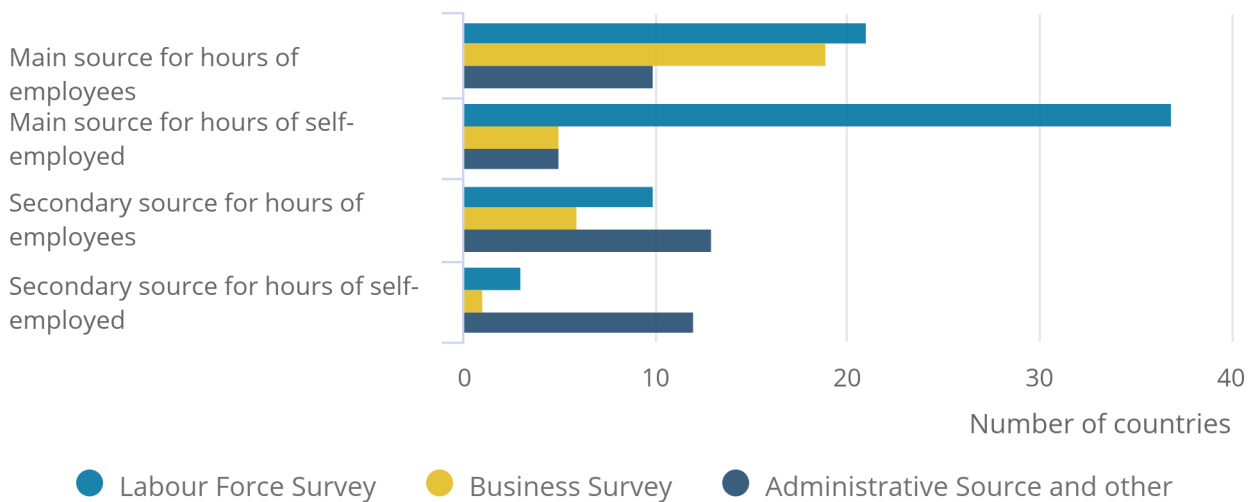**Source: Organisation for Economic Co-operation and Development**

Similarly, for hours worked (Figure 2) a labour force survey was the main source, particularly for the self-employed, with administrative data being the main secondary source. The survey also noted that for hours worked by employees, the business statistics were also a main source for some countries, rather than a labour force survey.

Figure 2: Sources used for hours worked

The sources used by countries, main original sources and other sources, to construct estimates

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Source: Organisation for Economic Co-Operation and Development

Notes:

1. Population census is not used by any country as a source for hours worked.

4 . Common adjustments for labour inputs internationally

These coverage issues described in Section 3 meant that all four data sources had their own coverage and exhaustiveness constraints and so each on its own was insufficient to provide estimates of labour inputs that match the output concepts defined by the production boundary. Therefore, certain adjustments were necessary to bridge the labour concepts with the national accounts concepts. The survey identified four main categories of adjustments applied by countries.

The first concerned periodicity, where the original data sources may be collected on a different periodicity to the labour inputs. For example, in the UK the data from the Labour Force Survey (LFS) or a short-term employment survey may be collected monthly, however, our labour productivity estimates are commonly estimated on a quarterly or annual basis, in line with the main national accounts and gross domestic product (GDP) aggregates. Similarly, some administrative sources may collect data annually and it may be necessary to spline the data into a quarterly series or even extending series backwards, as the periodicity of the original data sources may vary over the years.

The second adjustment concerns aligning persons to jobs or jobs to persons. When the units of measure collected in the original data source differ from those used in the national accounts then it is important to align these unit measures as the ratio of persons to jobs can differ across countries. For example if the source collected information on jobs and the national accounts employment data was presented in number of persons worked, then it is important to adjust the jobs to persons.

The third adjustment was the economic territory. This covered several adjustments to align estimates of workers with the economic territory in which they work. For example, we may need to capture non-resident persons working in domestic (resident) production units and exclude those in the resident population that work in non-resident units such as foreign embassies, consulates, foreign military bases within the reporting country or work abroad. This is also known as the distinction between the national and domestic territory. As GDP is generated in the "domestic" territory it is important to align the labour inputs with the domestic concept of the production boundary.

