

Article

# Earnings and low pay: distributions and estimates from the Labour Force Survey

This article explores the distribution of earnings using the Labour Force Survey (LFS) with a focus on low-paid jobs.

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# 1 . Authors

James Rowlings and Ashley Nanton

## 2 . Main points

- This article explores the distribution of earnings using the Labour Force Survey (LFS) with a focus on low-paid jobs.
- The analysis is for Quarter 4 (Oct to Dec) of 2016; during this period there was a visible concentration of jobs paid at levels close to the National Living Wage (NLW) of £7.20 per hour.
- In the same period there were visible differences between the pay distributions of jobs held by UK and non-UK nationals; a greater proportion of non-UK nationals worked in jobs that paid wages close to the NLW.
- There were also differences between earnings distributions of jobs held by men and women graduates and non-graduates in Quarter 4 2016; the earnings of non-graduate women were more concentrated around the NLW compared with those of non-graduate men.
- A greater proportion of private sector jobs than public sector jobs were paid close to the NLW in Quarter 4 2016.
- By industry, distribution, hotels and restaurants were the industrial group with the highest proportion of jobs below or close to the National Minimum Wage (NMW) and the National Living Wage (NLW) in Quarter 4 2016; in contrast, construction, and energy and water had the lowest proportion of jobs paid below or close to the NMW or NLW.

## 3 . Introduction

The Annual Survey of Hours and Earnings (ASHE) is the recognised source of National Statistics for estimates of pay in the UK and is the official source of estimates for the number of jobs paid below the National Minimum Wage (NMW) or National Living Wage (NLW). It is, however, not the only source. The Labour Force Survey (LFS) can also be used to produce estimates of low-paid jobs, particularly when a breakdown is required using information not collected on ASHE (such as nationality).

This article provides estimates of earnings using the LFS. The first section examines the distribution of hourly earnings for a number of different characteristics. The article goes on to examine specific characteristics of jobs paid below or close to the NMW or NLW.

Low-pay estimates using the LFS have not been produced for a number of years. Previous LFS-based analyses were conducted by Office for National Statistics (ONS) and the Low Pay Commission (LPC). Earlier articles focused on the characteristics of those paid below the NMW and on methodological issues in using the LFS for low-pay estimates (Hicks, Conn and Johnson 2009). This article uses the same imputation methodology as in previous analysis, but offers alternative and more current estimates.

An imputation method is used to impute missing stated hourly pay rates. These account for about two-thirds of LFS observations on individuals aged 16 and over. The method imputes hourly pay using nearest neighbour donation, for cases in which the respondent failed to provide their hourly earnings. The use of the direct hourly rate question yields better estimates of hourly earnings than the derived hourly pay variable; the latter relies on dividing gross weekly pay in the pay period by usual hours of work, overestimating the incidence of low pay. Studies have shown that using the stated hourly rate produces more reliable estimates (Skinner et al 2002, Dickens and Manning 2004). More information is available in the "Methodology" section of this article.

The NLW of £7.20 was introduced in April 2016 and applies to individuals aged 25 years and over. This age band represents around 90% of all jobs included in the analysis.

## 4 . Reliability of the Labour Force Survey for earnings analysis

This section discusses the reliability of using the Labour Force Survey (LFS) as a source of earnings profiles and low-pay estimates.

There are two potential concerns with using LFS data rather than Annual Survey of Hours and Earnings (ASHE) data. Firstly, one drawback of the LFS is its smaller sample size compared to ASHE. This means that estimates produced using LFS data tend to be less precise than those produced using ASHE. Secondly, the LFS is a respondent-based household survey, whereas ASHE is a survey of employers. Potential sources of inaccuracy in the LFS data are therefore proxy and estimated responses, for example, situations in which a person responds on behalf of a partner who is not available when the data are collected.

There's also an impact of relying on memory in the LFS, as respondents may provide only an estimate of their earnings, without checking further documentation for clarification. In contrast, ASHE data usually come from company records, which more accurately reflect the amounts and numbers of hours for which employees are paid.

In the LFS, stated hourly rates also present a problem when the National Minimum Wage (NMW) changes, as the respondent may not know that their hourly rate has changed. They may in such cases state their previous wage, introducing inaccuracy to their response. This again is not an issue in ASHE.

The LFS can, however, be a useful source of earnings estimates if the LFS can be considered reliable. As the LFS is a household survey, it contains variables on personal characteristics, which ASHE does not. For example, disability, ethnicity, nationality, country of birth and qualifications are included in the LFS, but not in ASHE.

In addition, ASHE is an annual survey, whereas the LFS is produced quarterly. This means that the LFS can produce more timely earnings estimates than ASHE.

To address these concerns, this article cross-checks the results from the LFS data with the ASHE data. The analysis is also restricted to variables for which the sample size is sufficiently large, to ensure reliability of the estimates. In addition, to boost the overall sample size we use an imputation method to calculate missing hourly wage rates.

Figure 1 compares the distributions of hourly earnings using each of the data sources. The collection of ASHE data occurs annually in April. To offer a reasonable comparison, the closest corresponding months (April to June) for the LFS are also used. The distributions of earnings are a similar shape in both ASHE and the LFS, most notably the clear spike around £7.20 per hour – the introductory National Living Wage (NLW) rate in April 2016.

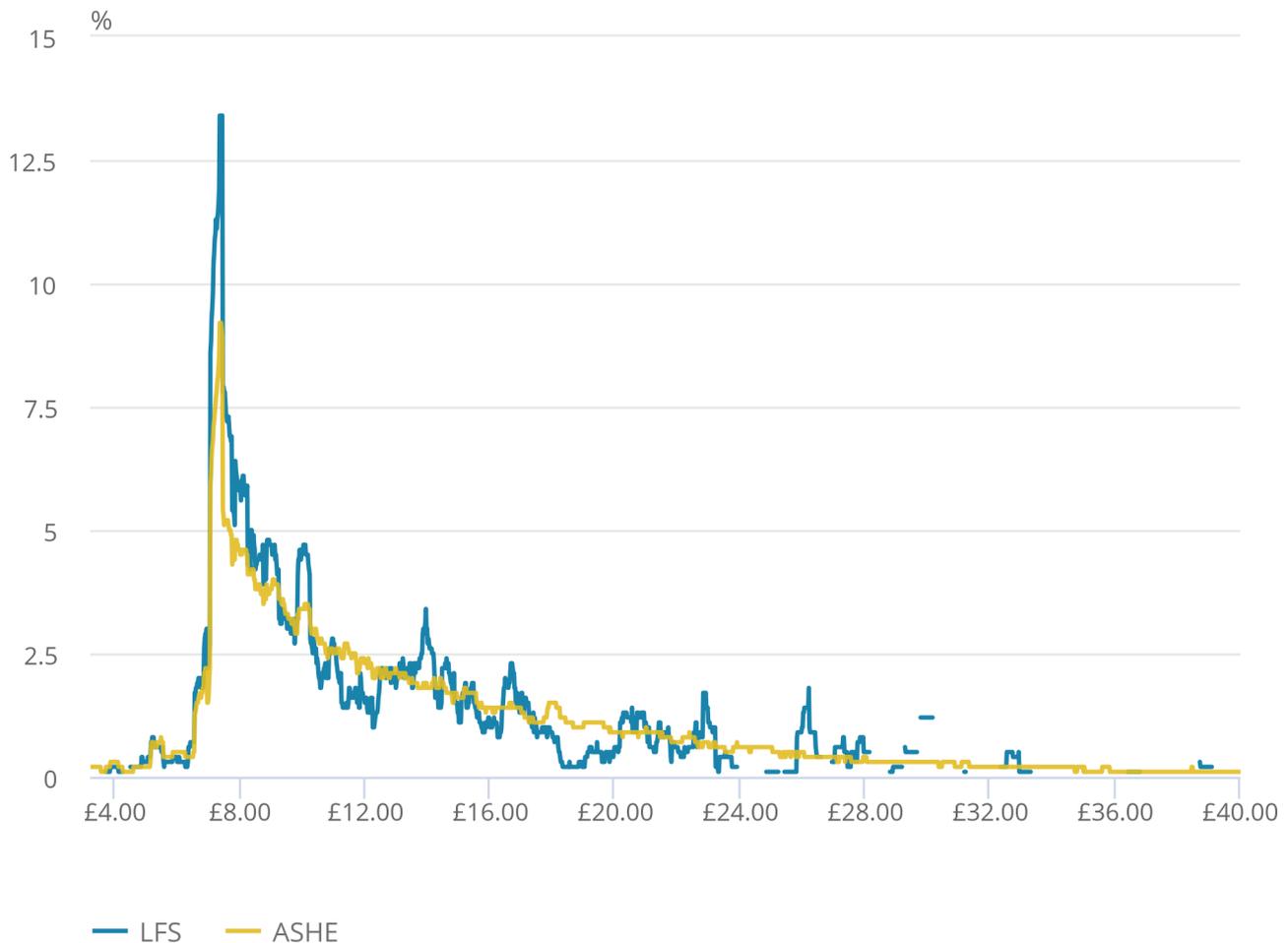
The distribution estimates from the LFS appear to be more volatile than those from ASHE. This is potentially due to the smaller sample size in the LFS. Figure 1 nevertheless demonstrates that the LFS can be considered an alternative source of low pay data after imputation, due to the similarity of estimates obtained from it with those from ASHE.

