

Behavioural aspects of the National Minimum Wage

Measuring and interpreting behaviour in the low-wage labour market

Report prepared for the Low Pay Commission

Final Report

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Executive Summary

This report investigates the behaviour of employers and the impressions of employees concerning the National Minimum Wage (NMW). It studies the accuracy and interpretation of the main data sources used for quantitative analysis of the impact of the NMW.

From studying employer data (ASHE), the report finds that:

- Information from employers is accurate but it reflects psychological influences on employers, not the optimising behaviour commonly used in economic theory/analysis
- Employers do not appear to be concerned about the cost implications of small variation of a few pennies in the wage; at the margin, signalling effects (such the ability to claim one is paying 'above the NMW') and simpler wage rates appear to be more important
- In particular, although the NMW is the most common wage, employers show a preference for setting wages at 'round' numbers (divisible by 5p, 10p, 25p and 50p) and for clustering around 'focal points' (£5.50, £5.75, £6.00) near the NMW
- This behaviour is widespread, and more pronounced the smaller the firm
- This behaviour appears to be persistent over time and robust: it does not appear to have been affected by general economic conditions, and the difference in proportion between adding 15p to an NMW of £3.85 or an NMW of £5.85 also seems irrelevant
- The LPC can 'game' the level of wages if it sets the NMW at, or just below a 'focal point'
- Although the choice of 'focal points' is constant, the numbers at those focal points (and at the NMW) are rising over time
- Firms anticipate the introduction of the NMW: a significant number are paying the next October's NMW in April
- Large firms are more likely to anticipate the next NMW; small firms are more likely to lag in adjusting to the NMW
- This behaviour of employers in response to a particular value of the NMW is reasonably predictable

As a result the NMW has an impact on employers beyond the simple effect of setting a minimum level of wages: employers adjust wages at the margin on non-financial grounds. Concerns about a penny more or less on the NMW are much less important than whether the NMW is on a 'round' number or not.

These results provide a psychological rationale for the distribution of the ASHE data. As ASHE is the basis for the National Statistics on the numbers of the low paid, the continuing accuracy of the data is reassuring. However, this does raise concerns that the impact of changes in the NMW might be given an economic interpretation which is not justified. Some simple images may be able to address this impression.

More importantly, the study questions whether the definition of 'minimum wage worker' should be given a behavioural basis which reflects better employers' reaction to the NMW; specifically, that the definition of 'minimum wage worker' as "earning up to the NMW plus 5p" be amended to "earning up to the next 10p wage above the NMW". However, one consequence of this would be to

increase the numbers of 'minimum wage worker' in most years, dramatically in the case of 2010/2011.

Studying the employee data (LFS), the report finds that

- The tendency to give responses at focal points is much more pronounced than in ASHE
- This is not restricted by the NMW; if a focal point lies below the NMW, this will be reported
- If the subject refers to documentation when completing the form, the results seem more accurate; but proxy responses on behalf of an absent respondent seem to follow the same pattern of behaviour as direct responses
- There is no clear evidence for significant differences in hours between the two datasets
- Microeconomic analyses do not appear to be significantly affected
- The behaviour varies with the NMW, but in a very predictable way

Some researchers have raised queries about the LFS data; in particular, arguing that responses from households may be less accurate than those from firms, making results difficult to interpret. The report finds some support for that view, but qualifies it strongly in the context of minimum wages. There is measurement error but it is highly predictable, may be low impact, and can be dealt with relatively easily: the authors' predictions for 2012 employee data have proved, if anything, too complex. As the LFS is one of the key data sources for the LPC – the only one for some analyses – this is an important qualification.

The report recommends that

- the LPC recognises that the penny value of the NMW has real effects, and that these are modelled when considering potential values for the NMW
- when the broad level of the NMW has been determined, LPC consider 'snapping' to the nearest 5p value; this would align with employer behaviour
- the NMW be increased on similar boundaries to prevent 'concertina effects' where economic causes are confused with numerical ones
- the NMW not be set just below major focus points
- LPC reconsider its definition of 'minimum wage worker' to reflect employer behaviour
- LPC include 'blobograms' (as defined and used in this paper) in its reports to aid identifying of clustering effects (in ASHE) and measurement errors (in LFS)
- best practice analysis should show an explicit awareness of 'concertina effects' and check the robustness of LFS findings
- further research could most productively concentrate on sub-markets (low-paying sectors and/or regions) and on the increasing concentration of employment at round numbers

The report also notes that the maintenance of the development rate at £4.98 will provide a natural experiment in 2013.

1. Introduction

The National Minimum Wage (NMW) was introduced into the UK in 1999. At the same time, the Low Pay Commission (LPC) was set up to review the evidence on the impact of the NMW and make recommendations on the level and structure of the NMW. The Commissioners are advised by a secretariat, including a research team who carry out analyses and commission external reports, such as this one. The research team also carries out primary data collection, mainly qualitative studies, to provide context and corroboration or denial for the statistical studies.

Annually the LPC produces a review of research evidence. This review is available on the LPC website, as are all the commissioned research studies. As a result of these different strands of analysis carried out over several years in changing economic conditions, the evidence base for the LPC recommendations is broad, detailed, and transparent, and is cumulatively summarised in the LPC's Annual Reports.

The quantitative analysis makes much use of statistical data held by government departments, particularly the survey data produced by the Office for National Statistics (ONS). However, Ormerod and Ritchie (2007a) raised concerns about the use and interpretation of this data. In some cases, the data appeared to be implausible when different data sources were compared. In others, the data seemed to be recorded correctly, but to show a pattern of behaviour which reflected the numerical characteristics of the NMW, not the economics of the labour market. The timing of data collection also appeared to be an important factor in drawing inferences. Follow-up work in 2009 (Fry and Ritchie, 2012¹) reinforced these initial findings.

Measurement error clearly poses a problem for statistical analysis, but even when the data are correct, incorrect inferences may be drawn if the data reflects inertia or psychological choices rather than financial ones. This is particularly likely to affect comparisons over time.

This report builds on those earlier studies in four ways: by extending the earlier analysis with more recent data and additional statistics; by proposing and testing hypotheses on patterns of behaviour; by reviewing the impact of data issues on earlier work; and by developing guidelines for researchers in this area.

This report is structured as follows. The next section provides the context: the development of the NMW, the economic theory of minimum wages, relevant literature, and data sources. These are covered in detail in the work of other authors, and so only relevant factors are summarised here.

Section 3 investigates employer behaviour, specifically the rules for setting wages and how companies respond to the changes in the NMW. Earlier work suggested that, although the data are collected without significant error, the data reflect a strong psychological influence on wage-setting behaviour. The validity of the data is important: the data studied here are used to calculate the

¹ The work was largely carried out in 2009, for an internal ONS paper. It was published in 2012 as part of the preparation for this project, to avoid repetition of uncontentious results and to allow for reference to the predictions made in that paper.

official estimates of those being paid at or below the NMW. The concern here is that the impacts of changes to the NMW are not being attributed to appropriate causes.

Section 4 looks at how employees provide survey information on their labour market activities. Earlier findings strongly indicated implausible responses linked to the absolute value of the NMW. This is important because the survey under scrutiny is the only large-scale source of information on how the NMW is related to personal characteristics such as ethnicity, education and so on. The data source is also widely used in microeconomic analyses. The purpose of this section is to see if the earlier findings can be substantiated and, if so, whether a predictable pattern of behaviour can be identified.

Because Sections 3 and 4 contain a large amount of data analyses, each subsection is preceded by a summary of observed behaviour, theoretical considerations and hypotheses to be tested, and evidence gathered. The findings are summarised at the end of the chapter.

The analysis of chapters 3 and 4 raises some clear potential concerns about the analysis of low pay, but potential does not necessarily lead to an actual impact. Section 5 considers whether the findings of the analysis sections are material to understanding low pay. It suggests that only some of the potential issues have a notable statistical impact, and the predictability of human behaviour allows for some simple correction mechanisms where this is important. The more important issues may lie in the analysis applied to changes; indeed, the section considers whether the NMW, far from being a simple wage floor, should be seen as an essential element in a psychological 'game' with employers.

Section 6 concludes with recommendations for the LPC and for researchers looking into low pay.

The Annexes contain additional detail on some of the statistics presented in the report.

2. Contexts

2.1 The National Minimum Wage

The NMW was a manifesto commitment by the 1997 Labour government, coming a decade after the UK abolished Wages Boards and Councils which set minimum wages for particular industries. The first NMW was set in April 1999, but this moved to October from 2000 onwards to avoid clashes with the change of the tax year in April.

