

# Measuring low pay: Focus points and rounding

## Authors:

Catrin Ormerod and Felix Ritchie  
Earnings Analysis Branch  
Social Economic Micro Analysis and Reporting Division  
Office for National Statistics  
01633 81(2019)  
[Catrin.Ormerod@ons.gov.uk](mailto:Catrin.Ormerod@ons.gov.uk)

## Summary

Earnings information from household surveys is less accurate than employer information. Household surveys include proxy responses and may not use documentation, so earnings are often approximated at 'round' values. However the setting of the 2005 NMW at £5.05 provides a natural experiment in how survey responses are approximated. This paper identifies a tendency to round certain information: employers in setting hourly wage rates and employees in reporting their earnings in household surveys. An important implication, that LFS low pay estimates will be affected by the proximity of the NMW to round numbers, is demonstrated by comparing low pay estimates across years.

## Introduction

The ONS uses information on hours and earnings to measure the number of jobs paid below the National Minimum Wage (NMW)<sup>1</sup>. The main source of information for these low pay estimates is the Annual Survey of Hours and Earnings (ASHE)<sup>2</sup> and the National Statistics for low pay are based on ASHE figures (Milton (2004)).

However, ASHE is not the only source for official low pay statistics. The household-based Labour Force Survey (LFS)<sup>3</sup> also includes information on hours and earnings, as well as personal characteristics. As ASHE has very limited information on the individual, LFS estimates are required to support the ASHE estimates where breakdowns by personal characteristics are required (for example, skill, ethnicity and disability). Also, despite improvements to the sampling in ASHE the LFS still adds value with individual level information about low earners.

A high value is therefore still placed on the LFS estimates of low pay, and the LFS methodology has recently been improved (Ormerod (2006)). However, information on hours and earnings from the LFS is not as accurate as that provided in ASHE. Understanding the differences between ASHE and LFS estimates is important for sectors of the population which cannot be estimated using ASHE.

Estimates from the ASHE and LFS differ for two main reasons. The first is a methodological issue. ASHE estimates of low pay are based on a derived hourly pay

rate, calculated by dividing actual earnings by hours. The LFS figure is based upon the stated rate supplied by respondents, where this is available; otherwise this is imputed using a model where the derived rate of pay has the most influence (see Ormerod (2006) for a full description of the methodology). A more detailed description of the differences that arise from this methodological view point can be found in Griffiths et al (2007).

This paper focuses on the second reason for the differences; the source of the information. ASHE estimates should be provided by employers from actual pay records (and ONS survey checks confirm that this is overwhelmingly the case). LFS responses are recalled by the respondents, often without reference to documentation. In around 30 per cent of cases the respondent is not available when the survey is carried out, and a “proxy response” is provided by another member of the household.

One widely-held concern about the LFS data has been recall bias, and the large proportion of proxy responses increases this concern. It is difficult to assess the true extent of this problem because, by its nature, there has been no corroborating information available on individual responses. Lam et al (2006) observe that companies tend to pay wage based around ‘round’ numbers such as £5.00, £5.50, £6.00 per hour, which reduces the likelihood of respondents rounding figures further. Ormerod and Ritchie (2006, 2007a) suggest that worries over discrepancies between ASHE and LFS may be overrated: there is evidence to suggest that for the broad range of earnings the LFS is an unbiased estimator of the ASHE data. However, these general conclusions do not necessarily satisfy concerns about the data at the unit level.

2006 provides a unique opportunity to study this issue using survey returns alone. In April 2006, when ASHE is collected and LFS estimates are available, the National Minimum Wage for employees aged 22 or over was £5.05 per hour. The closeness of this figure to the ‘memorable’ and popular (prior to 2006) wage rate of £5.00 per hour provides a natural experiment in how respondents view their earnings; and this can be contrasted with 2004, when the NMW hit one of the other ‘round’ numbers, £4.50, exactly.

This paper uses the data to answer the question: is there significant recall error in the LFS? The answer is that recall error can be observed, but not where it was expected, and the results do support the use of the current LFS method for calculating low pay. The results also support the view of Lam et al (2006) that employers also tend to prefer ‘round’ numbers and focal points when setting wages.

The next section discusses rounding and the scope for recall error. The following section examines the 2004-2006 responses to try to identify cases of recall error. The paper then considers the impact on low pay estimates, and the final section concludes with some comments on the interpretation of LFS and ASHE data.