**Figure 1: Distribution of nominal hourly earnings, ASHE (April 2016), LFS (April to June 2016), UK**

Plus or minus 20 pence

Figure 1: Distribution of nominal hourly earnings, ASHE (April 2016), LFS (April to June 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Annual Survey of Hours and Earnings (ASHE)

Source: Office for National Statistics, Annual Survey of Hours and Earnings (ASHE)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings. 2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## 5 . Analysis of the distribution of earnings

This section of the analysis uses data from the Labour Force Survey (LFS) to estimate earning distributions of jobs for different groups and characteristics in Quarter 4 (Oct to Dec) 2016. The distributions include both main and second jobs, as well as apprenticeships.

Earnings distributions are examined for six main groups. First, we look at the difference between earnings distributions of different nationality groups. Second, we examine the difference in pay distributions by disability status. Third, we compare pay distributions by gender and whether or not individuals have had a graduate-level education. Next, we look at differences between occupation-based skill levels. These skill-levels are hierarchy based and a higher level presents a more skilled occupation. Finally, we compare the pay distributions between public and private jobs.

Much of the analysis presented in this section focuses on the lower end of the pay distribution. This is due to smaller sample sizes at the upper end of the income distribution, which can result in imprecise estimates due to sampling variability.

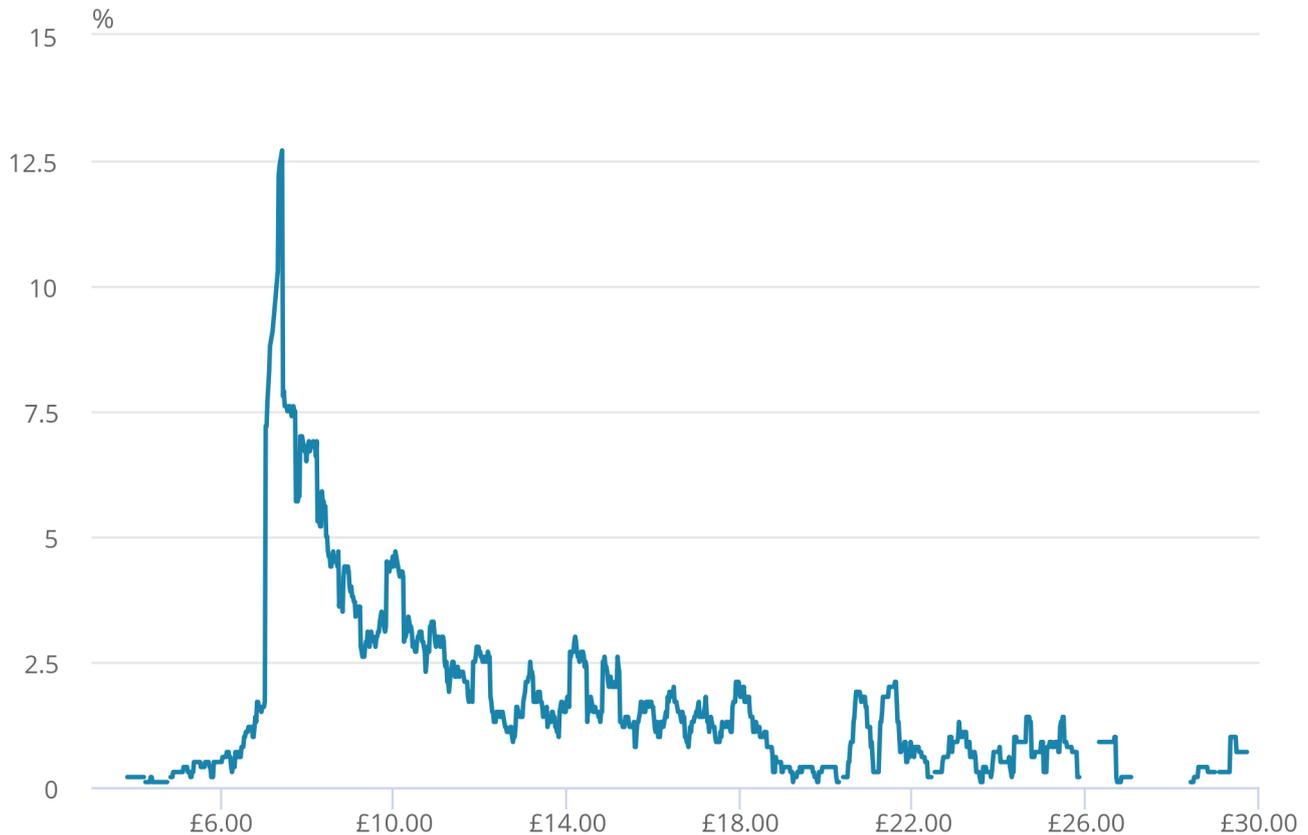
Figure 2 presents a pay distribution for all employees aged 16 and over in Quarter 4 2016. The shape of the distribution has not markedly changed since Quarter 2 (Apr to June) 2016. As in Figure 1, there is a large spike around the prevailing National Living Wage (NLW).

**Figure 2: Distribution of hourly earnings, LFS (October to December 2016), UK**

Plus or minus 20 pence

Figure 2: Distribution of hourly earnings, LFS (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## Nationality

Figure 3 compares pay distributions of hourly earnings for UK and non-UK nationals. There is a difference between distributions in the size of the spike around the National Living Wage (NLW), which suggests that a greater proportion of non-UK nationals than UK nationals were in jobs that pay close to the NLW. This could be attributed to differences in occupations between nationalities. For main jobs filled by non-UK nationals, 21% were in “elementary occupations<sup>1</sup>”, whereas for UK nationals, only 11% of jobs were in that occupation group.