The original NMW had an ‘adult’ rate (for those aged 22 and over up to 2009 and aged 21 and over from 2010) and a ‘development’ rate (covering those aged 18-21 up to 2009 and 18-20 from 2010). A ‘youth’ rate was introduced in 2004 for 16-17 year olds and an ‘apprentice’ rate introduced in 2010, applying to those under 19 and those over 19 for the first 12 months of their apprenticeship. Table 1 details the rates in specific years. For those not covered by the age band, there was no minimum wage in that year.

Table 1 National Minimum Wage rates and applicability

NMW start date	NMW year	Rate by classification			
		Adult	Development	Youth	Apprentice
1 Apr 1999	1999	£3.60	£3.00	--	--
1 Apr 1999	2000	£3.60	£3.00	--	--
1 Oct 2000	2001	£3.70	£3.20	--	--
1 Oct 2001	2002	£4.10	£3.50	--	--
1 Oct 2002	2003	£4.20	£3.60	--	--
1 Oct 2003	2004	£4.50	£3.80	--	--
1 Oct 2004	2005	£4.85	£4.10	£3.00	--
1 Oct 2005	2006	£5.05	£4.25	£3.00	--
1 Oct 2006	2007	£5.35	£4.45	£3.30	--
1 Oct 2007	2008	£5.52	£4.60	£3.40	--
1 Oct 2008	2009	£5.73	£4.77	£3.53	--
1 Oct 2009	2010	£5.80	£4.83	£3.57	--
1 Oct 2010	2011	£5.93	£4.92	£3.64	£2.50
1 Oct 2011	2012	£6.08	£4.98	£3.68	£2.60

The column “NMW year” relates to the relevant time for NMW estimates. The official NMW statistics are based upon data from ASHE (see below), a survey of earnings in a week of April each year. Thus the 2001 ‘NMW year’ had an adult minimum wage of £3.70, set in October 2000.

2.2 Theoretical and practical impact of the NMW

The theoretical impact of the introduction of a minimum wage is straightforward. The bottom of the wage distribution is truncated as all those previously earning below the NMW receive the higher wage. This may have an impact on employment as increased wage costs affect employer’s profits. There may be some ‘spillover’ effects on wages further up the distribution: for example, companies increase other wages to maintain wage differentials between jobs, or employers wanting to

differentiate themselves from low wage jobs increase their ‘starting price’. If companies do not fully accommodate the change in the minimum then these spillover effects will disappear further along the wage distribution. The median and mean wages are likely to increase. The mode may vary depending on how far the spillover effects reach; the minimum may become the new mode. Figure 1 illustrates some possible cases.

Figure 1 Theoretical impact of a minimum wage

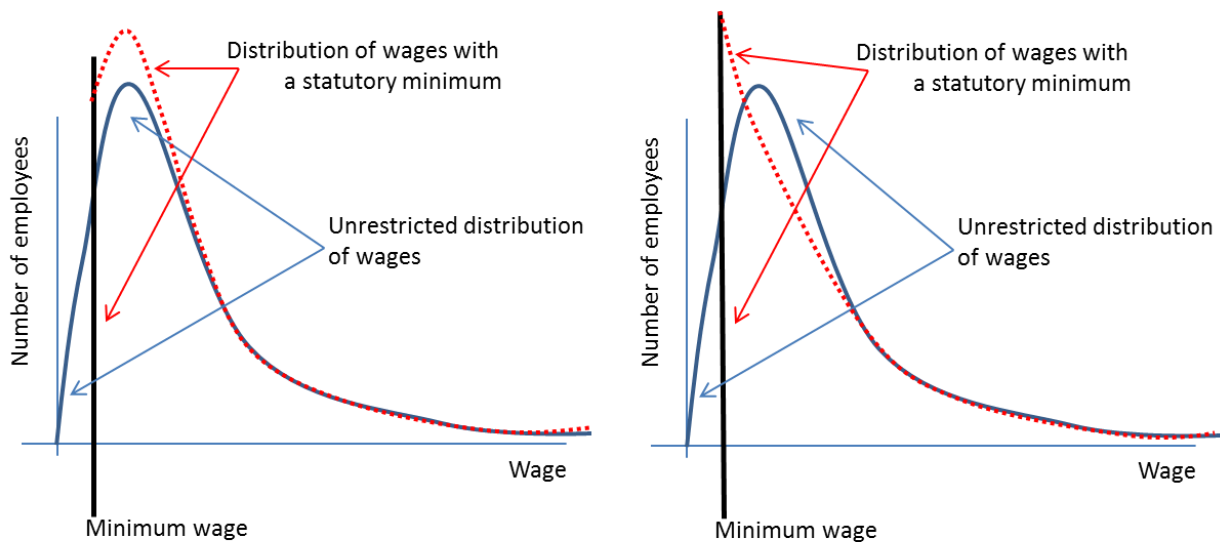


Figure (a) Largely benign effects

Figure (b) More negative effects

Figure 1(a) illustrates a case where there are some employees who previously earned below the minimum wage, where companies partially adjust to maintain differentials on wage rates, and where there is no significant loss of employment (and so the areas under the two curves are roughly the same). This simple illustration allows various policy-relevant conclusions to be drawn. The fact that employment does not drop significantly implies the main impact of the NMW is a redistribution of rent from employers to employees, and in favour of the low-paid – higher-paid employees are largely unaffected².

Figure 1(b) illustrates a case where the impact is less positive. The earnings distribution is very compressed around the minimum. Spillover effects are negative: overall employment has fallen, and it appears to have become unprofitable to employ labour above the minimum because of the increased wage bill for those whose wages have been raised to the minimum. In this case, it appears that employers have little willingness or ability to accommodate the raised minimum wage. This minimum does not benefit those in work or out of work.

The level of the NMW, the rate of change, and the state of the economy may all have an impact; and the characteristics of labour and product markets may vary markedly across industrial sectors, so

² ‘Rent’ for economists is payment over and above that strictly necessary to encourage someone to participate in an activity. For an employee, this is wages above the rate they would be willing to work for; for an employer, this is profit above that just necessary to keep them in business.

that the effect of the NMW can be positive in some types of businesses and negative in others. The impact of the NMW is therefore an empirical issue: it cannot be determined by theory alone.

Overall, the evidence gathered by the LPC suggests that the NMW has been largely benign in that it does not appear to have led to significant job losses but that it has increased the wages of the lowest earners. There is some industry variation, and there may be some impact on certain parts of the population, particularly the young and disadvantaged groups. There is some evidence of compressions of wage differentials but the general effect is that differentials are still being maintained; the spillover effects do not travel far up the distribution. There is some evidence that employers are addressing increased wage costs in other ways, for example by moving to higher-skill jobs. Finally, the impact of the current recession is still being evaluated.

This evidence has to be interpreted cautiously, as there is no counter-factual to provide a control for the observed behaviour. Researchers have tried to counter this by comparing the NMW period with earlier periods (for example, when Wages Board existed), by comparing contemporaneous findings from countries with different wage policies, and by looking at differences between the impact of adult and development rates. In general, findings that the NMW has had a generally beneficial effect seem to be robust to different estimation techniques. For full details, see the LPC Annual Reports (LPC, 2012).

2.3 Relevant research findings

It is not possible to survey here the full range of LPC and other research findings; the LPC annual reports alone contain over one thousand pages of evidence, all the LPC commissioned research is available online, and the bibliography maintained on the LPC website is comprehensive.

However, it is worth noting the genesis of this work. In 2005 the newly-formed Earnings Analysis Branch at ONS took responsibility for producing low pay statistics and produced a number of papers on the calculation of low pay. These relating to measurement were summarised in Ormerod and Ritchie (2007a). That article was updated in 2010 (Fry and Ritchie, 2012) to include more recent data and an evaluation of changes to the LFS as a result of the earlier work; limited resources meant the work was otherwise little changed. However, it was clear that these earlier papers raised a number of important issues about the LPC's major information resources. As a result, the decision was taken to undertake (with LPC funding) a more systematic review of the issues. This report is the result.

Outside of this body of work, relatively little has been written on the specific topics addressed here, but much work has been done on the relevant areas. The characteristics of the main datasets are generally accepted as background information. Measurement error is itself a field of statistical research, and statistical resolution is well understood (if not the approach suggested in this study). Behavioural economic models (which argue that humans are often irrational, inconsistent, working with limited information, and content to 'make do') are currently fashionable. Rather than trying to summarise this work generically, we refer readers to Fry and Ritchie (2012) for specific references and the LPC Annual Reports as the starting point for wider reading on low pay.