## Focus points and rounding

LFS respondents are asked to recall wage rates, total hours and total earnings; the latter two are also expected to refer to the same period. Given the larger potential for error in deriving a wage rate based upon recalled hours and total earnings, the stated rate is the preferred measure of wage rates for LFS respondents. However, a stated rate is only relevant for half the respondents and the derived rate is then used to impute a stated rate. ASHE in contrast reports total hours and earnings accurately and therefore the official low pay estimates from this source uses a derived measure of hourly earnings.

Lam et al (2006) showed that employers like to pay employees on wage rates at 'round' values, such as £4.50, £5.00 and to a lesser extent £5.75, £6.25. It is likely that household members paid at these wage rates would accurately recall rates, total wages and total hours. However, the actual wages paid in survey weeks often do not correspond to round values, and the concern here is that LFS respondents who do not refer to pay records carry out the rounding themselves: £4.95 being reported as £5.00, and so on. Total hours and earnings may also be rounded. Thus both ASHE and LFS show a large number of employees being paid £5.00 per hour prior to 2006. Whether this a true figure or rounded is impossible to determine.

However, the April 2006 National Minimum Wage (NMW) of £5.05 provides a natural experiment to test rounding by comparing stated and derived rates surrounding the £5.05 mark. Individuals rounding wages are likely to round down to £5.00; rounding wages up to £5.10 does not seem a likely alternative to using the actual wage. Observing large numbers of employees paid at £5.00 rather than £5.05 would imply significant rounding. This conclusion can be tested by comparing the ASHE records, which are compiled from documentation and are less likely to be subject to rounding error. The findings can also be tested by comparing the data with other years.

As well as rounding on the wage rate, household respondents may be rounding on total hours and earnings too. This is also likely to lead to more observations at £5.00 on the derived wage. This then leads to a further source of supporting information. If the derived and stated wage rates differ, the two can be investigated for evidence of rounding.

Two years are studied in comparison with 2006. In 2004, NMW was set at £4.50. This is one of the 'focal points' where employers tended to fix wages; it also a relatively straightforward number to use in calculations. In contrast, in 2005 the NMW was £4.85, which does not have any obvious 'round' numbers in the vicinity. Hence, if rounding by household surveys is a significant issue then in the LFS:

- 2004 should show little rounding effect, with derived and stated rates similar and a peak of employees paid at the NMW
- 2005 should demonstrate no particular peak around the NMW, and a distribution of values around the NMW
- 2006 should demonstrate a peak at £5.00, below the NMW.

## Earnings around the NMW

### *Differences between the stated and derived rate*

**Figure 1** shows the distribution of earnings around the NMW in ASHE and LFS for individuals aged 22 and over using the stated and derived hourly rate measures. ASHE estimates of low pay are based on the derived hourly rate of pay and this is shown in figure 1a. Peaks at the NMW can be seen clearly for 2004 at £4.50, at £4.85 in 2005 and at £5.05 in 2006. Peaks in the derived rate are also clearly visible at other focus points in the distribution, £5.00, £5.50 and £6.00.

In 2005 the peak at £5.00 is particularly high suggesting that when the minimum wage is close to a round number many employees chose to pay the next round number up. This is not the case in 2006 with the minimum wage at £5.05. Rounding to the next focus point at £5.50 may be too much of an increase from the NMW (it would have been a 13.4 per cent increase in hourly rate compared with the 4.1 per cent in the NMW itself) and there is therefore a higher peak at the NMW in 2006 than observed in previous years. The change in the percentage of jobs below the NMW is also related to the size of the uprating (see Lam et al (2006) but the position relative to a focus point also appears to be significant. Lam et al also showed that companies have some flexibility in setting wages, many choosing to pay their lowest paid employee at a slight premium above the NMW. However, there will be limit on the premium that they pay, with convenience competing with cost.,