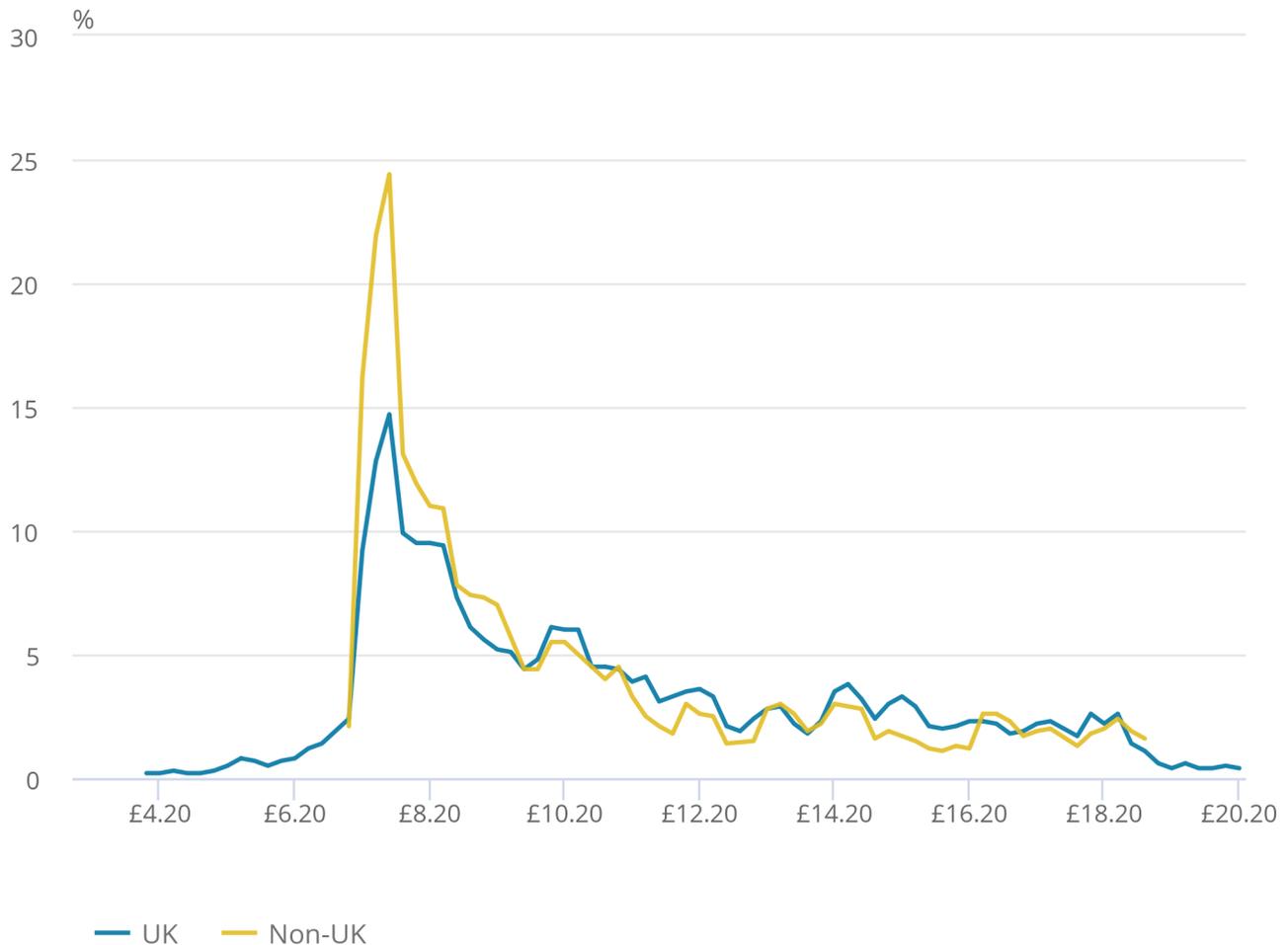
There is also a relatively large difference between the median wages of each distribution. The median hourly wage for jobs filled by UK nationals is £10.94 whereas the median hourly wage for jobs filled by non-UK nationals is £9.30.

**Figure 3: Distribution of hourly earnings by nationality, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 3: Distribution of hourly earnings by nationality, Labour Force Survey (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## Disability

Figure 4 displays pay distributions of hourly earnings by disability status, examining the differences in pay between those employees who declare themselves as disabled and those who do not.

The scope of disability used in this analysis corresponds to the definition under the Equality Act 2010. This defines an individual as disabled if they have a physical or mental impairment that has a substantial and long-term negative effect on their ability to do normal daily activities. The earnings distribution was less prominent at the National Living Wage (NLW) for those with no disability, compared to individuals with a disability.

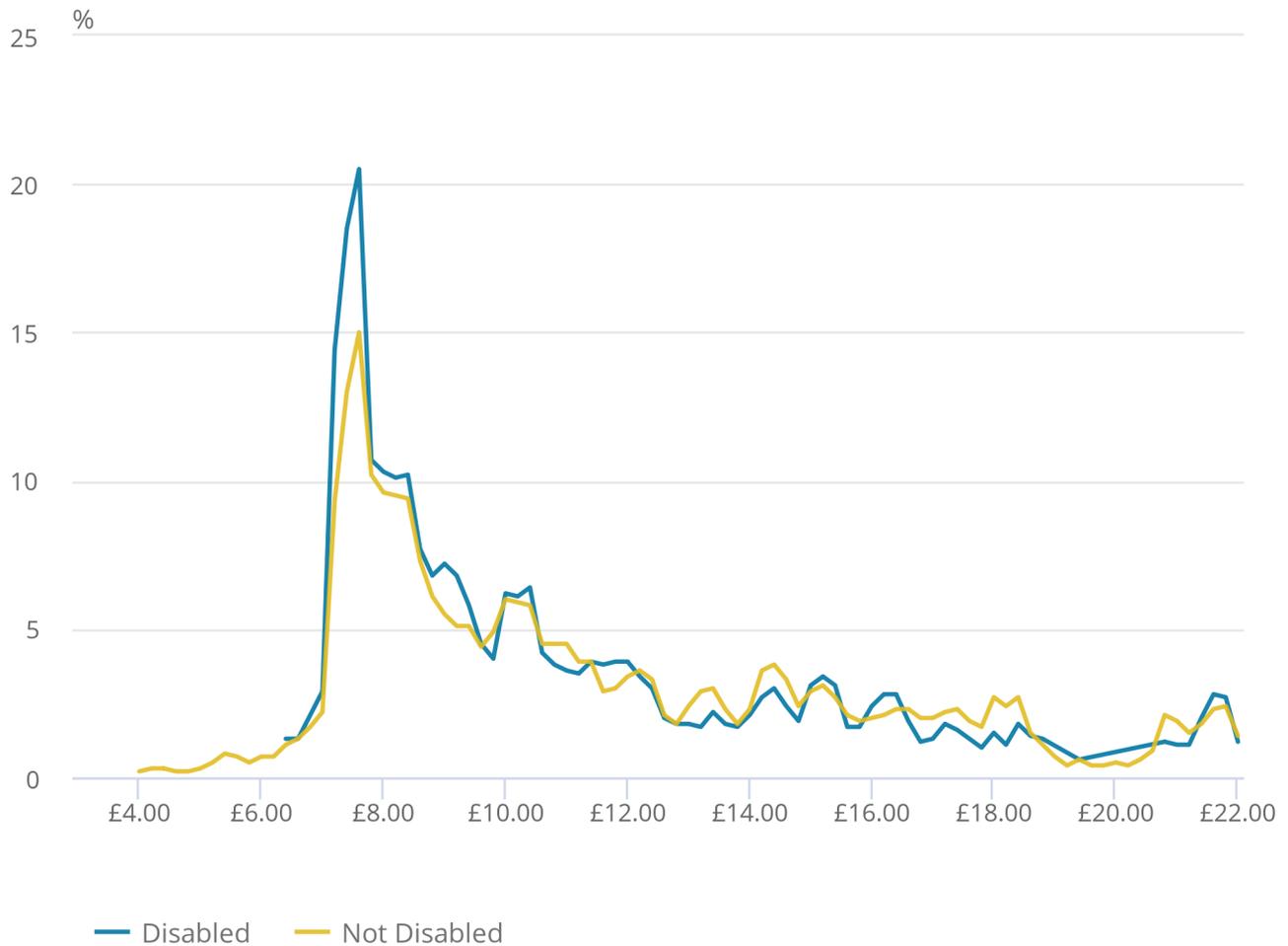
A potential reason for a difference in the size of spikes around the NLW could be due to a difference in working patterns between disabilities. For those disabled, 37% were employed in part-time jobs, compared with 25% of those not disabled. Part-time jobs are generally lower paid than those full-time jobs, with the overall median for part-time jobs in Quarter 4 (Oct to Dec) 2016 at £8.24; this is much lower than the median for full-time jobs, which in Quarter 4 2016 was £12.08.