2.4 Sources of data

2.4.1 The Annual Survey of Hours and Earnings (ASHE)

The Annual Survey of Hours and Earnings (ASHE) is a one percent sample of employees using information provided by employers. It has been the main source of information on earnings in the UK since 2004. ASHE is used to generate the official estimates of the low paid, the percentage of jobs paid below the NMW.

ASHE is a longitudinal study: the same individuals are included each year that they are working. All jobs are included. The ASHE survey form is sent to employers at the end of April each year, based on HMRC Pay As You Earn (PAYE) information on employees' whereabouts in March. Employers are asked to identify hours and earnings for a worker during a specific week in April. This is a statutory survey carried out under the Statistics of Trade Act 1947; it is an offence for employers to fail or refuse to comply with the survey. In practice, valid response rates are around 80%. The main reason for the shortfall seems to be people changing employment between March and April. ASHE statistics (and the microdata for restricted circulation) are published in November of that year.

ASHE's predecessor was the New Earnings Survey (NES), which ran from 1975 to 2003. This used the same sample frame and questions. Two changes were made to the survey which affect the measurement of the low paid. First, high job turnover is normally associated with lower-paid transient jobs, and so greater efforts were made to trace those who moved jobs between the March and April dates. Second, the HMRC sampling frame is the list of PAYE records, and those not earning enough for PAYE are also likely to be on a low hourly rate; ONS therefore sought to identify these workers by other methods. Follow-up analysis by ONS suggested the former measure, but not the latter, had improved the measurement of the low paid. See Milton (2004) for a description of the ASHE estimate and its forerunners, the design goals of ASHE and the impact; and Holt (2008) for an analysis of ASHE's characteristics with particular relevance to low pay.

Note that in the analysis below data from 2002 and 2003 are from the NES, although they are labelled as 'ASHE' to simplify exposition. These are the raw data; they have not been adjusted to take account of the revised ASHE methodology. This is because the focus here is on the individual responses rather than population estimates.

ASHE records several components of income: basic, incentives, shift premia etc, and it is possible to derive a rate based on several combinations of components. The LPC recommends that earnings included in the *derived* hourly rate used to calculate low pay estimates should be basic, incentive and other payments, but excluding any shift premium. ASHE also has a *stated* rate of earnings, given by the employer. The stated rate is available for about one-third of respondents, but the proportion is much higher for those on hourly pay; these are generally lower earners.

A stated rate is more likely to be based on basic pay only, but it is difficult to ensure that the respondent has included the desired components in the basic rate. Although validation against the derived rate can help, Griffiths et al (2006) suggest that guidance is not explicit in ASHE and there is scope for miscalculation: 5%-10% of stated-derived rate differences may be caused by errors in definition, and a further 15%-20% of rates have an unexplainable difference of more than £1. ONS currently uses this hourly rate for the validation of the derived rate but it is not used in reporting.

In this report, unless otherwise stated ASHE statistics will be based upon the LPC's preferred derived rate.

As well as hours and earnings, ASHE collects information on the employee's age, gender and occupation. Information about the employer is taken from ONS' Interdepartmental Business Register (IDBR). This holds information about employers at both the corporate and establishment level and is thought to be the most accurate source of such information.

2.4.2 The Labour Force Survey (LFS)

ASHE is not the only source for official low pay statistics. The household-based Labour Force Survey (LFS) also includes information on hours and earnings, as well as much a wider range of personal data. 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 level, ethnicity and disability).

The LFS surveys around 60,000 households every three months; households are surveyed for no more than five waves, and they are asked to supply earnings information on the first and fifth wave. The LFS estimate is based on information on first and second jobs. An improved methodology was developed by the ONS in 2005 to use improved information on second jobs (Ormerod (2006)).

The LFS is voluntary, and so responses rates are lower compared to the ASHE. Response rates fall across waves: wave one has the highest response rate, wave five the lowest. Response rates have fallen steadily across all waves in the period covered by this report: from around 78% down to 62% for wave one, and from 65% to 45% for wave five; see ONS (2012).

LFS respondents are asked to recall information about their previous week's employment. Ideally this is done with reference to documentation (pay slips, et cetera), but this is not strictly required. If the survey respondent cannot be available, another household member may be asked to complete the form on the survey respondent's behalf. These are termed 'proxy' responses.

The LFS collects information about the employer: location, size, and industry. There is a question about whether the LFS responses refer to the whole employer, or the specific establishment where the employee works. The general belief is that this relates to the employer as a whole.

2.4.3 The Monthly Wages and Salary Survey (MWSS)

The MWSS is a monthly survey of employers, stratified by industry and size band. It is used to calculate ONS' headline estimate of monthly earnings growth, the Average Earnings Ratio (AER). Like ASHE it is a statutory survey, but uses the IDBR directly as its sampling frame: large firms are over-sampled.

MWSS does not store information on individual wages. It only describes the average earnings for a company as a whole. However, it does allow company-wide variation in wages to be identified (for example, at bonus times, or across-the board increases in pay scales). Companies showing a large change in their salary bill are asked to describe the cause of the change. However, as this information is text-based and is used by ONS purely for quality checks, it has not been taken onto the ONS data systems as yet.

2.4.4 JobCentrePlus data

To supplement the official data sources, desk research was carried out on jobs advertised by JobCentres, using the Department for Work and Pensions' online search facility. The search was made on 22nd May 2012.

Two areas were selected: Cardiff (pop. 350,000; commuter destination, post-industrial, relatively low wage, medium unemployment, large public sector), and Basingstoke (pop. 85,000; commuter source, high wage, low unemployment, mostly private sector). The searches were carried out for all jobs within a fifteen mile radius of the reference location.

Hourly wage rates are those quoted in job ads at JobCentrePlus. As the focus is on the way perceptions affect wage rates, the analysis considered a valid rate either as the single rate or as the upper or lower limit for a job. Thus a quoted rate of "£7.25ph" will appear once, but a rate for the job of "£6.50-£7.10ph" will contribute two observations. Where only a minimum or maximum is stated ("£6.50+" or "up to £7") this is included. The analysis distinguishes between jobs which pay £6.08 (the current NMW) and those which just offer 'NMW'. The latter could refer to one of several wage rates depending on the age of the respondent; more importantly, this report studies how people think about wage rates, not the exact wage rates payable.

Limiting the analysis to wages up to £10 per hour produced 85 quotes for Cardiff and 116 for Basingstoke. This does not represent all jobs in the area. The DWP website search function only returns the first 250 jobs, which have to be analysed manually for the most part. Changing the search terms changes the output, but provides some duplicates which can only be identified by comparing job reference numbers. Removing double-counting is a time-consuming process, so only the basic search function was used. Finally, the data are not weighted: the advertisements rarely specify how many jobs are available.

In addition, employers using job centres are likely to be of a particular type. For example, the jobs advertised are mostly in the private sector, and many are for skilled manual labour. This data collection therefore cannot be taken as representative of the job market or of local employers. However this was not the purpose. ASHE and the LFS already provide quantitative evidence on the realised wage claims; this data is intended to illustrate how employers approach the decision to set a wage rate. This is why all wage rates observed are included in the analysis; we are not interested in the actual distribution of wages but in any evidence on the thought processes that have gone into choosing a feasible wage range.

2.5 How estimates of low pay are calculated

Estimates of low pay are generated by comparing individuals' hourly earnings with the appropriate NMW rate. Until 2004, ONS placed equal weight on the low pay estimates of LFS and the New Earnings Survey (NES), ASHE's predecessor. This was an acknowledgement that neither survey gave a definite answer on the number of low paid. ASHE was developed to remedy this uncertainty, and is considered to be the most reliable estimate; hence, the National Statistic for the number of low paid is simply the ASHE figure. However, the nature of low pay analysis is to try to understand which groups of individuals are more affected by the NMW. The LFS is vital to this analysis because ASHE has very limited personal data. ASHE and LFS estimates are therefore examined together by the Low

Pay Commission (LPC) and others to assess the impact of the NMW on earnings and other related subjects.

The main difference between the two estimates has usually been attributed to the different sources of the information. ASHE is collected from the employer and as such the earnings information is thought to be more reliable as it is mainly provided with reference to company records. The LFS is provided by the individual and it is subject to recall error, which is compounded when the information is provided by proxy response. These differences are described in detail in Hayes et al (2007). Ormerod and Ritchie (2007b) do provide some evidence that the LFS is an unbiased estimator of ASHE earnings data (if not hours), but this is viewing the data as a continuous distribution. Due to the binary nature of low pay estimates, measurement errors, even if unbiased, lead to over-estimates of the number of low paid.