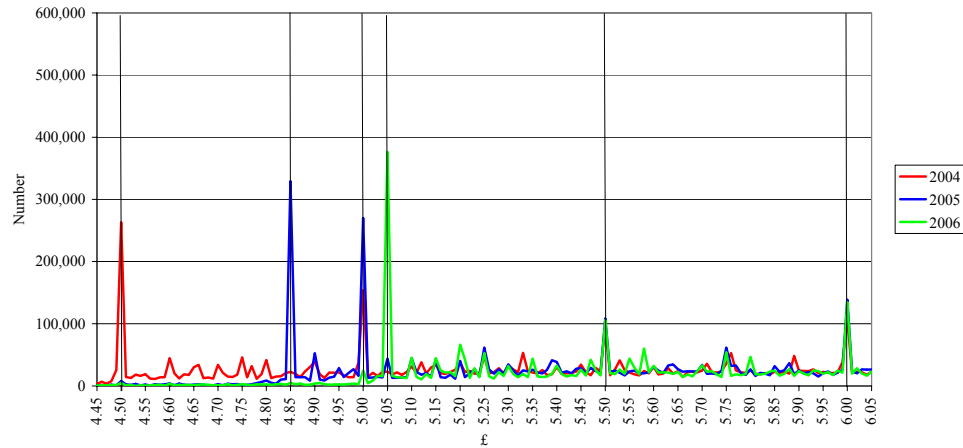
Employers are aware that they can not round down and are unlikely to round-up by a large amount. It therefore appears that the NMW, depending on its position relative to a focus point, can encourage some employers to take their earnings higher than the NMW if this is set close to a focal point. This could suggest that many employers could use £5.50 as their lowest wage following the uprate in October 2006 to £5.35.

This contrasts with the picture for the derived rate of pay from the LFS, in figure 1b. Here peaks are clearly visible at the focus points but only small peaks appear at the minimum wage values. Respondents on the LFS may not match the hours and earnings for a period; this will give an inaccurate derived hourly rate. Equally respondents may round their hours or earning resulting in a 'rounded' derived rate. As employers respond to the ASHE they will be eager to provide accurate hours and earnings information as they do not want wages to appear to be below the NMW. LFS respondents do not have the same incentive.

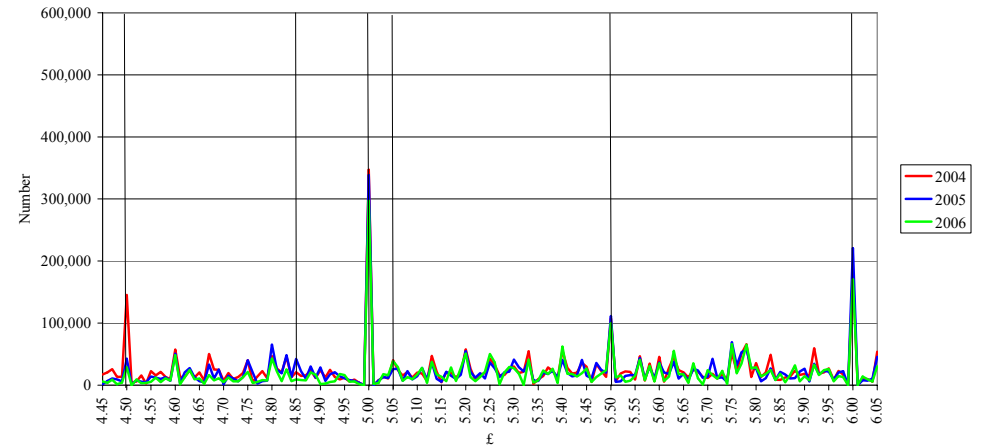
For the stated rate in ASHE (figure 1c) peaks are clearly visible at the NMW and at focus points. For the LFS stated rate earnings are all focussed on 5 pence bands with higher peaks at focus points (for example no respondent reports £4.23, only £4.20 or £4.25 is observed). In 2006 the LFS stated rate shows a peak at £5.00 and at the NMW value of £5.05. The peak at £5.00 is much lower in 2006 than for previous years and seems to have shifted to the £5.05 point. Concern that individuals being paid at £5.05 are rounding to £5.00 is not as problematic as anticipated. Rounding the stated rate is less common than thought.