**Figure 4: Distribution of hourly earnings by disability, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 4: Distribution of hourly earnings by disability, Labour Force Survey (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings. 2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## Gender and graduate status

Figure 5 presents pay distributions for those employees without a degree or equivalent qualification, broken down by gender. There is a clear difference between the spikes around the National Living Wage (NLW) of men and women, with a higher proportion of employed women paid close to the NLW compared with employed men.

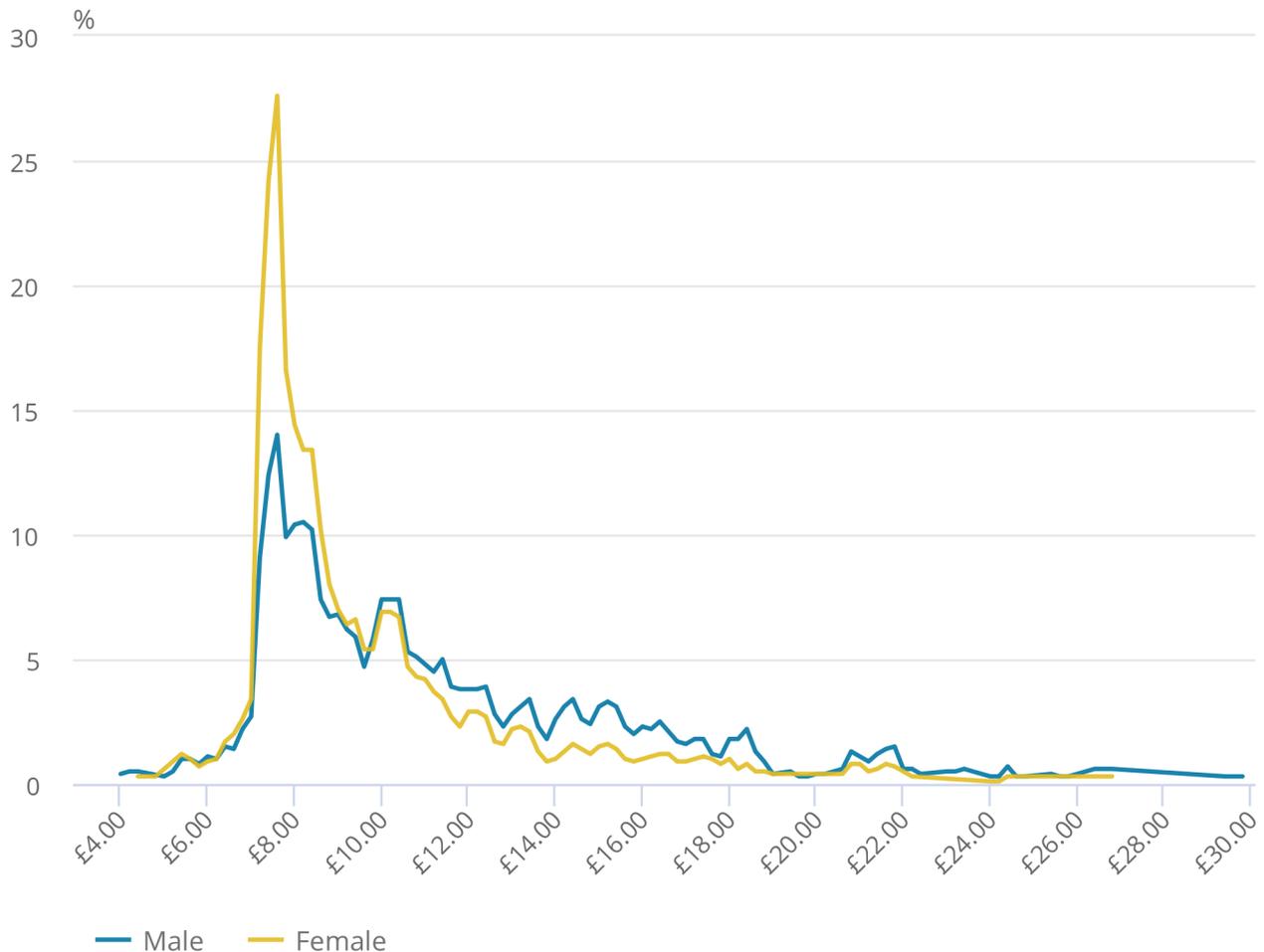
The difference between the earnings of men and women without degrees could be partly attributed to different working patterns. Employed women without a degree were more likely to be in part-time jobs, which tend to be lower paid, with 48% of non-graduate women working part-time, compared with 15% of non-graduate men.

**Figure 5: Distribution of hourly earnings of non-graduates by gender, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 5: Distribution of hourly earnings of non-graduates by gender, Labour Force Survey (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

**Source: Office for National Statistics, Labour Force Survey (LFS)**

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

Figure 6 presents pay distributions for those employees with a degree equivalent or above, broken down by gender. In contrast to the earnings distributions of those without a degree, there was no spike around the NLW in the distributions of jobs filled by men and women with a degree.

The median earnings of each distribution, however, indicate a divergence between graduates of each gender. In Quarter 4 (Oct to Dec) 2016, the median earnings for graduate male employees was £17.92, whereas that for graduate female employees was £15.00.

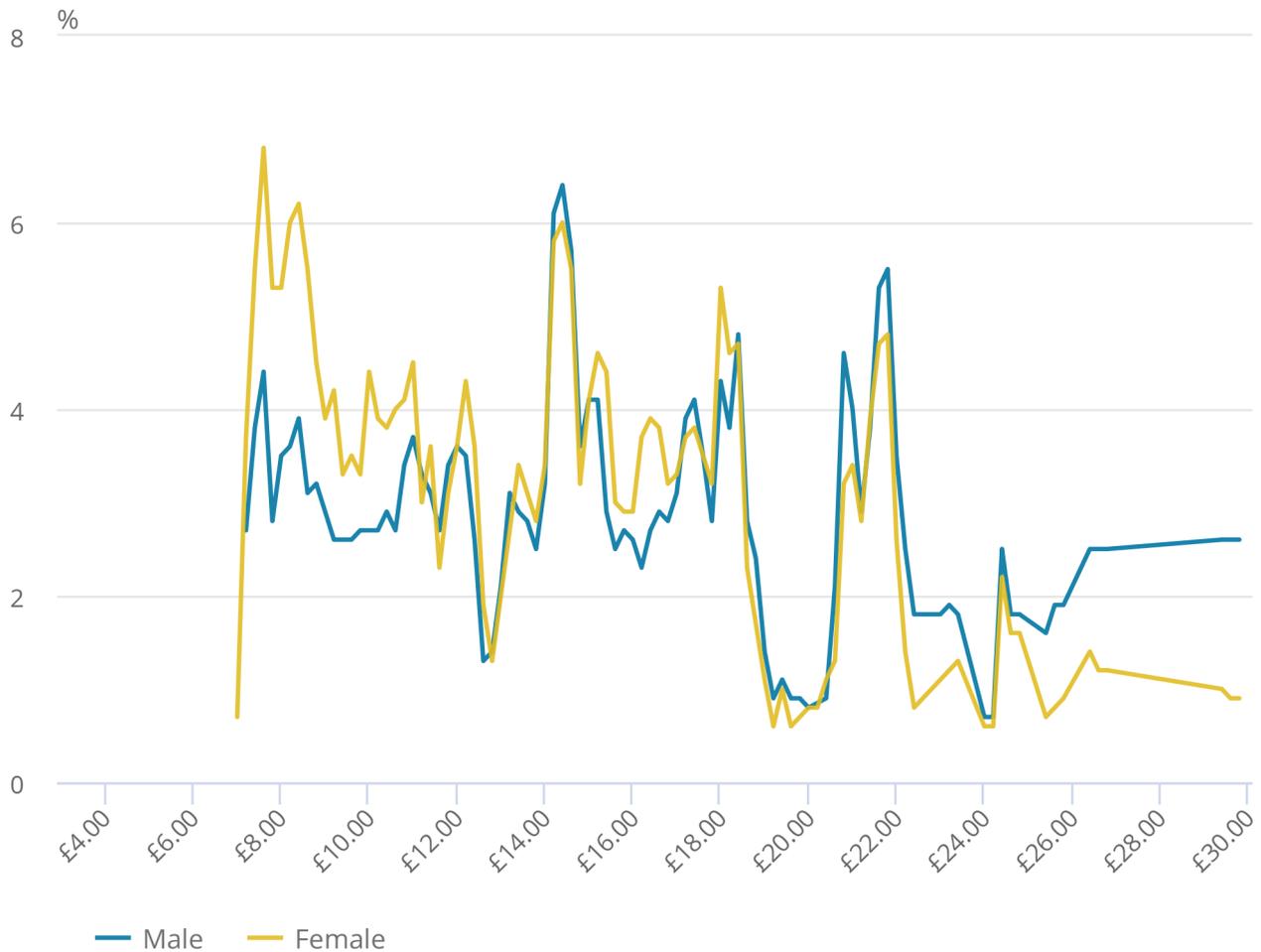
Both genders were predominately located in “professional occupations”<sup>2</sup> in their main jobs, (45% for male graduates and 50% for female graduates). Professional occupations require a high level of knowledge and experience and consist of practical application of theoretical knowledge.