However, as Ritchie and Ormerod (2007a) note, there are also differences in the measures used and the basis for those measures. For ASHE the derived rate - earnings for the period divided by hours worked - is believed to be the best measure of hourly pay because it is extracted from pay records and based on actual earnings and hours. The stated rate is present in only about half of cases, and may not reflect incentive or other (non-overtime) payments which the LPC recommends be included. In most cases the additional payments are not a significant cause of difference (Griffiths et al, 2006) but the derived rate remains the preferred measure.

For the LFS a stated hourly rate appears to be a more accurate measure for pay per hour than the derived hourly rate calculated by dividing weekly earnings by hours worked. For individuals providing both derived and hourly rate information in the LFS it has been shown that the distribution of the derived rate is much wider than the stated rate and can seem implausible. This is likely to be because the stated rate requires less information. The derived rate requires that respondents provide hours information that exactly matches the earnings information for the period and this results in an inaccuracy in the derived hourly rate. An individual's wage rate is likely to only change occasionally, but the actual hours worked and earnings may fluctuate from week to week; so it seems a fair assumption that recall error is less likely to be a problem for wage rates. LFS estimates are therefore based on the hourly rate where this is provided. Where a respondent does not provide hourly rate information this is imputed using a 'nearest neighbour' model where the derived rate has the most influence.

LFS hourly rates are only applicable for certain types of jobs whilst total earnings and hours are provided by most respondents; around half of the dataset has a value for the stated rate. In addition, there is some concern over whether the stated rate measures the current wage rate. However, individuals who provided stated rate information are generally low paid and as estimates of the low paid focus on this part of the earnings distribution this is not seen as a major issue; and as individuals who are paid around the NMW are less likely to receive payments on top of their basic pay, the question of what the stated rate actually measures may not be so important for low pay estimates.

In summary, there is a basic difference between the data sources and methodologies used to create the ASHE and LFS low pay estimates. ASHE is based on employment records, whereas the LFS is more subject to recall error. The LFS stated rate is felt to be less affected by the need to match up hours and earnings and so is the preferred measure, but In ASHE derived pay is felt to be the better

estimate of actual pay. ASHE has an hourly rate, comparable to the LFS hourly rate; but issues with the LFS derived rate make it difficult to produce a credible derived LFS estimate on the ASHE basis (Hayes et al, 2005).

3. Employer behaviour: where and when are wages set?

3.1 Wage setting behaviour

3.1.1 Summary of theory and evidence

Observed behaviour

- Near to the NMW, wages are set at a relatively small number of points
- There is no smooth distribution of wages; rather, wages are bunched together
- The pattern repeats every year with respect to the NMW, but the actual distribution of wages reflects the absolute level of the NMW

Theory

- Wages should reflect marginal product of workers; even in large companies, wages should reflect the marginal product of the average worker.
- There is no obvious reason why productivity across a range of firms with different capital stocks, production models and output markets should 'bunch'; this suggests that wages are not set at marginal product.
- As other characteristics (age, skills) also can be expected to follow smooth distributions, this suggests that optimisation is not the driving force for wage-setting

Hypotheses

- (H1.1) a significant number of wages near the NMW are set according to the characteristics of the numbers, including but not limited to:
 - simple marketing messages (H1.1a)
 - simple wage calculations for full or part hours (H1.1b)
 - simpler maintenance when updating (H1.1c)
- (H1.2) this has changed over time with the increase in the minimum wage: either
 - the higher NMW has made the proportional gaps between the NMW and 'focus points' easier to absorb (H1.2a); or,
 - the higher NMW has squeezed margins so that there is less scope to move to focus points (H1.2b)
- (H1.3) This effect is more likely to be found in small firms; across larger firms the distribution of wages is more likely to be smooth, reflecting more effort spent in fine-tuning wages to output

Evidence

- Wages are clustered around 'focus points'
- Wages are more likely to be divisible by 5, 10, 25 and 50, both as absolute numbers (£5.25, £6.50 etc) and relative to the minimum wage (5p above, 10p above etc), suggesting these are convenient for humans
- There is less evidence of numbers divisible by 2 or 4, suggesting that division of hours into halves and quarters is less important
- Larger firms are less likely to have wages at 'focal points', and are more likely to round to 5p or 10p than 25 or 50p compared to smaller firms (large firms also have more employees and so may have more wage 'options')

- Other firm characteristics are difficult to interpret, but some suggestion that being public sector reduces the likelihood and scale of rounding
- The most common wage within 50p of the NMW is always the NMW
- The next most common wage is always divisible by 50p; further wage peaks are all at 10p or 5p
- There is some variation in later years, or possible errors: high numbers of observations at £4.09 /£4.51 for NMWs of £4.10/£4.50 suggest rounding errors
- This effect does not appear to be proportional or to change over time; it is related to the ‘roundness’ of numbers, and is related to absolute values rather than relative distance from the NMW
- Rounding behaviour appears to be persistent within the same organisation

3.1.2 Wage distributions

Table 2 shows the distribution of wage factors for absolute levels of wages, and for the difference between the wage and the NMW. Data is based upon the ASHE derived wage rate, averaged over all years 2002-2011. Wages greater than the NMW and less than £1 over the NMW are included, where the relevant NMW for that individual (youth, adult etc) has been used. For wages relative to the NMW, only two factors (5p and 10p) were considered for reasons noted below³.

Table 2 Factors for ASHE derived wages, NMW<wage<NMW+£1, all years

		Absolute wage						Relative wage		
Highest factor, in pence		2	3	4	5	10	25	50	5	10
Expected frequency		50%	33%	25%	20%	10%	4%	2%	20%	10%
Observed frequency	All size bands	54%	34%	29%	35%	22%	15%	10%	30%	16%
	0-9 employees	59%	34%	35%	51%	35%	32%	24%	38%	21%
	10-49 employees	57%	34%	31%	48%	32%	24%	18%	37%	20%
	50-249 employees	55%	34%	29%	39%	25%	17%	12%	32%	17%
	250+ employees	52%	34%	27%	30%	17%	9%	7%	26%	13%
Relative variation	All size bands	1.07	1.02	1.14	1.77	2.20	3.64	5.24	1.48	1.55
	0-9 employees	1.18	1.02	1.38	2.53	3.51	7.96	11.99	1.92	2.10
	10-49 employees	1.15	1.03	1.26	2.39	3.20	6.07	8.99	1.86	2.03
	50-249 employees	1.09	1.03	1.16	1.97	2.47	4.22	6.03	1.62	1.73
	250+ employees	1.04	1.02	1.08	1.49	1.74	2.36	3.26	1.30	1.33

The table shows expected and observed frequencies and the relative difference. For example, if wages were evenly distributed one would expect two percent of all wages to be divisible by 50p. In

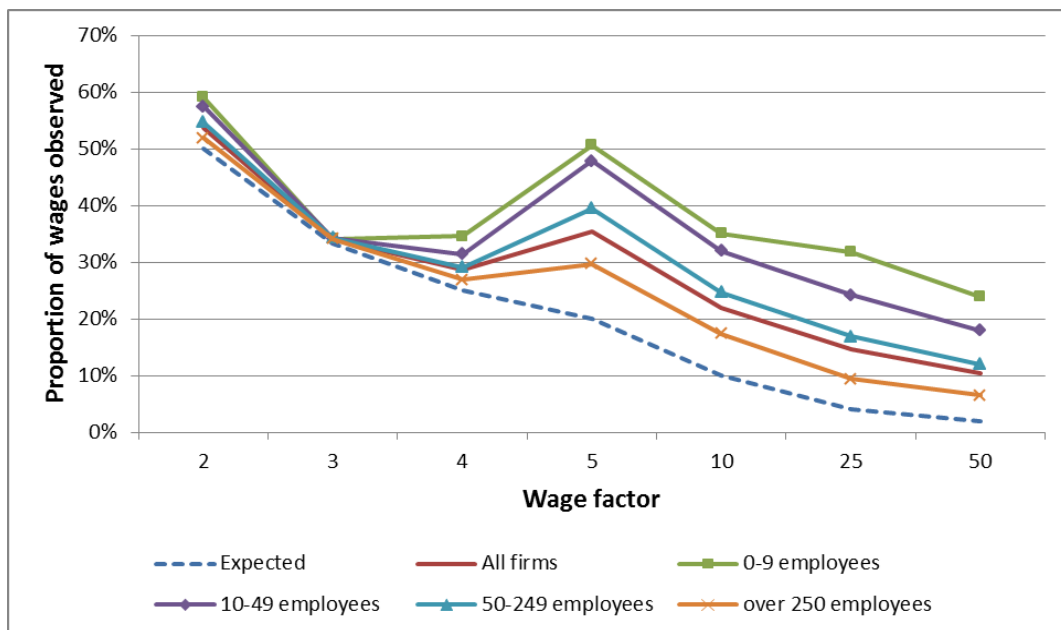
³ Note that including intermediate numbers (6p, 7p, 8p, 9p) as well as focal points would allow the hypothesis that wages are set at focal points to be formally tested. This was not done in this project for reasons of time, but we are grateful to the LPC research team for pointing this out. This will be followed up in subsequent work.

practice, the figure is ten percent, 5.24 times higher than expected. The numbers are gross frequencies (that is, they do not take account of the fact that a wage divisible by 50p is also divisible by 25p).