Depending on the sources used, it may be necessary to apply conceptual, coverage or other exhaustiveness adjustments to align the labour inputs with the output concepts. For example, the UK's LFS excludes military and collective households whilst business statistics can exclude non-market services such as education and health, as well as the self-employed and unpaid family workers.

The fourth concept covered the unobserved economy, that is, the economic activity that is not recorded. Most sources typically miss information on employment and hours worked in the unobserved economy, which are required to maintain consistency with the production boundary of output measures. Typical examples include construction, trade, catering and personal services.

These adjustments are required to record the labour inputs that generated the value added in the domestic territory on a consistent basis. The study found that these adjustments varied significantly across countries, depending on the sources available, and some countries like the UK did not apply any adjustments to the labour inputs but rather constrained them to its LFS aggregates.

5 . Methods used to estimate hours worked

The Organisation for Economic Co-operation and Development (OECD) study identified three main approaches in estimating hours worked.

Direct method

This approach annualises the average weekly hours worked directly collected from the data source, usually a labour force survey, for all weeks of the calendar year. With this method we typically multiply the number of actual hours worked in the reference week, which are likely to be self-reported in survey, by the number of working weeks in the year, after adjusting for public holidays. The UK has used this method as the best conceptual match to the required concept available from routine data collections

Direct method with additional adjustments

This is an extension of the direct method. Some countries may use the direct method and apply additional adjustments that are necessary to reflect the source coverage, for example, residents working abroad and bias issues in the labour force survey, such as over-reporting hours worked.

Component method

Under this approach the starting point is data on a normal, usual, paid or contractual hours basis and then adjusting the differences derived from a variety of data sources as components, for example, annual leave, sickness, maternity or strikes. This is an indirect approach as the starting point is not the target concept, that is, actual hours worked. It requires a series of explicit adjustments, known as components, to align with the concept of actual hours worked.

The report concluded that different countries use variants of the three approaches and that this heterogeneity significantly impacted comparative productivity estimates. Table 1 summarises the methods, main sources and adjustments applied by each of the G7 countries. It shows France and Germany adjusting down the hours worked by employees up to 18.8% and 12.4% respectively and Canada adjusting down the number of self-employed people sourced by the labour force survey by 41%.

Table 1: Labour input sources for G7 countries

G7	Canada	France	Germany	Italy	Japan	UK	United States
Method	DM, WITH ADJ	CM	CM	CM	CM	DM	DM
Hours - main Employees	LFS	BS	AS	LFS/AS	BS	LFS	BS
Hours - main Self-employed	LFS	AS	LFS	LFS/AS	N/A	LFS	LFS
Hours - secondary Employees	AS	LFS/AS	LFS/BS/AS	BS/AS	LFS	AS	LFS/BS
Hours - secondary Self-employed	AS	LFS/AS	AS	BS/AS	N/A	N/A	N/A
Employment - main Employees	LFS	AS	BS/AS	LFS/BS/AS	LFS/PC	LFS	BS
Employment - main Self-employed	LFS	AS	LFS	LFS/BS/AS	LFS/PC	LFS	LFS
Employment - secondary Employees	PC/BS/AS	LFS/BS/AS	LFS/AS	AS	AS	BS/AS	AS
Employment - secondary Self - employed	PC/AS	LFS/AS	N/A	AS	AS	N/A	N/A
% change in average hours worked Employee	unquantified	-18.8%	-12.4%	N/A	1.0%	0.0%	0.0%
% change in average hours worked Self-Employed	unquantified	53.5%	-6.4%	N/A	0.0%	0.0%	0.0%
% total adjustment made to number of employees	10.0%	0.3%	6.3%	9.9%	3.3%	0.0%	2.6%
% adjustments made to number of self-employed	-41.0%	0.1%	0.9%	0.0%	8.6%	0.0%	0.0%

Source: Office for National Statistics

Notes

1. DM - Direct Method, CM - Component Method, ADJ - Adjustments, LFS - Labour Force Survey, BS - Business Survey, AS - Administrative Survey, PC - Population Census, N/A - Non-applicable Back to table