However, for more senior occupations there exists a divide, 18% of male graduates were “managers, directors and senior officials”, whereas only 9% of female graduates featured in this occupation group. The difference between the two median earnings for graduates could be partly due to a lower proportion of graduate women in senior occupations.

**Figure 6: Distribution of hourly earnings by gender for graduates, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 6: Distribution of hourly earnings by gender for graduates, Labour Force Survey (October to December 2016), UK  
Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## Skill level

The Standard Occupational Classification 2010 (SOC 2010) classifies occupations into nine major groups, based on criteria such as the qualifications, skills and experience associated with each job. These nine major groups can be combined further into four skill levels. Level 1 indicates relatively low skill requirements and level 4 indicates relatively high skill requirement. These estimates are also available in ASHE, but here we offer more timely and some alternative analysis.

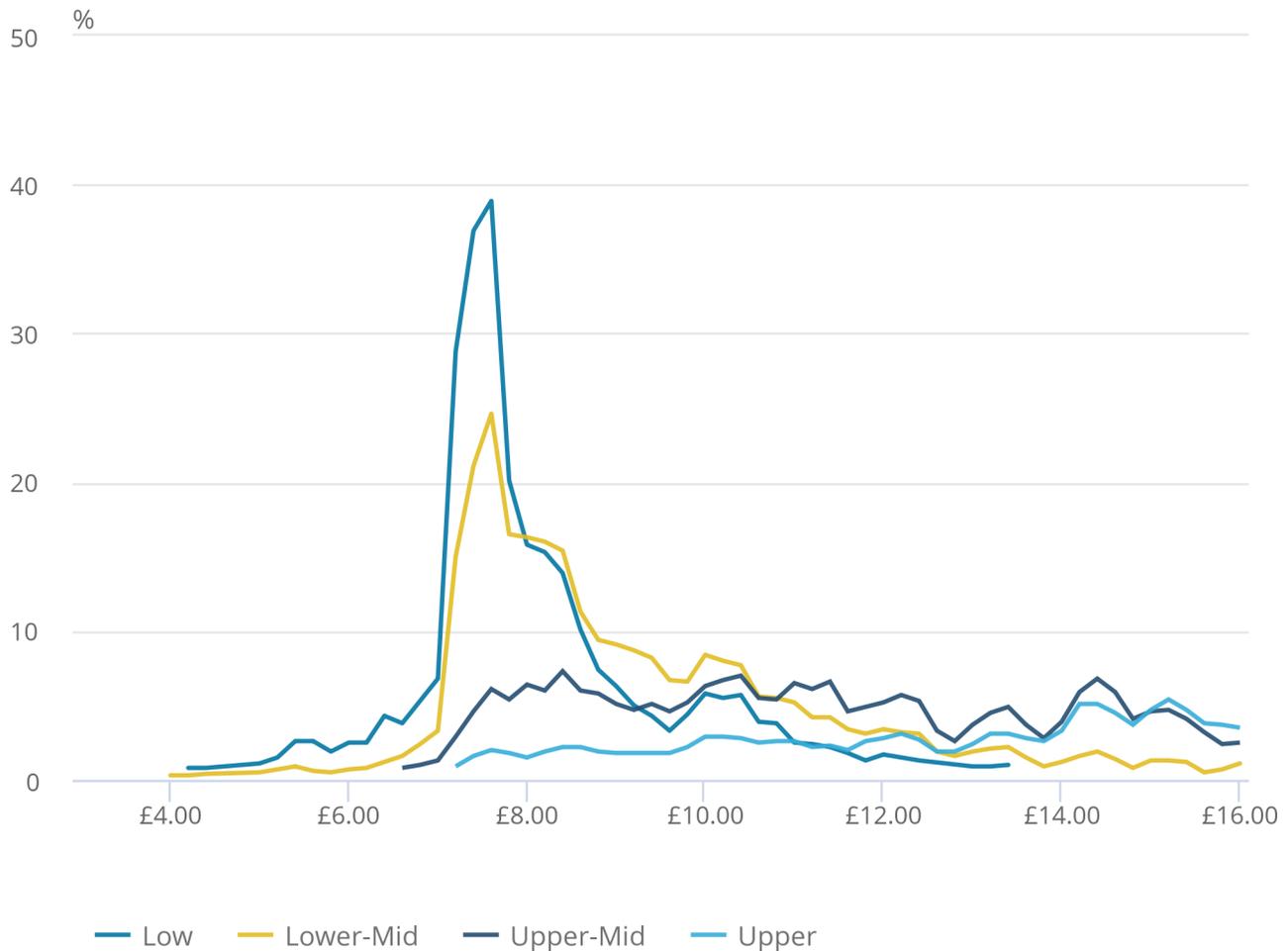
Figure 7 presents pay distributions for those jobs categorised by skill group. It shows that the distribution of earnings differs considerably for each. A relatively large proportion of jobs in the “low” category pay close to the National Living Wage (NLW). This is also true of jobs in the “lower-mid” skill category, albeit to a lesser extent. Jobs in the “upper-mid” and “upper” categories do not display a clear spike around the NLW.

**Figure 7: Distribution of hourly earnings by skill level, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 7: Distribution of hourly earnings by skill level, Labour Force Survey (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

## Public and private sector

Figure 8 presents pay distributions for public and private sector employment. While ASHE provides the lead estimates for public and private sector pay analysis, the LFS will allow for more timely and additional estimates to be conducted.

While ASHE classifications of public and private sector workers are consistent with those used in national accounts, the LFS tends to overstate the numbers in public sector employment and understates those employed in the private sector. This could be attributed to respondents being unaware of the sector they are currently employed in.

There is a larger spike around the National Living Wage (NLW) for private sector jobs compared with public sector jobs. This suggests that a higher proportion of private sector jobs are paid less per hour than public sector jobs. The median hourly wage for the private sector is £10.00, whereas the median hourly wage for the public sector is £13.75.

Examining the lower end of the pay distribution can potentially highlight differences between sectors. For those main jobs in the private sector that were paid less than £10 per hour, 24% of those were in “elementary occupations” and 20% were in “sales and customer service occupations”. This could be a potential reason for the large spike in private sector jobs earning around NLW, as these types of occupation are often associated with lower pay.