**Figure 1:** Earnings for individuals aged 22 and over, 2006

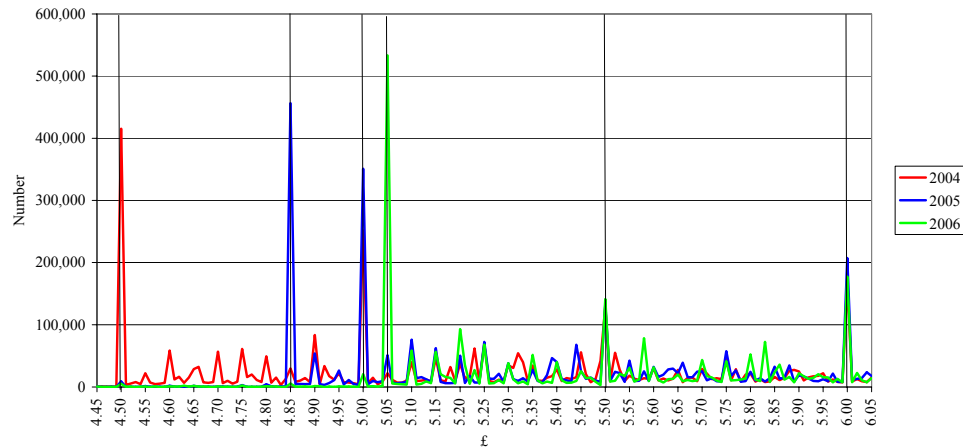
a) ASHE Derived rate of pay



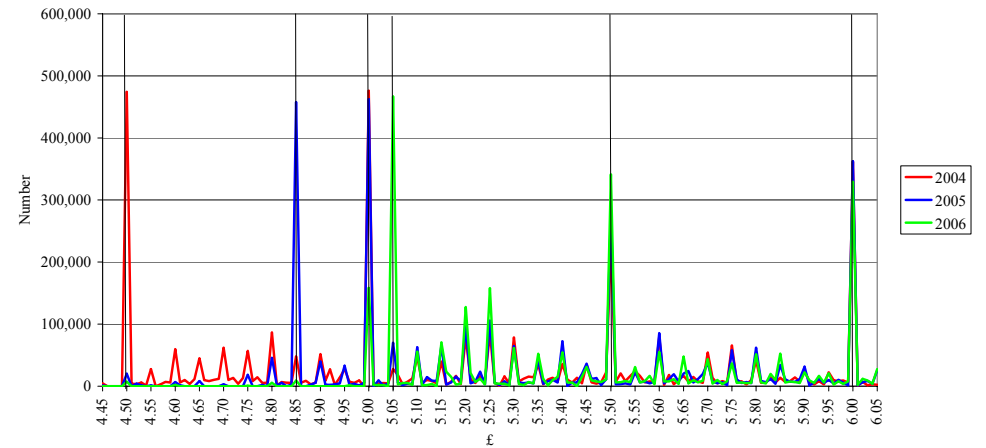
b) LFS Derived rate of pay



c) ASHE Stated rate of pay



d) LFS Stated rate of pay



Notes:  
LFS March-May quarter

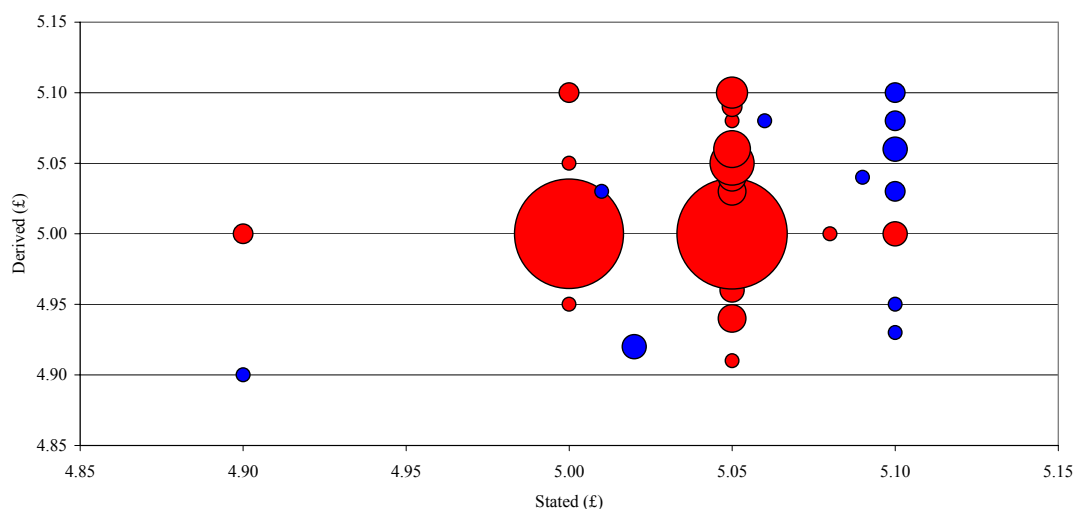
These charts therefore support the current methodologies for ASHE and LFS. The derived rate in ASHE shows peaks at the NMW, suggesting a derived rate based on actual earnings and hours measure hourly rates well. The stated rate shows almost no individuals being paid less than the NMW. There is the counter argument that employers are aware their information is being used to measure the low paid and care is taken to ensure the calculation would be correct at this level. This is however still more reliable than the stated rate in ASHE, as employers will be even more reluctant to write down a stated rate less than the minimum wage.