6 . OECD recommendations

The Organisation for Economic Co-operation and Development (OECD) recognises the direct method of estimating hours worked is not necessarily inferior to the component-based approach but without the use of additional adjustments the data collected suggest it could potentially overestimate the actual hours worked. Looking across the countries submitting data, they recommend the component method as the best compromise strategy for estimating labour inputs, though they recognise that not all countries may be able to capitalise on administrative sources. Therefore, when comparing international productivity they encourage countries that use the direct method without adjustments to consider adapting a "simple" component method as an interim step. Re-estimating the labour inputs using the simplified component approach increases the UK's relative productivity, narrowing the gap to the US by around 8 percentage points from 24% below US productivity to 16% below, because the UK currently uses the direct method.

In light of these findings the OECD are also proposing to revise the country-specific labour inputs data presented in their productivity database using the following criteria:

1. For countries that apply the component method or the direct method with adjustments, they will use these estimates. For the EU countries, these values are consistent with ESA 2010 Transmission Programme tables 1.

2. For countries that apply the simple direct method, that is without any adjustments, the OECD will derive the employment estimates using a simplified component method with adjustments from a labour force survey.

7 . Proposal for improving our international comparison of productivity (ICP) estimates

The debate about how to best compare estimates of labour productivity across countries can be simplified to two options:

- use the best estimate created by each country, on the basis that that country understands its data better than any other

- use a consistent method across all countries to produce estimates on the same basis

In theory, if the appropriate adjustments are applied consistently across all countries we would be able to compare data directly from national statistics domains. Although in practice we have seen there are significant differences in sources and methods used which in turn can vary such as by incorporating a wide variety of adjustments to hardly any, depending on the country.

Using the data from the OECD's productivity database alongside a small number of adjustments with a component method, can bring those countries using the direct method onto a broadly comparable basis to those that already apply the component method. However, for countries that apply the simple direct method the database will contain OECD derived values and will only include adjustments for "actual hours" sourced from the EU Labour Force Survey (EU-LFS). The EU LFS is another set of questions countries collect from the national labour force survey. As the data are collected across the EU countries systematically it can provide a comparable basis across the countries including the UK. There are some differences in the results collected from the EU-LFS and the UK's national Labour Force Survey. For example, in the former survey, the treatment will vary for the respondents who:

- are 15 years old

- live in halls of residence

- are engaged in government schemes in full-time study

- have found a job that will start in three months or longer

- have taken a leave of absence for three months or longer

As the aim is to identify a source that is comparable across all countries when compiling estimates of ICP, we propose to review incorporating the OECD's proposed methodology in our ICP publication using the simplified component method applying the same adjustments to estimates for deriving "actual hours worked" consistently across the countries. Whilst this may not necessarily be the best estimate of productivity across the countries as some may have better national sources such as administrative data to capitalise on, it is a more coherent method for making comparisons across countries. Table 2 summarises the adjustments we propose to apply consistently to all countries when compiling ICP estimates. These are consistent with the OECD's simplified component approach.

The success of all options considered will be in part determined by the availability of relevant data from other countries. To do this we need to gain access to the EU-LFS data. In the absence of sustainable data sources we would need to review whether it would be meaningful to continue producing estimates of ICP drawn from heterogeneous methods, sources and adjustments applied to labour inputs by different countries.

Table 2: Proposals for improving international comparison of productivity (ICP) estimates
The aim is to derive actual annual hours worked consistently from EU-LFS variables

Average weekly hours	x	Annual weeks worked
+ usual hours in main job + extra hours in main job (= overtime + variable hours - flexi) + hours in additional jobs		52 weeks less - holiday weeks - full week absence (non-holiday) - part-time absence - absence due to sickness and/or maternity

Source: Office for National Statistics

8 . Wider impact on UK labour productivity inputs and National Statistics

Although international comparison of productivity (ICP) estimates were the catalyst for us to initiate the discussions with the Organisation for Economic Co-operation and Development (OECD) that resulted in this wide international cooperation across countries, the findings may also have a wider impact on the UK labour productivity estimates we publish. The OECD recommend the component method for estimating labour inputs and although they recognise that not all countries may have the use of administrative sources, they encourage countries using the direct method without adjustments to consider adapting the simple component method as an interim step.

