

Summary of the methodology for measuring low pay

Introduction

On 17 October 2002, ONS released estimates for 2002 of the number of jobs in the UK which receive hourly pay less than the National Minimum Wage rates. Table 1 shows the latest figures for the past four years.

Table 1: Number of jobs paid below national minimum wage rates¹.

	18-21		22 and over		All jobs	
	Thousands	Per cent	Thousands	Per cent	Thousands	Per cent
April 1999 ²	40	2.3	490	2.2	530	2.2
April 2000 ²	40	2.2	200	0.9	240	1.0
April 2001 ³	40	2.1	210	0.9	250	1.0
April 2002 ⁴	50	2.5	290	1.2	330	1.3

²Rate is £3.00 per hour (aged 18-21) or £3.60 per hour (aged 22 and over).
³Rate is £3.20 per hour (aged 18-21) or £3.70 per hour (aged 22 and over).
⁴Rate is £3.50 per hour (aged 18-21) or £4.10 per hour (aged 22 and over).

The estimates are based on a methodology which utilises hourly rate information from the Labour Force Survey (LFS) and a grossing procedure for the New Earnings Survey (NES) to reduce the effect of non-response and sample frame bias. This methodology creates separate NES and LFS estimates, and the advice of ONS is that the mid-point between the NES and LFS estimates represents the best estimate of the number of low paid jobs.

Background

The National Minimum Wage (NMW) came into force in April 1999. The minimum wage rates were set at £3.00 per hour for 18-21 year olds and £3.60 for those aged 22 and over with some exceptions for workers receiving training during the first six months of employment.

In terms of measuring low pay, both the NES and LFS have limitations. The NES information should be accurate as it is taken from payroll records but the survey has limited coverage of those workers earning below the PAYE threshold. In addition, the survey estimates are not grossed up to population level, which gives some cause for concern regarding the effect of non-response. The LFS has more complete coverage of jobs, especially casual and low paid jobs, but the data on earnings and hours are less precise, particularly when supplied by proxy respondents.

During 1999, as a result of concerns about the methods used to produce estimates of jobs paid below the NMW from the LFS and NES, ONS set up a project to investigate what could be done to develop an improved methodology for measuring low pay.

¹ It should be noted that these estimates cannot necessarily be used as a measure of non-compliance with the legislation because it is not possible to discern from either the LFS or the NES whether an individual is eligible for minimum wage rates. For example, it is not possible to identify people such as apprentices, and those undergoing training who are exempt from the minimum wage rate or are entitled to lower rates. If employees receive free accommodation, employers are entitled to offset hourly rates by up to 50p per hour. There are other technical reasons why the money paid in one pay period may apparently vary from the minimum wage regulations.

Professor Chris Skinner from the University of Southampton acted as an advisor on the project and consultations were held with experts across government. A similar project during 2002 produced further refinements to the methodology.

The methodology

The methodology for estimating the number of low paid jobs produces independent estimates based on the two main sources of earnings data after adjustments designed to correct the deficiencies inherent in the surveys:

- the LFS estimate for main jobs is based on hourly rate information where available and on an imputed hourly rate for those respondents who are unable to supply an hourly rate
- the NES is grossed up to reduce the effect of non-response and sample frame bias

Imputation of LFS hourly rate

From April 1999 onwards, LFS respondents were asked if they were paid an hourly rate in their main job and, if so, what was their basic hourly rate of pay. Analysis showed that this hourly rate variable was a more reliable measure than the hourly pay variable that was derived by dividing weekly pay by usual hours worked. As a consequence of this finding, the hourly rate variable is used in measuring low pay from the LFS.

Where the hourly rate question has been answered, then it is used. Where it is not available, imputation is used. The basic method used is regression imputation, where hourly rate is explained by a model with approximately 40 explanatory variables. Where hourly rate is missing, the regression equation is used to impute a value.

Several of the explanatory variables relate to the nature of the job and its pay, of which the most significant is derived hourly pay. The others include variables for industry, occupation, educational attainment, region of residence, and some personal characteristics such as age (including the age categories which are used to determine an employee's NMW threshold), sex and marital status. Most of these are binary variables, so a large number of variables are needed to reflect all the possibilities. This is the reason for the large number of explanatory variables in the model.

In the imputation process, an hourly rate based on the regression equation is calculated for all cases, including those that have a given hourly rate. The cases with a given hourly rate are used as donors for the cases that do not have a given hourly rate, using a nearest neighbour method.