For absolute wages, the higher factors are over-represented. This is negatively correlated with firm size: for the smallest firms (0-9 employees), one quarter of all wages paid are a multiple of 50p, compared to one in fourteen for the largest. In all cases, small firms are more likely to set wages at round numbers.

Figure 2 presents the same data graphically.

Figure 2 Frequency of wage factors – employer data



It can be seen that the proportion of wages divisible by 2p, 3p, or 4p differs very little from the expected gross frequency of these numbers, irrespective of the size of firm. However, at all factors of 5p and above the observed frequency is much higher than expected, and inversely related to the size of firm.

These results do not provide much support for the argument that wages are set to make partial-hour calculations easier. Wages divisible by two, three and four pence (reflecting pay units of half-hours, twenty minutes and quarter hours respectively) do not appear to be over-represented. These part-hour wages were not considered for the relative differences, as the logic of this suggests that NMW also has to have the same factor⁴.

The table also appears not to support one of the findings of Lam et al (2006) who argued that jobs were sometimes advertised as “10p over the minimum wage” or in similarly relativistic terms, perhaps as a simple marketing message. While there is some over-representation of higher factors in the relative wages, this is less noticeable than for the absolute values. It is feasible that 25p/50p

⁴ That is, if it is proposed that firms pay 4p over the NMW to facilitate part-hours wage calculations, the NMW itself needs to be divisible by 4p. This is rarely the case for the adult NMW.

differences might show some over-representation, but ex ante this seems less likely and was not checked⁵.

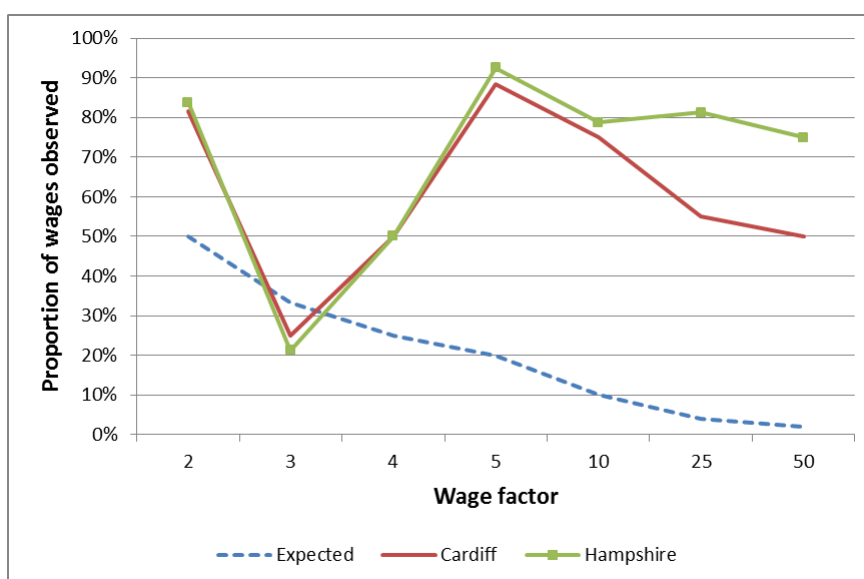
Table 3 and Figure 3 display information collected from JobCentre Plus websites for 140 posts advertised around Basingstoke and Cardiff.

Table 3 Absolute wage factors from JobCentrePlus websites

	Absolute wage factor							
	2	3	4	5	10	25	50	
Expected frequency	50%	33%	25%	20%	10%	4%	2%	
Observed frequency								N
Basingstoke	84%	21%	50%	93%	79%	81%	75%	80
Cardiff	82%	25%	50%	88%	75%	55%	50%	60
Relative frequency								
Basingstoke	1.68	0.64	2.00	4.63	7.88	20.31	37.50	
Cardiff	1.63	0.75	2.00	4.42	7.50	13.75	25.00	

Source: JobCentrePlus website accessed 22nd May 2012

Figure 3 Wage factors in Cardiff and Hampshire



The table and figure tell a similar story, with some notable differences. Wages with a factor of three are relatively rare, whereas wages divisible by two and four are more likely compared to expected frequencies and the frequencies calculated from the ONS data. The dominance of the largest factors is much more striking, with three-quarters of all wages in the Basingstoke area being at a 50p price point.

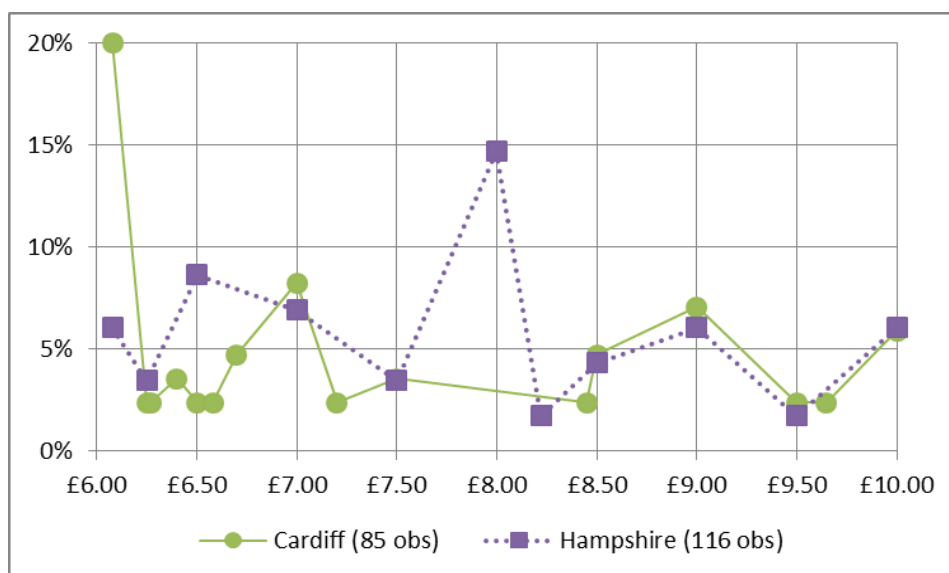
The variation with the ONS data may be due to the much smaller numbers: 140 observation instead of tens of thousands. It may also be because the data are not restricted to figures close to the NMW

⁵ The reason this was considered unlikely is that a gap of 25p/50p or more seems more likely to 'snap' to one of the big focus points in absolute focus points; say, £6.25 or £6.50, rather than £6.18 or £6.43, for an NMW of £5.93.

but can go up to £10 per hour. These data are therefore informative in showing how employers may react when unconstrained: if the employer is already considering a wage of £9-£10 per hour, then the NMW is of little relevance.

Figure 4 provides more detail on the specific quoted rates, this time including those stated “£6.08” but excluding jobs advertised as “at NMW” as this may not refer to the adult rate. Single observations have been dropped for clarity.

Figure 4 Distribution of JobCentre quoted wages



Source: JobCentrePlus website accessed 22nd May 2012

Basingstoke is a more affluent area, with lower unemployment and higher costs of living; this is reflected in the predominance of higher stated wage rates. The high proportion of 50p-factor wages is clear: other wages, apart from those at or just above the NMW, have just a single observation. In Cardiff, the NMW is the dominant wage rate and there is more variety in wages observed, but again, apart from the NMW and the 50p points there are few repeated observations. Annex 1 contains the full results.

These data are indicative and do not prove that earnings in Cardiff are lower; for example, the Cardiff search threw up more jobs in construction and technical occupations, whereas Basingstoke had more service roles. Nevertheless, they support the contention that wage rates are not smoothly distributed but cluster around ‘focal points’.