### ***Rounding in the LFS***

For the LFS there is no concentration around the NMW values for the derived rate, suggesting either rounding or a mismatch in earnings and hours makes the measure unreliable. The stated rate shows clearly peaks at the NMW values, suggesting that individuals are aware of their hourly rates and do not round these. The derived rate is used in the LFS when a stated rate is not provided. Comparing responses to the derived and stated rate at this level therefore helps to understand the nature of the LFS low pay estimates.

**Figure 2** shows the number of respondents with derived and hourly rate values around the NMW in 2006. The size of the point is related to the number of respondents. Most respondents have a derived rate of £5.00. Half of these also have a stated rate of £5.00, but the other half have a stated rate of £5.05. For all the respondents with a stated rate of £5.05 a variety of derived rates are provided. This suggest that for individuals having both a stated and derived rate the stated is more accurate. This is based on the assumption that a reported hourly rate of £5.05 is correct, it is unlikely that an individual would report such a value when estimating or rounding.

**Figure 2:** Number of respondents with stated and derived hourly rate values between £4.85 and £5.15, aged 22 and over, March-May 2006



Note: small numbers have been randomly adjusted to maintain confidentiality

Further examination of the individuals involved shows that rounding is the predominant cause of the inaccurate derived rate. **Table 2** shows some examples of common recording errors on LFS which results in derived rate appearing at focus points. This is particularly applicable to 2006 where a small degree of rounding causes a respondent's earnings to fall below the NMW.

**Table 2:** Examples of common reporting errors in 2006

	<b>Actual</b>	<b>Reporting error 1 – rounding hourly rate</b>	<b>Reporting error 2 – rounding total earnings</b>
Weekly earnings	202.00	202.00	200.00
Weekly hours	40.00	40.00	40.00
Derived rate	5.05	5.05	5.00
Stated rate	5.05	5.00	5.05
Frequency of error		Less common	More common

This is intuitively sensible. Employees are likely to know their hourly rate as this does not change from week to week. Weekly hours and earnings can however vary from week to week which makes recalling them more difficult. On examining the data closely the majority of rounding appears to relate to total earnings causing a round hourly rate to be provided.

It has been suggested that this is an unlikely result; unless individuals work a whole number of hours and round to the nearest £5, there would not be the large number of individuals who generate a derived wage of *exactly* £5.00. One possibility is that the cause and effect is reversed: individuals state a £5.05 or £5.00 wage rate but use the latter to calculate and report total earnings. Looking at the individual data points, this does seem a feasible solution; in many cases it is not clear why the 'rounded' number (£187.5 for a 37.5-hour week, giving a £5.00 derived rate) is necessarily much easier to remember than an 'unrounded' number (£189.38, giving a £5.05 rate) but calculating the total from multiplying up is simpler. This cannot be tested in the data, but may be an issue for the survey interviewers to consider.

### *Bad memory, bad knowledge or bad records?*

It was noted above that two of the concerns about the accuracy of the LFS relate to the use of proxy responses and the lack of supporting documentation. A natural question to ask is whether these contribute to the rounding effect. **Table 3** shows the types of responses and whether documentation was used for hourly rates quoting £5.00 or £5.05.