Donor classes for LFS imputation

NMW legislation has continued to set different thresholds for 18-21 year olds and those aged 22 or over, and not to apply to those aged under 18. In view of this, ONS separates the data into these three age groups before donors are allocated to cases. Consequently it is not possible, for instance, for the hourly rate of an 18-21 year old person to be donated to a person aged 22 or over.

Grossing the NES

The NES is an employer survey that is conducted annually. Sampling is based on the Inland Revenue's PAYE records. The purpose of the survey is to gather information on employee jobs and average earnings. The NES attempts to survey 1% of all employee

jobs. In practice the sample actually used to produce estimates is only about 60% of the target sample.

The attrition occurs at different stages of the process for a variety of reasons. In the first place, the Inland Revenue are not able to trace some individuals because they don't have PAYE records. There is a further loss at the stage where forms are sent to the employer for completion - some workers will have changed job between the drawing of the sample and the survey, some workers and businesses will be untraceable, some people will be out of scope for the survey because they are occupational pensioners or unpaid directors. Finally, some records will not be usable because the information is incomplete or, in the case of those whose pay is affected by absence, the hourly rate information may be unreliable. Some of these factors are likely to affect the measurement of low pay.

Comparison with other sources suggests that the NES under-represents young workers and those working for small firms. The former may be because these workers are less likely to have paid tax in their career and, therefore, less likely to have a PAYE record. The latter may result from the greater difficulty in tracing small firms and non-response. As it is known that the incidence of low earnings is higher for young workers and for small firms, both factors will lead to the NES under-estimating low earners.

Analysis has shown that it is possible to improve the quality of NES estimates of low pay by using estimates based on the sample grossed up to population levels (that is, all employee jobs in the UK) rather than the ungrossed sample. Grossing up the sample reduces some of the known bias in the NES sample even though it cannot correct for all of it. The grossing process can ensure that we have the right number of jobs in each cell of the grossing matrix. However, if the cases in the sample for any given cell are not representative of the whole population for that cell then grossing will not correct for this. Therefore, the grossed NES is still likely to underestimate the numbers earning below National Minimum Wage rates.

Grossing methodology

The aim is to gross up the NES sample to the total population by weighting by characteristics of the individuals and of the firms for which they work. In order to do this we produce a population matrix with control totals for each of the individual characteristics by each of the firm characteristics. The control totals for the characteristics of the firms are taken from the Inter-Departmental Business Register (IDBR). The control totals used relate to industrial classification (15 sectors) and the number of employees (6 size-bands). The control totals for the personal characteristics are taken from the Labour Force Survey. These control totals relate to age (5 bands) and gender.

As the information for the characteristics of the population is taken from two different sources, we only have the marginal totals for the population matrix. We use Iterative Proportional Scaling to fill in the individual cells. The initial cell values are taken from the whole NES sample file (this includes all those in the sample population who have an Inland Revenue PAYE record or work for a firm that supplies the ONS with a centralised return).

Additional NES variables

For the purposes of measuring low pay, ONS derives two new variables from the NES data set. Firstly, an hourly pay variable is derived that conforms as closely as possible to the definition of pay used in the NMW legislation. This includes basic and incentive pay, but excludes premiums for overtime and shift working. Secondly, whereas the NES data set has age measured at 1 January, the low pay estimates use age measured at 1 April, a date in the pay period reported on by the NES.

Detailed estimates using the methodology

Table 2 shows the NES adjusted estimate, the LFS adjusted estimate and the central estimate which is ONS's preferred point estimate.

Table 2: Number of jobs paid below national minimum wage rates, UK. Comparison of LFS and NES adjusted estimates and the central estimate.

	LFS adjusted estimate		NES adjusted estimate		Central estimate	
	Thousands	Per cent	Thousands	Per cent	Thousands	Per cent
All jobs						
April 1999 ¹	530	2.2	530	2.2	530	2.2
April 2000 ¹	240	1.0	230	1.0	240	1.0
April 2001 ²	270	1.1	230	0.9	250	1.0
April 2002 ³	360	1.4	300	1.2	330	1.3

¹Rate is £3.00 per hour (aged 18-21) or £3.60 per hour (aged 22 and over).
²Rate is £3.20 per hour (aged 18-21) or £3.70 per hour (aged 22 and over).
³Rate is £3.50 per hour (aged 18-21) or £4.10 per hour (aged 22 and over).

For further information please contact Nigel Stuttard, telephone +44 (0)20-7533 6167, e-mail nigel.stuttard@ons.gov.uk.