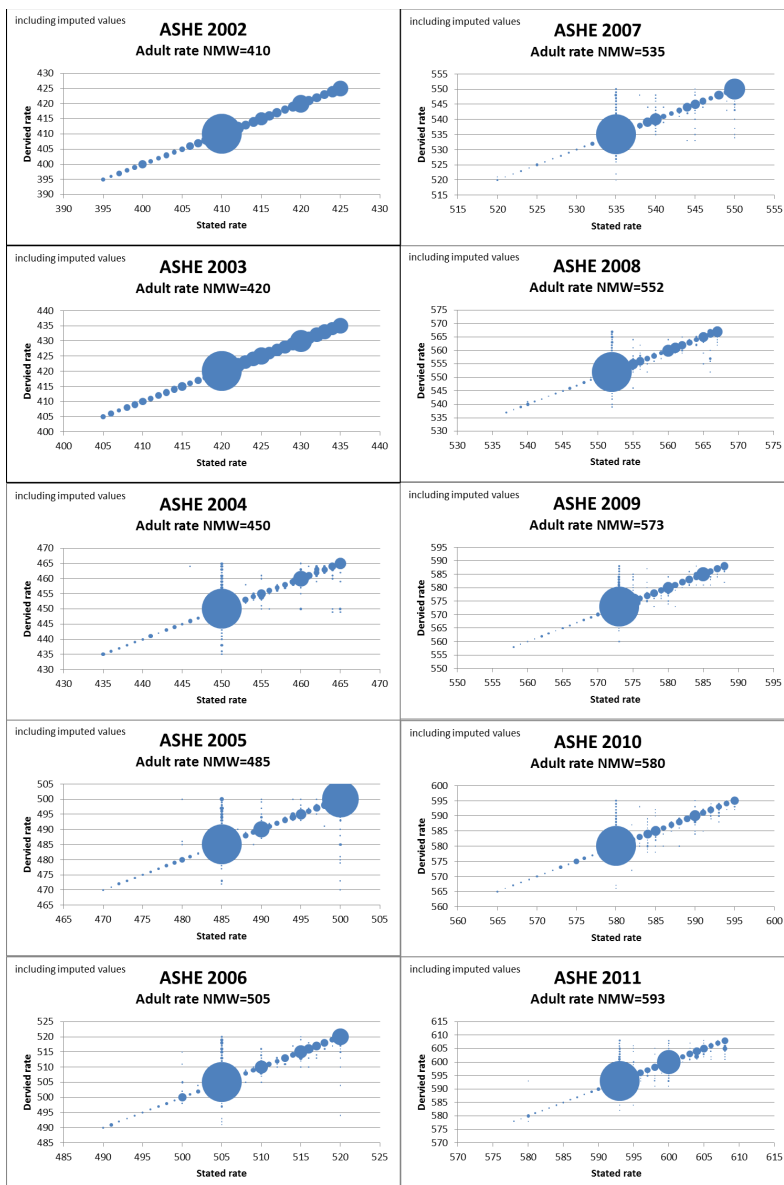
3.1.3 Choosing the wage rate

The previous section argued that wages are not evenly distributed but cluster around ‘focal points’, and that these are based upon the absolute level of the wage. The next consideration is how those focal points relate specifically to the minimum wage: in other words, given a specific NMW, can the reaction of employers be predicted?

The blobograms below plot derived versus stated wages for ASHE for the years 2002-2011; a similar representation will be used later for the LFS data. The size of the bubble reflects the relative share of observations within the range $NMW \pm 15p$; thus for the adult rate in 2002, observations are most

concentrated at the NMW of £4.10, then at £4.20 and £4.25. These are fully imputed (where no stated rate is included, this is set equal to the derived rate), but a similar result occurs where stated and derived rates exist (see the graphs in the LFS comparisons, below). The stated rate was introduced with ASHE and so in 2002 and 2003 all the points are on the diagonal. The graphs have been reduced in size so that the overall impression can be seen; larger images are in Annex 2. Graphs have been disclosure-controlled: wage combinations with 2-4 observations are given a frequency of three, 5-9 observations a frequency of seven. Finally, the graphs have been limited to 20p above and below the NMW on both axes, so that all graphs have the same scale. These adjustments make no difference to the overall image.

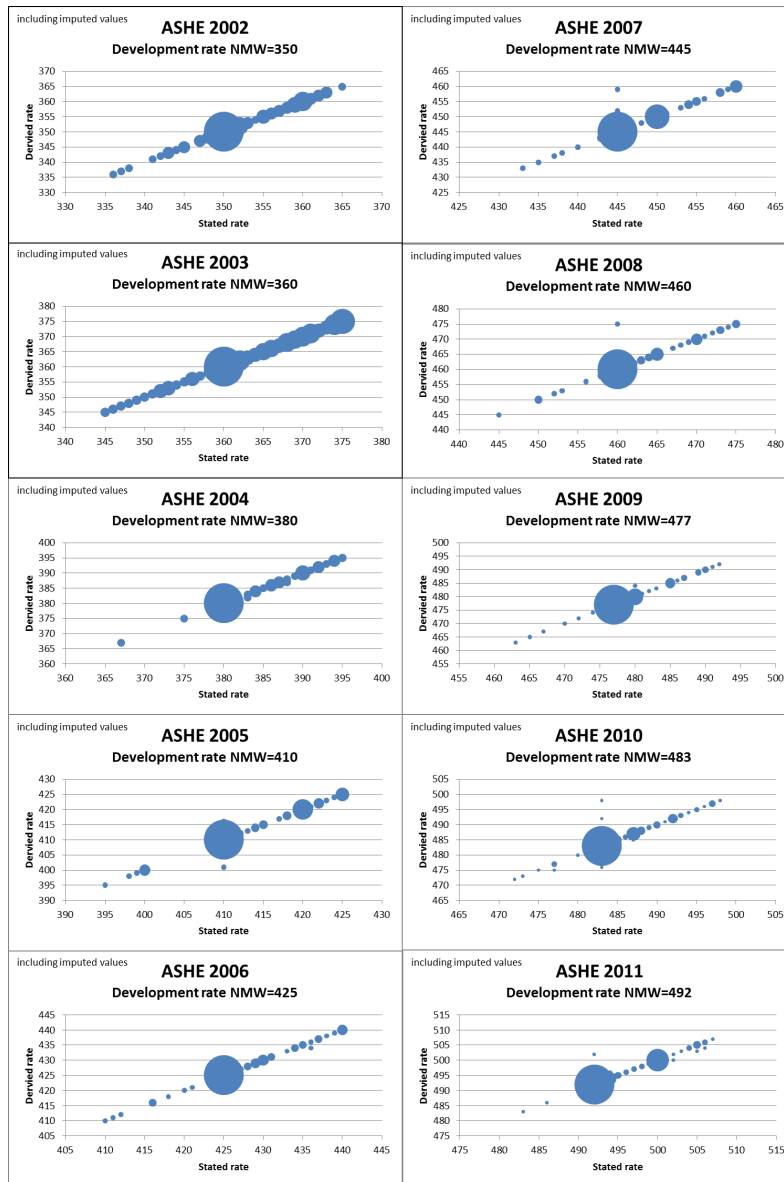
Figure 5 ASHE frequencies - adult rate



Considering the adult rate first, it is clear that the NMW is the dominant value and that there are few wage payments made below the NMW. The dominance arises because the analysis is limited to a small range around the NMW.

The stated rate rarely deviates from the derived rate. Where it does, it tends to be the stated rate that is constant and the derived rate that varies (the off-diagonal points are vertically arranged). This reflects the conclusions of the previous section: the stated rate is more likely to concentrate at a few focal points whereas the actual rate is more variable.

Figure 6 ASHE frequencies - development rate



The development rate shows a similar pattern, but as there are fewer observations graphs are more sparse and there are almost no off-diagonals.

This image shows that wages are more concentrated at some points but that the distance of these points from the NMW varies. An examination of the figures shows that the points of concentration tend to focus on a few 'round' numbers above the NMW. Again this reinforces the perspective that the NMW is a 'starting position': wages above that are considered for the characteristics of the absolute number, rather than their distance from the NMW.

Table 4 provides more detail on this behaviour. This table considers, for each year, which are the wages most likely to occur in the vicinity of the NMW ($\pm 50p$), in pence. Two measures are considered: the most frequently-occurring wages in the range, and the wages closest to the NMW with the most observations.