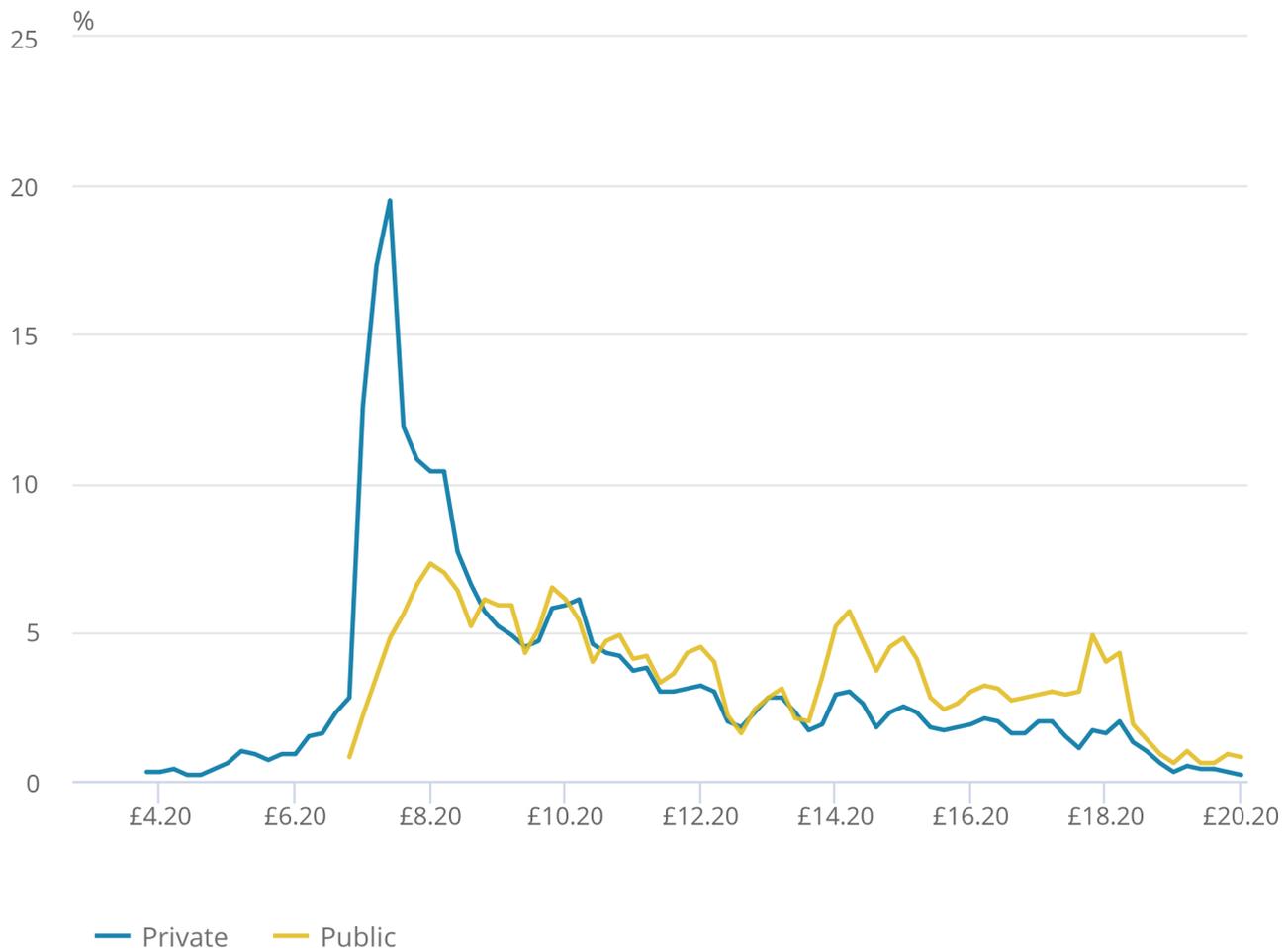
Among public sector jobs there is a different occupational structure. For those jobs in the public sector that were paid less than £10 per hour, 40% of those were “caring, leisure and other service occupations” and 23% were “administrative and secretarial occupations”. These occupations are less associated with lower pay and could present a reason for the less prominent spike around the NLW.

**Figure 8: Distribution of hourly earnings by sector, Labour Force Survey (October to December 2016), UK**

Plus or minus 20 pence

Figure 8: Distribution of hourly earnings by sector, Labour Force Survey (October to December 2016), UK

Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

Source: Office for National Statistics, Labour Force Survey (LFS)

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
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**Notes for: Analysis of the distribution of earnings**

1. This major group covers occupations that require the knowledge and experience necessary to perform mostly routine tasks, often involving the use of simple hand-held tools and, in some cases, requiring a degree of physical effort. More information on [occupation categories](#) is available.
2. This major group covers occupations whose main tasks require a high level of knowledge and experience in the natural sciences, engineering, life sciences, social sciences, humanities and related fields. The main tasks consist of the practical application of an extensive body of theoretical knowledge, increasing the stock of knowledge by means of research and communicating such knowledge by teaching methods and other means. More information on [professional occupations](#) is available.

## 6 . Analysis of jobs paid less than or close to the National Minimum Wage or National Living Wage

By examining the different earnings distributions, it is interesting to analyse the characteristics of those jobs that are located around the National Living Wage (NLW) spike. In this section we split characteristics into three main groups: job characteristics, personal characteristics and other characteristics.

In this section, we look at jobs that are paid less than or close to the relevant National Minimum Wage (NMW) or NLW for the individual's age. We define the threshold as those jobs that pay less than 1.02 times the relevant minimum or living wage. For example, a 27-year-old earning £7.32 would be included in this group, as their wage is less than 1.02 times the minimum wage for someone of his age, which is £7.20. We also include those below the age of 25, corresponding to their relevant NMW.

These estimates include second jobs where applicable but omit jobs that are apprenticeships.

Table 1 presents the proportions of jobs paid less than or close to the NMW or NLW, broken down by specific job characteristics. The occupation that had the highest proportion of lower-paid jobs in Quarter 4 (Oct to Dec) 2016 was "elementary occupations". This was followed by "sales and customer service occupations".

Median hourly earnings for elementary occupations and sales and customer service occupations are similar. In Quarter 4 2016, median earnings for "elementary occupations" were £7.63, whereas those for "sales and customer service occupations" were £7.66.

In Quarter 4 2016, the industrial group with the highest proportion of jobs paid below or close to the NMW or NLW was "distribution, hotels and restaurants". This industrial group featured a high proportion of lower-skilled jobs, with 22 % of all jobs in this industry classified as "low" skilled and 47% of jobs classified as "lower-mid".

Table 1 also shows that the smallest firms by headcount had the highest proportions of jobs paid less than or close to the NMW or NLW; 14% of jobs were low paid in the workplaces for which there is 1 to 10 employees, compared with 3% of jobs in workplaces of 250 employees or more.

**Table 1: proportion of jobs below or within 2% of NMW/NLW: by job characteristics, Quarter 4 (Oct to Dec) 2016**

<b>Occupation (Main Job)</b>	
Managers, directors and senior officials	1.6%
Professional occupations	0.4%
Associate professional and technical occupations	1.3%
Administrative and secretarial occupations	2.4%
Skilled trades occupations	4.2%
Caring, leisure and other service occupations	15.2%
Sales and customer service occupations	19.8%
Process, plant and machine operatives	11.9%
Elementary occupations	25.6%
<b>Industry (Main job)</b>	
Agriculture, forestry and fishing	11.1%
Energy and water	1.9%
Manufacturing	5.7%
Construction	1.9%
Distribution, hotels and restaurants	19.3%
Transport and communication	3.8%
Banking and Finance	5.3%
Public Admin, Education and Health	4.8%
Other Services	11.7%
<b>Number of Employees at workplace (Main Job)</b>	
1 to 10	14.2%
11 to 20	11.9%
21 to 49	11.4%
50 to 249	5.3%
250 or more	2.8%

Source: Office for National Statistics, Labour Force Survey

Table 2 shows personal characteristics of employees in jobs that are paid less than or close to the NMW or NLW.