**Table 3:** Percentage of respondents with £5.00 and £5.05 hourly rate measures by proxy response and whether documentation was used, aged 22 and over, March-May 2006

Stated £	Derived £	Type of response			Documentation used				
		Personal %	Proxy %	Brought forward <sup>a</sup> %	Payslip %	Statement <sup>b</sup> %	Other %	None %	
5.00	5.00	46	54	-	7	-	2	92	
5.00	5.05	*	*	-	-	-	-	*	
5.05	5.00	79	21	-	13	-	-	87	
5.05	5.05	90	10	-	30	-	-	70	
Other General	Other	72	27	1	20	-	2	78	
		72	27	1	20	-	2	78	

Notes:

\* Frequency suppressed for confidentiality reasons

- Zero or less than 0.5%

a Information brought forward from previous quarter

b Bank or building society statement

Where the stated and derived value are both £5.05 the respondents are more likely to have provided the response themselves and with reference to documentation. Although it is impossible to tell whether the rates have been provided accurately it can be assumed that quoting such a number and obtaining a derived rate exactly equal to it suggests the information is accurate. This is borne out by the fact that 90 per cent of these individuals provided the information themselves.

Only a small number of cases have a stated rate of £5.00 and a derived of £5.05; hence the numbers are not shown here. Where the stated rate is 'accurate' at £5.05 and the derived rate is rounded to £5.00 this is more likely to be a personal response. In all cases proxy responses are more likely to round one or both rates.

The table supports the idea that documentation is a source of error: correct answers are more likely to be supplied with documentation. It is a concern that 7 per cent of payslips appear to suggest earnings below the NMW, but this may well be those employees who are exempt from NMW.



### *Effect on low pay estimates*

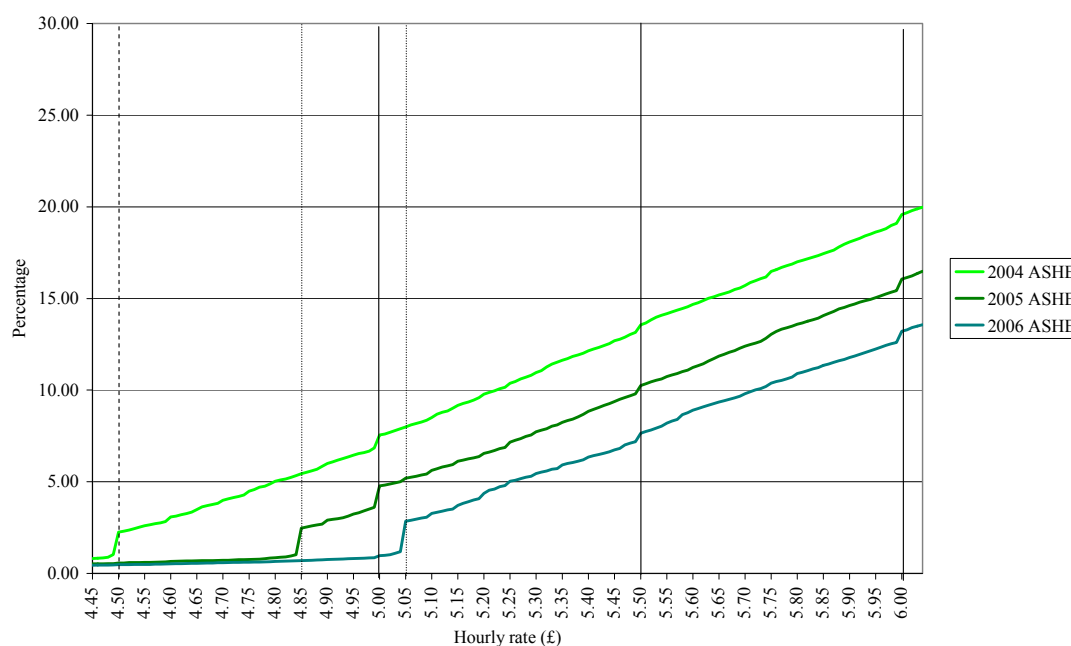
Griffiths et al (2007) show how the official measure of low paid (using ASHE) is sensitive to assumptions used in calculations. Ormerod (2006) demonstrates how a change in the methodology for a small part of the sample leads to a large impact on the LFS estimates of the low paid.

Interpretation of the percentage of jobs paid below the NMW in LFS can be improved by understanding the way individuals respond to questions on hours and earnings.