Table 4 ASHE frequencies near NMW

	Year	NMW	Modal wage	2nd most popular	3rd most popular	4th most popular	Major wage <i>30% of NMW</i>	Minor wage <i>10% of NMW</i>
Adult rate	2002	410	NMW	450	420	409	450	409
	2003	420	NMW	450	430	451	450	419
	2004	450	NMW	500	475	460	500	460
	2005	485	NMW	500	525	490	500	490
	2006	505	NMW	550	520	525	.	510
	2007	535	NMW	550	580	575	.	550
	2008	552	NMW	600	586	575	600	560
	2009	573	NMW	600	575	585	600	575
	2010	580	NMW	600	625	612	600	600
	2011	593	NMW	600	625	637	600	600
Development rate	2002	350	NMW	400	370	349	349	349
	2003	360	NMW	400	375	410	359	361
	2004	380	NMW	400	420	424	400	381
	2005	410	NMW	450	420	440	450	400
	2006	425	NMW	450	475	460	450	450
	2007	445	NMW	490	450	485	450	450
	2008	460	NMW	500	485	505	500	465
	2009	477	NMW	500	510	480	500	480
	2010	483	NMW	500	515	487	500	487
	2011	492	NMW	500	494	525	500	494

So, for example, in 2002 the adult NMW of £4.10 is also the mode. The next three most popular wage rates are £4.50, £4.20, and £4.09. The wage closest to the NMW, which has at least 30% of the observations of the NMW, is £4.50. £4.09 is the wage closest to the NMW where at least 10% of the numbers at the NMW are observed.

For ASHE, the NMW is always the mode within a range of 50p of the NMW; this will be contrasted with LFS data later. The second most popular rate is always, with one exception, the next 50p boundary, whether this is 7p away (adult rate, 2011) or 50p away (development rate, 2002). As these reflect gaps of 1.1% and 14.1% respectively, this consistency is notable. The third most popular is often the first 'available' 25p point.

The last two columns illustrate potential problems with the derived wage calculations. For the Development Rate, in 2003 the most popular wage is £3.60, the NMW for that group. However, at least 30% of the numbers at the NMW reported £3.59, and at least 10% £3.61. If these numbers are rounding errors then this suggests that the numbers at the NMW should be at least 40% higher (calculations on the base data show that this should be 47% in fact) and that a significant number of employees are being mistakenly identified as earning 'below the NMW'. From 2004 onwards this appears to be less of a problem, but it does suggest some caution when analysing pre-2004 'ASHE' data (NES).

In the last two years there appears to be more variation, with wages not on the 5p mark (and not appearing to be a rounding error) occurring for both the adult and development rate. The variation in the development rate might be rounding errors, but the unusual values in the adult rate (£6.12 and £6.37) seem harder to explain.

Figure 7 shows the above graphically. Numbers of observations are unweighted. In the bottom two graphs, the size of the circles indicate the number of observations.

Figure 7 ASHE observations near NMW



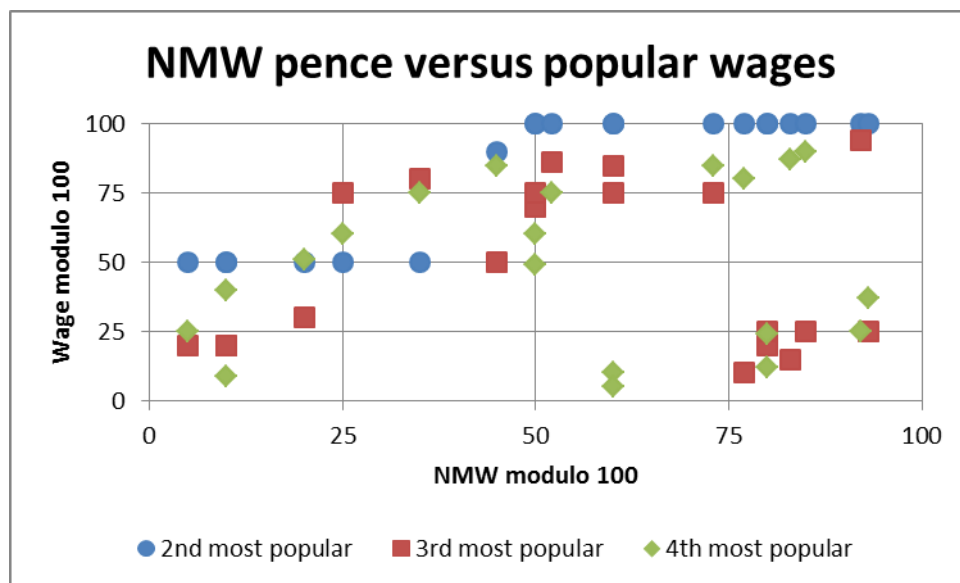
This illustrates the relationship between focal points. The NMW is the base; the next two most popular wages alternate, depending on how far the NMW is from a 50p point. The top two charts illustrate the flipping between the popularity of rates.

Interestingly, the actual number of observations does not follow the same pattern of alternating popularity. When the NMW is close to a 50p mark (the vertical lines in the graph indicate years when the NMW is 15p or less below a 50p point), then the number of observations at that second most popular wage does not seem to rise consistently. Nor does the third most popular wage seem to move consistently, despite its alternation around the 50p mark.

There is a general increase in numbers at all points over time (including at the NMW), suggesting that wages are becoming more concentrated at a smaller number of focus points. However, the absence of any clear relationship between focal points and numbers around the NMW suggests that decisions about wages are still dominated by the very specific numbers near each NMW.

Finally, how predictable are these values? Figure 8 shows the pence value only of the NMW matched to the pence value of the popular wages nearby; so, an NMW of £4.10 and wage of £4.56 would generate the pair (10, 56). The wages are taken from all years and from the adult and development rates:

Figure 8 Predictability of wages near NMW



These confirm the predictability of focal points. Irrespective of the year, rate or size of the NMW,

- The next most popular wage will be the first 50p marker after the NMW
- If the NMW is between 25p and 75p in the pound, then the third most popular wage will be around the first 75p; otherwise, it will be around the first 25p
- The 4th most popular wage will usually be on a 10p marker near the 3rd most popular

As has been noted by the LPC, the first of these predictions will provide a particular challenge in 2011-12 when the £6.08 NMW suggests that the next major wage will be £6.50 – a 7% premium. In 2005-6 the premium for £5.50 over £5.05 was 10%, but this was during a strong labour market.

3.1.4 Is there variation over time?

As seen in Figure 7 above, there seems to be a general increase in rounding, smaller than but in line with the general increase in numbers at the NMW. However there is a separate question as to whether the rounding behaviour itself has changed. As noted in the summary, Section 3.1.1, there are two potential hypotheses:

- H1.2a: as the NMW has increased the proportional gap between the NMW and focus points has fallen over time, allowing companies more opportunity to move to convenient focus points; for example, if the NMW is £3.35 then paying £3.50 is a 4.4% premium over the NMW, but when the NMW is £5.35 paying £5.50 drops to a 2.8% increase in wages
- H1.2b: as the NMW increases and more employees are paid at or near the statutory minimum, the scope for adding eg 15p to the basic wage is increasingly restricted: more workers will get that increase, and more workers will be affected by spillovers up the pay scale; in addition, the impact of the recession might induce employers to restrict variation in wages

These hypotheses are considered by using the data in Table 4. This allows for the same NMW to be observed at different times (adult versus development rates) and for similar ‘pence’ values to be seen at different scales. Both hypotheses can therefore be considered.

Table 5 below selects rows from Table 4 and rearranges them to make comparisons easier.

Table 5 Comparisons over time and scale

	Type	Year	NMW	2nd	3rd	4th
<i>Example 1: similar wages at different times</i>						
(a)	Adult	2002	410	450	420	409
	Development	2005	410	450	420	440
(b)	Development	2009	477	500	510	480
	Development	2010	483	500	515	487
	Adult	2005	485	500	525	490
<i>Example 2: similar pence values at different scales</i>						
(c)	Development	2002	350	400	370	349
	Adult	2004	450	500	475	460
	Adult	2008	552	600	586	575
(d)	Development	2003	360	400	375	410
	Development	2008	460	500	485	505
(e)	Development	2004	380	400	420	424
	Adult	2010	580	600	625	612

Considering cases (a) and (b), it is clear that the same NMWs observed at different times in different groups, tend to produce very similar outcomes in terms of focal points. The last three cases show more variation, particularly in case (c), the 50p-NMW; but as this is the NMW with the maximum possible variation in these figures, this should not be surprising. Nevertheless, the bottom three

cases all provide some support for the argument that maintaining proportional differences may be less important than the level distance to the next focal point.