The OECD findings do not, on their own, suggest that the UK should change its methodology, but the suggestion that UK hours could be overstated is something we will investigate. It is possible that the Labour Force Survey respondents understate their leave or sickness absence, or the way we account for non-respondents is biasing the figures upwards.

We have estimated UK productivity using the direct method because it has historically been the best method given the data available in the UK. On a national level it would not be possible to apply the component method in the short term. However, as work on administrative data is evolving, it may be possible to consider applying the component method in the long run. In the interim we will complete a scoping study to identify sustainable sources to capture conceptual and exhaustiveness adjustments on the economic territory, the unobserved economy and any other adjustments that are consistent with the national accounts production boundary, which are consistent with Eurostat's tabular approach used in the gross national income (GNI) process table. The study will also review dependencies with wider labour market statistics and the current availability of administrative sources for estimating variables to derive "actual hours" worked, such as sick absences, that will be analysed against the current Labour Force Survey (LFS) responses.

We will present the framework of the feasibility study at the 2019 Productivity Forum that will be held in March 2019. We will engage with national user groups including the Productivity Research Group, the National Institute of Economic and Social Research, the Economic Experts Working Group, as well as other national statistics institutes that have already incorporated best practice methodology in line with international guidance.

National labour productivity estimates are a National Statistic and therefore follow the UK Statistics Authority's Code of Practice for Statistics, which requires consultation with users. Although the final details of the feasibility study will be agreed after consultation with users, the study will cover the following broad areas of work:

1. A mapping exercise between the industry-specific conceptual and exhaustiveness adjustments applied in the production approach of gross domestic product (GDP) and the labour market statistics, particularly for the agriculture, construction, trade, catering and personal services industries.

2. An analysis of the national and domestic concept of employment using the compensation of employees estimates paid to and received from the rest of the world consistent with the UK primary income account.

3. A review of available administrative data to derive estimates of sick absences and identify how the LFS accounts for these absences with the aim of deriving "actual hours" worked.

9 . Conclusions

We have noted significant differences in productivity between the UK and other G7 countries with output per hour worked in the UK being proportionally lower than most of the G7 countries. With good international co-operation, we initiated and partly funded a review that was led by the OECD and resulted in the publication of International productivity gaps: Are labour input measures comparable? (PDF 3.33MB).

The review concluded that although countries produced common variables of labour inputs, such as hours worked or employment in persons or jobs, methodologies, data sources and adjustments varied significantly across countries. Actual hours worked across countries were significantly affected by the method used to estimate labour inputs, with the hours worked (recorded from a Labour Force Survey) being systematically higher than those using the component method.

When making international comparisons of labour productivity, a more harmonised method across all the countries is more favourable than the best estimate that is available by each country, as labour inputs can be compiled across countries using heterogeneous methods and sources. Therefore, we are exploring whether to incorporate the OECD's simplified component method into our ICP publication when comparing productivity estimates across countries. This is dependent on ongoing discussions with Eurostat with the aim of securing access to the EU-LFS dataset.

The findings have also initiated a review of the current methodology used to compile our national labour productivity series. The OECD recognises the direct method of estimating hours worked is not necessarily inferior to the component-based approach, though without the use of additional adjustments it could potentially overestimate the actual hours worked. In particular, applying the simplified component method, for estimating hours worked has a significant impact on productivity as it reduces actual hours worked. The findings showed an impact on levels, and did not particularly change the growth rates, which is the focus of the ICP release. Of course, it is possible that adjustments to employment and hours worked could vary over time and therefore impact growth rates. The UK is particularly affected as it is one of the few countries using the direct method because it has historically been the best method to use given the data available in the UK. Although these methodological differences can partly explain the productivity gap between the UK and the other G7 countries, it does not eliminate it. However, by improving our current methodology and reviewing the coverage and exhaustiveness of our data inputs we can potentially make better informed comparisons of labour productivity estimates across countries.

10 . Acknowledgements

We welcome users' feedback and are interested in your views. If you would like further information please contact us at productivity@ons.gov.uk.