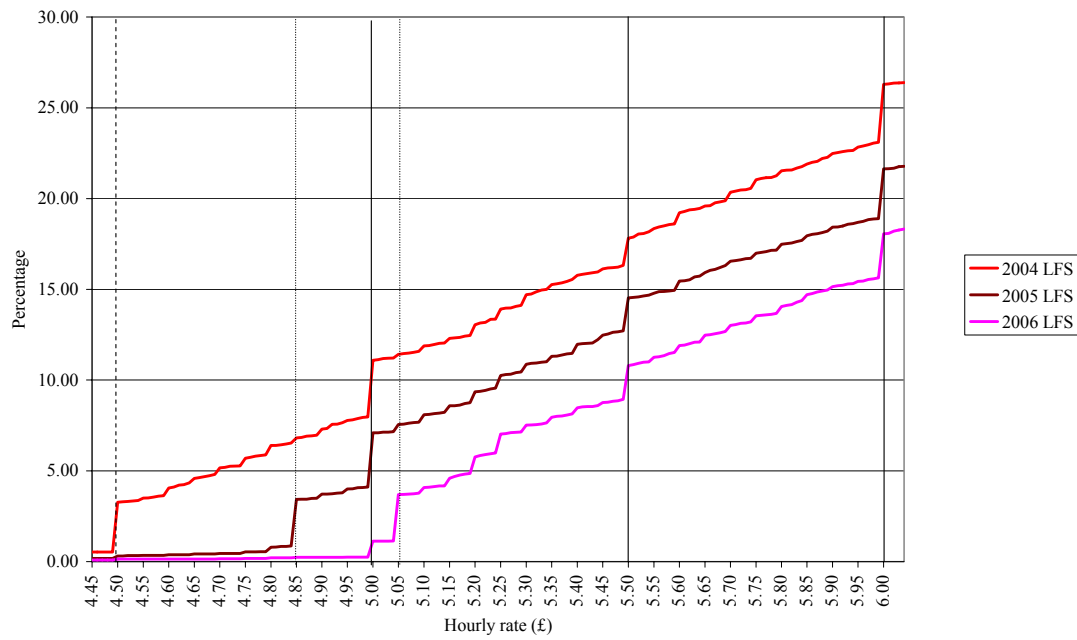
**Figure 3** shows the percentage of jobs paid below various thresholds including the NMW. **Figure 4** shows the equivalent LFS estimates. Jumps in the distribution are clearly visible at the NMW values for ASHE, but very little movement is seen elsewhere; there are little jumps at the focus points.

For LFS there are large jumps at the NMW and at the focus points. The jump at the NMW in 2006 at £5.05 appears to be less than the jump at other NMW values. The £5.00 threshold appears to have taken some of the increase that would normally be seen at the NMW. This suggests that the LFS measure in 2005 may be higher than the true value because the £5.00 mark is so close and a small error has a large effect on the low pay estimate.