Jobs filled by those with no qualifications were most likely to be paid less than or close to the NMW or NLW. This accounted for 27% of employees without qualifications in Quarter 4 2016. The higher the qualification an employee had attained, the less likely it was that they were paid less than or close to the NMW or NLW.

In Quarter 4 2016, a higher proportion of employees with a disability were in jobs paid less than or close to the NMW or NLW compared to those without a disability. The proportion of employees with a disability in jobs paid less than or close to the NMW or NLW was 12%. Jobs filled by disabled employees across all levels of pay were not heavily concentrated in one occupation. Among all low-paid jobs, however, 32% worked within elementary occupations.

Non-white employees were more likely than white employees to be paid less than or close to the NMW or NLW. Of all the ethnic categories, "Other" ethnic groups had the highest proportion of jobs below or around the NLW (at 17%)<sup>1</sup>. Of jobs filled by non-white employees, 16% of jobs were "low" skilled, whereas for those filled by white employees, 12% were "low" skilled.

In Quarter 4 2016, a higher proportion of jobs filled by women were paid less than or close to the NMW or NLW compared with jobs filled by men (10% and 6% respectively). Of all jobs paid less than or close to the NMW or NLW, 67% were filled by women and 33% were filled by men in Quarter 4 2016.

**Table 2: proportion of jobs below or within 2% of NMW/NLW: by personal characteristics, Quarter 4 (Oct to Dec) 2017**

Highest Qualification Held:	
Nqf level 4 and above	3.1%
Nqf level 3	8.4%
Trade apprenticeships	6.8%
Nqf level 2	10.0%
Below nqf level 2	11.6%
Other qualifications	17.2%
No qualifications	27.0%
Ethnicity:	
White	7.6%
Non-White	9.7%
Disability:	
Disabled	12.3%
Not Disabled	7.1%
Age Group:	
16 to 24	10.3%
25 to 40	8.2%
41 to 59	6.1%
60 and over	11.5%
Sex:	
male	5.8%
female	9.9%
Nationality:	
UK national	7.2%
Non-UK national	13.6%

Source: Office for National Statistics, Labour Force Survey

Table 3 shows the share of jobs paid less than or close to the NMW or NLW by other characteristics. In Quarter 4 2016, a larger proportion of low-paid jobs were filled by part-time employees compared with full-time employees (18% and 4% respectively). The majority of jobs paid less than or close to the NMW or NLW were classified as low skilled, with 42% of low-paid jobs classified as low skilled for elementary occupations and 27% classified as low skilled for sales and customer service occupations.

Zero-hour contracts are often assumed to be associated with low-paid jobs. Table 3 shows that 20% of jobs with zero-hour contracts were paid less than or close to the NMW or NLW in Quarter 4 2016, a much greater share than the 8% of jobs with non zero-hour contracts.

Table 3 shows regional variation in the share of jobs that were low paid<sup>2</sup>. In Quarter 4 2016, the country with the highest proportion of jobs paid less than or close to the NMW or NLW was Wales, at 12%. Within England, the North East and the North West had the highest proportion of jobs paid less than or close to the NMW or NLW, whereas those with the lowest proportion of low-paid jobs were located in the south of the country.

**Table 3: proportion of jobs below or within 2% of NMW/NLW: by several characteristics, Quarter 4 (Oct to Dec) 2017**

Working Pattern:	
Full-time	4.4%
Part-time	17.9%
Zero Hour contracts:	
Yes	20.3%
No	7.5%
Regions:	
Scotland	7.3%
Northern Ireland	10.5%
Wales	11.7%
South East	6.0%
South West	8.1%
London	4.5%
The Midlands	9.0%
The North East	9.9%
The North West	9.2%
East of England	7.1%
Skill:	
Lower	24.7%
Lower-mid	11.6%
Upper-mid	2.3%
Upper	0.8%

Source: Office for National Statistics, Labour Force Survey

**Notes for: Analysis of jobs paid less than or close to the National Minimum Wage or National Living Wage**

1. "Other" ethnic group includes respondents in Northern Ireland identifying themselves as "Irish Traveller" and respondents in all UK countries identifying themselves as "Arab".
2. Note that regional variation refers to region of residence, rather than workplace.

## 7 . Methodology

The Labour Force Survey (LFS) is a household survey for which results are published on a quarterly basis. Respondents are in the survey for five quarters (or waves) and earnings information is asked of those in waves one and five of the survey. These estimates for individuals are then weighted to make estimates for the whole population.

Among the earnings questions asked in the LFS are those about a respondent's basic hourly rate of pay, as well as gross weekly pay for the pay period and actual hours worked in the week preceding the interview. A derived hourly rate can be calculated by dividing gross weekly pay by the usual number of hours worked. The LFS also collect a stated hourly rate directly from respondents.

In theory, the two measures should give the same estimates of hourly pay; in practice, they can differ by considerable amounts due to measurement error in the LFS. Skinner et al (2002) provides more detail in "The Measurement of Low Pay in the UK Labour Force Survey". For a household survey such as the LFS, a stated rate is more accurate than a derived rate for measuring low pay, as less information is needed to be accurately recalled (see Ormerod and Ritchie 2007).

Although the stated rate is the preferred measure of low pay in the LFS, the main difficulty is that not all respondents give a stated hourly rate, which happens in about two-thirds of cases. To overcome this, Office for National Statistics (ONS) developed an imputation technique. The values of hourly pay are imputed using nearest neighbour donation for those respondents who did not provide one. A summary of the methodology is detailed in this section.

Firstly, a regression analysis with the natural log of the stated hourly rate as the dependent variable and a list of independent variables including derived hourly rate of pay, occupation, qualifications, age, gender and marital status is performed.

The regression allows outlier observations to be identified using a measure called the Cook's distance. Outliers may correspond to errors in the recorded data, which may be detected by looking for systematic discrepancies between the stated and derived imputed rates. For example, where the stated measure of earnings for an individual is recorded as being approximately 10-times bigger than the derived measure for the same individual, and where the Cook's distance for the observation suggests that the observation is an outlier, it may be concluded that an error in data entry has been made. In such cases, the observation is treated by dividing the stated measure by 10 to amend the observation. A similar approach is used to detect 100-fold errors.

An observation on stated earnings may have a large Cook's distance simply because the level of earnings is far from what would be expected given the individual's other surveyed characteristics. Such observations at this stage have their stated earnings value set to missing. These missing values are later filled by imputation, as explained in this section.

The estimated parameters from the final regression model are then used to predict a fitted value of the log of stated measured earnings for each observation. The observations are then put in order of their fitted value. This means that observations that are similar to each other appear close to (or for most similar observations, next to) each other in the dataset. More similar observations in terms of characteristics included in the regression are closer "neighbours" in terms of position in the dataset.

Observations are then split into separate groups that correspond to the National Minimum Wage (NMW) or National Living Wage (NLW) for that period. In Quarter 4 (Oct to Dec) of 2016 the ages are split into four groups: 16 to 17, 18 to 20, 21 to 24 and 25 and over, to prevent donation across the NMW bands.

Imputation then proceeds as follows: cases that do not have a stated hourly rate take as donor values stated hourly earnings from the five cases immediately above and the five cases immediately below them in the rows of the dataset; each case therefore ends up with up to 10 values of hourly earnings. As the dataset has been arranged so that “similar” observations in the same age band lie closer together in the rows of the dataset, the donor earnings values should be plausible given the individual’s characteristics.

For observations for which stated earnings are missing, the average is taken across the 10 nearest neighbour donor values. This figure is used as that observation’s earnings estimate. Observations that have a non-outlier value for stated earnings do not require use of their donor values. The earnings for such observations remain as stated.

The regression and imputation steps previously mentioned are repeated separately for earnings in second jobs. The main and second job datasets are then combined to create a dataset for all jobs. The data from different age bands are recombined. The resulting set of pay data are used to produce the distributions presented in the first section of this article.

Our analysis also includes estimates of “low pay”, by which we mean proportions of jobs paid either below or less than 1.02 times the NMW or NLW. For this we use earnings estimates obtained by the methodology previously mentioned for both main and second jobs. The estimates are for jobs occupied by those aged 16 and over, excluding apprentices and the self-employed. We restrict our analysis to the part of the hourly earnings distributions below £40 per hour.

It is worth contrasting our LFS-based measure of low pay with that used to produce the official low-pay figures from the Average Survey of Hours and Earnings (ASHE). The ASHE low-pay estimates use a derived measure of hourly pay. This is calculated from gross pay less any overtime payments, shift or premium payments, divided by basic weekly paid hours. It applies only to those aged 16 and over, and only to those whose earnings were not affected by absence. For individuals that meet these criteria, the derived weekly pay value is checked against the applicable NMW or NLW for the individual’s age. Apprentices are included in the most recent ASHE estimates and their earnings are counted as “low-paid” if they are below the specific apprenticeship NMW rates.

It is useful to compare the distribution of imputed earnings calculated using the method of this article, with the distributions based on the stated and derived LFS earnings variables for Quarter 4 of 2016. This makes clear the effect of the choice of method on our results. To be as comparable as possible with the original LFS variables, we use earnings for main jobs only. The distributions are presented in Figure 9.

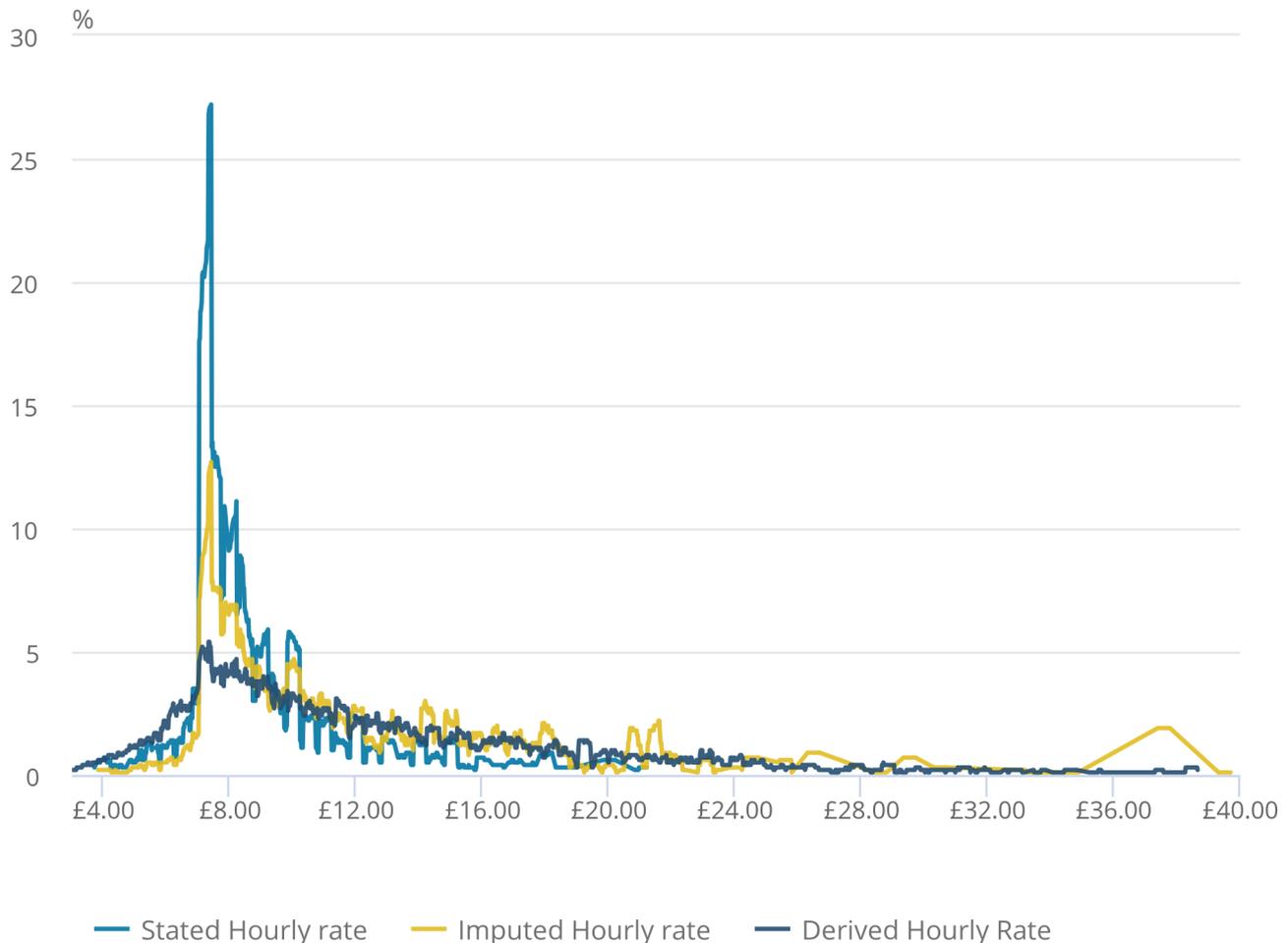
It can be seen that the distribution of the directly-measured earnings variable displays a very sharp peak, representing an implausibly high percentage of jobs paying around the NLW. The distribution for the derived earnings variable meanwhile has far more weight in the lowest parts, especially below the NLW.

The distribution for the imputed earnings variable lies between these two extremes close to the NLW. Compared with the stated and derived rates however, the imputed rate has proportionately less weight in the lowest parts of the distribution, and more on average in the upper parts.

**Figure 9: Comparison of stated measured, derived and imputed Labour Force Survey earnings distributions, main jobs, UK, Quarter 4 (Oct to Dec) 2016**

Plus or minus 20 pence

Figure 9: Comparison of stated measured, derived and imputed Labour Force Survey earnings distributions, main jobs, UK, Quarter 4 (Oct to Dec) 2016  
Plus or minus 20 pence



Source: Office for National Statistics, Labour Force Survey (LFS)

**Source: Office for National Statistics, Labour Force Survey (LFS)**

**Notes:**

1. Each point on the x-axis represents a rolling sum of the density of jobs receiving greater than or equal to 20 pence below, and strictly less than 20 pence above, the stated hourly earnings.
2. As the density records the rolling sum of jobs paid within 20 pence of the stated amount at each point on the x-axis, jobs paid the April 2016 Adult National Living Wage (£7.20) will appear between the x-axis values of £7.00 and £7.40.

We can also compare the means and medians of the hourly earnings variables from the LFS and with our imputed measure. Table 4 shows that both the mean and median of the imputed hourly rate for main jobs lie in between those of the stated and derived estimates from the LFS. As Figure 9 suggests, however, the imputed hourly rates are closer to the derived rate than the stated rates both in terms of mean and median.

As we have shown in Figure 1, the earnings distribution for Quarter 2 (Apr to June) 2016 derived from the imputation procedure closely matches that produced using the official ASHE source. In particular, it is able to capture the spike around the NLW.

**Table 4: Means and medians for stated, derived and imputed hourly LFS earnings variables, main jobs, Quarter 4 (Oct to Dec) 2016**

	Imputed	Stated	Derived
Mean	£13.63	£9.44	£13.81
Median	£10.80	£8.00	£11.05

Source: Office for National Statistics, Labour Force Survey

## 8 . Future analysis

This article uses Quarter 4 (Oct to Dec) 2016 data to illustrate the methodology of providing pay estimates from Labour Force Survey (LFS) data. Future analysis will look to incorporate more recent data.

On 26 October 2017, the Annual Survey of Hours and Earnings (ASHE) will release its earnings estimates for 2017, which provides the official pay estimates for the UK.

## 9 . References

Office for National Statistics, 2009, [Economic and Labour Market Review. Characteristics of those paid below the National Minimum Wage.](#)

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