**Figure 3:** Percentage of jobs paid below various hourly rate values, ASHE 2004-2006



**Figure 4:** Percentage of jobs paid below various hourly rate values, LFS 2004-2006

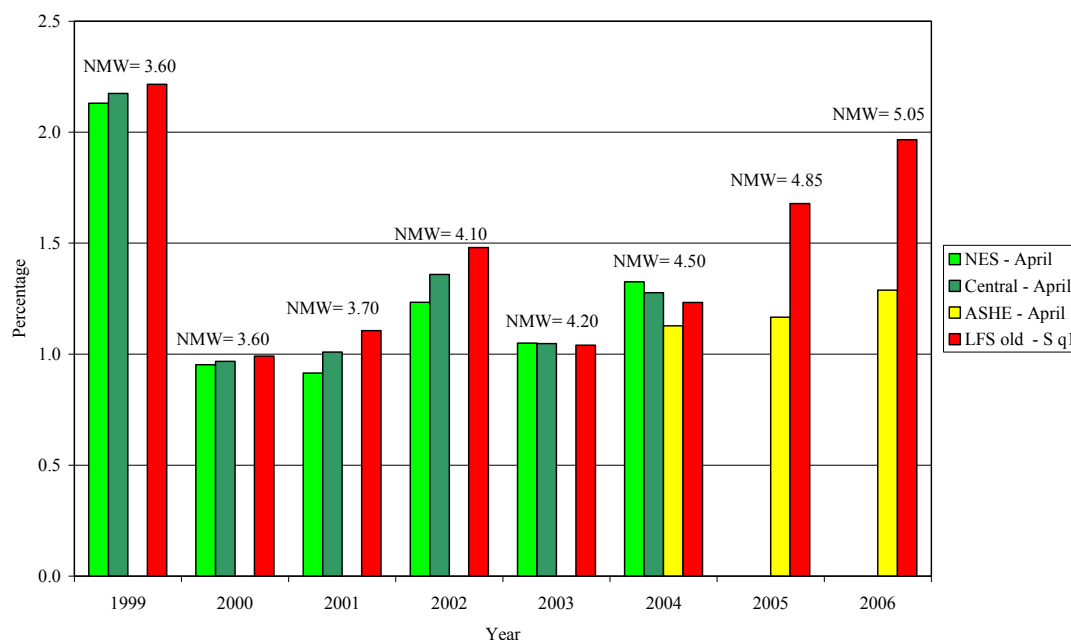


Notes:  
LFS March-May quarter

A margin of 1 per cent in a response does not appear to be important to respondents; however when looking at specific cut off points in the distribution like the NMW this can cause estimates to vary from year to year. It is therefore likely that the LFS estimate would be more accurate if the NMW was placed on a focus point; for example the £4.50 value in 2004.

This is demonstrated in **Figure 5**.

**Figure 5:** Annual estimates of the percentage of people paid below the NMW, 1999-2006



Notes:  
 NES NES estimates, applicable until 2003  
 Central Central estimate derived using ASHE and LFS methodologies  
 ASHE ASHE estimate, applicable from 2004  
 LFS old LFS old methodology  
 S q1 Seasonal quarter 1 (March, April, May)

In 2004 the estimates are similar as the NMW sits on a ‘round’ number. This issue does not affect the ASHE estimates in the same way and this therefore supports these estimates as the main source of information on low pay.

## Conclusion

ASHE respondents, being the employer, may like to set wage rates at focal points, but they are less likely to round hours and earning figures. This supports the use of the derived hourly rate in ASHE low pay estimates.

LFS respondents, being employees, tend to round. The surprising result of this investigation is that respondents tend to round earnings and not hours or hourly rates. Respondents appear to know their hourly rate fairly accurately.

As companies prefer to pay at round numbers and reporting is also rounded by employees, the issue isn’t generally important. However, when the NMW is just above a ‘round’ number, for example the £5.05 rate in 2006, misreporting in the LFS can cause an over estimate in the estimate of the percentage of jobs paid below the NMW. It is conceivable that a NMW of, for example, £5.95, would conversely cause the estimate to be lower than the true value as respondents would report £6.00. Analysis of the NMW using the LFS therefore needs to be aware that the value of the NMW can directly affect the number of low paid.

## Endnotes

- 1 It should be noted that although low pay estimates attempt to measure the number of jobs that are paid below the NMW, the estimates cannot be used as a measure of non-compliance with the legislation. This is because it is not possible to discern from data sources on earnings whether an individual is eligible for the minimum wage. For example, it is not possible to identify people such as apprentices and those undergoing training, who are exempt from the minimum wage or are entitled to lower rates. If employees receive free accommodation, employers are entitled to offset hourly rates to reflect this.
- 2 The ASHE is a one per cent sample of employees on the Pay As You Earn (PAYE) register. Employers are surveyed, requesting information about hours and earnings of their employees. Since the ASHE replaced the New Earnings Survey (NES) in 2004 it is considered the most reliable source of information on earnings including those of low earners. The NES sample was extended to improve the coverage of the low paid and imputation and weighting was applied to ensure the sample was representative of the population. For more information on ASHE see:  
[www.statistics.gov.uk/STATBASE/Source.asp?vlnk=1319&More=Y](http://www.statistics.gov.uk/STATBASE/Source.asp?vlnk=1319&More=Y)
- 3 The Labour Force Survey (LFS) is a survey of households living at private addresses in Great Britain. It is the main source for information on the labour market in the UK. It is a random household survey of approximately 57,000 households every three months. As well as private households, the survey includes people living in student residence halls and NHS accommodation. For more information on the LFS see:  
[www.statistics.gov.uk/STATBASE/Source.asp?vlnk=358](http://www.statistics.gov.uk/STATBASE/Source.asp?vlnk=358)

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