In summary then, neither hypothesis seems to be supported. In other words, the predisposition to set wages at focal points is independent of time and seems to be independent of scale.

3.1.4 The likelihood of round numbers: company characteristics and preferences

It was noted above that the likelihood of firms paying round numbers appears to decrease with firm size. This section considers some other factors.

Table 6 displays the results of multivariate analysis on factors which are associated with companies paying round numbers.

Table 6 Multivariate analysis of factors affecting likelihood of rounded wage rates

Explanatory variables	Probability of round number		Likelihood of repeated rounding	
	<i>Coefficient</i>	<i>p-value</i>	<i>Coefficient</i>	<i>p-value</i>
Wage	0.046	0.000	0.279	0.398
Wage, squared	-0.004	0.000	-0.026	0.444
Basic hours	0.001	0.443	0.020	0.801
Female	-0.004	0.770	-1.059	0.442
Age	-0.002	0.000	-0.110	0.028
If full-time	-0.052	0.019	-6.699	0.002
size band 2	-0.443	0.000	-8.210	0.008
size band 3	-0.619	0.000	-13.713	0.000
size band 4	-0.929	0.000	-21.963	0.000
public sector	-0.420	0.000	-21.383	0.000
Observations	46780		1866	
R ²	0.055		0.144	

Notes:

1. Additional variables: 9 year and 11 region dummies.
2. Significant coefficients are highlighted in **bold**.
3. Each company has at least five wages observed 2002-2011

The first column of figures shows the result of estimating the probability that a wage is rounded to 4p, 5p, 10p, or 25p, for wages between the NMW and the NMW+50p⁶. The probability model evaluates a yes/no effect, and so the fact that a wage can be rounded to differing degrees (eg 100p is factored by all) is irrelevant. A positive coefficient indicates a higher likelihood, compared to the alternative. The second column shows whether this is a chance result: a value of under 0.05 indicates that there is a less than 5% probability that this value is really a zero and the resulting coefficient is in fact statistically insignificant. Variables for year and region were also included as additional controls, but are not reported here.

⁶ It was suggested in section 3.1.2 that the case for 4p as a rounding factor was not proven, especially as the basis for considering 4p (part-hours calculations) differs from the rationale for the other rounding numbers. We are grateful to the LPC for identifying this error. Deadlines meant the analysis could not be rerun but qualitatively results should not be affected: if 'rounding' is over-identified, Table 6 under-reports the significance of findings.

Most of the figures in the first column appear to be statistically significant. Therefore, the likelihood of being paid at a round number is higher if one is younger; part-time; and working in the private sector. The default company size is 0-9 employees, and so the likelihood of being paid a round number decreases with company size; this agrees with the findings of section 3.1.2.

The third and fourth columns show the result of estimating whether the likelihood of rounding within a company is chance or a consistent policy. The dependent variable is the proportion of observed wages (in the region $NMW < \text{wage} < NMW + 50p$) paid at round numbers. The statistics indicate that a smaller proportion of wages will be paid at round numbers if the employees are full-time, if the company is larger, and in the public sector. The specific wage, hours, age and gender of the employees do not appear to be significant; this makes sense as this finding relates to the overall company preference. This finding would seem to indicate that some kinds of companies might have a consistent preference for rounded wages. It is also likely that the nature of the business affects the amount of rounding, given the variation in the prevalence of low-paid work across sectors (LPC, 2012), but this was not explored in this study.

A second way to consider whether companies appear to operate wage policies is to look at wages paid over time. ASHE records whether individuals are in the same job as the previous year. Table 7 below describes the wage-setting behaviour experienced by those who remain in the same job for two years.

Table 7 Wage factors over time

Wage factor	Factor in lagged wage				
	0	4	5	10	25
0	11379	3546	2044	2290	2369
4	3195	1342	724	729	802
5	2064	613	750	605	646
10	2103	812	555	1396	915
25	2306	735	706	982	2401
<i>Chi-square (16) = 1347 (significant difference from random pattern)</i>					
	0	5			
0	11379	35017			
5	9668	43956			
<i>Chi-square (1) = 631 (significant difference from random pattern)</i>					

Numbers are unweighted and reflect each year-on-year comparison. That is, someone who is observed being paid near the NMW in the same job in three consecutive years 2004-2006 will contribute two observations: 2004 vs 2005, and 2005 vs 2006.

The top part of the table shows the numbers when wages are recorded as rounded to 4, 5, 10 or 25p, within 50p of the NMW. Only the highest factor is recorded for each wage. So for example, 2044 employees had a wage which was not rounded to any of the factors in one year, but which was rounded to 5p (but not 10p or 25p) in the previous year. In the lower part of the table, wages are either rounded to 5p or not.

The chi-square values show whether the patterns of numbers arises by chance; the high values shown here indicate that in both cases the outcome is not what would be expected from wages being randomly set. Specifically, the diagonal terms are larger than would be expected⁷, in other words, an employee whose wage is rounded to a certain factor could expect to see it rounded to the same factor in the next year. This suggests that companies are exhibiting a preference for paying at certain wages.

Finally, we consider whether companies may have a policy of maintaining a distance from the NMW; this is Lam et al's (2006) argument that the relative distance from the NMW is important. Following Lam et al (2006), a 'company minimum wage' (CMW) is calculated by taking the lowest wage for each company in a year, where that company pays above the NMW. So if a company has three employees in ASHE and is paying them £5.10, £5.25 and £5.25 when the NMW is £5.05, then the CMW is £5.10. This is feasible because business reference numbers are included in ASHE and so multiple employees within the same business can be identified.

The next stage is to consider how this changes over time. Table 8 below shows the proportion of businesses who always set a CMW above the NMW but within 5p or 10p of it⁸. Only businesses who have a CMW within 50p of the NMW observed for at least five separate years over 2002-2011 are included.

Table 8 Maintenance of distance from NMW

	Employer size band			
	0-9	10-49	50-249	250+
Not all within 5p	179	285	361	836
All within 5p	11	13	15	27
<i>% within 5p</i>	<i>5.8%</i>	<i>4.4%</i>	<i>4.0%</i>	<i>3.1%</i>
<i>Chi-square (3) = 3.395 (no significant difference between firms)</i>				
Not all within 10p	161	243	305	758
All within 10p	29	55	71	105
<i>% within 10p</i>	<i>15.3%</i>	<i>18.5%</i>	<i>18.9%</i>	<i>12.2%</i>
<i>Chi-square (3) = 12.640 (significant difference between firms)</i>				

As ASHE only samples 1% of employees, this likelihood of finding the true CMW for a business is small for all but the largest companies, and the requirement to see at least five years of low wages reduces the numbers still further. Nevertheless, this does provide some interesting indicators.

First, the proportions with a CMW always within 5p and 10p of the NMW seem surprisingly high, given combined probability of at least five wages all being within the same region, and given the earlier findings that wages are strongly clustered on the 10, 25p and 50p mark. However, it should

⁷ It could be argued that this is due to individuals wages remaining constant from one year to the next; these were not removed from the sample. We are grateful to the LPC for suggesting this.

⁸ The reason for the small gap is to identify firms who are tracking the NMW closely. It was felt that choosing a large value (such as NMW+50p) would have risked including in the 'tracking' group a large number of companies making ad hoc decisions about wages to pay in a relatively wide band.

be recalled that the lowest wages in a business for each year are being used; and the very small numbers (particularly for the 5p range) limit the robustness of any statistical inference.

It is possible to compare differences across firm sizes. In the 5p band the apparent predilection of smaller firms for paying within a narrow margin of the NMW are not statistically significant, even ignoring the sampling effects. However, in the 10p band there is some indication that larger firms are less likely to keep their minimum wages to a narrow band.

3.1.5 Wage-setting behaviour – summary of evidence

Section 3.1.1 provided several hypotheses surrounding wage-setting behaviour. The evidence for these is summarised below.

Hypothesis	Support?	Evidence
<p>A significant number of wages near the NMW are set according to the characteristics of the numbers ('ad hoc adjustment')</p> <ul style="list-style-type: none"> The aim of ad hoc adjustment is to create a simple marketing message ("10p over the NMW") The aim of ad hoc adjustment is to simplify calculations for part-hours The aim of ad hoc adjustment is to simplify maintenance 	<p>Yes</p> <p>Yes</p> <p>No</p> <p>Perhaps</p>	<p>Strong Repeated evidence that wages are set at 'round' numbers</p> <p>Weak Some evidence that wages relative to NMW are set at round multiples, but much less compared to absolute values. No direct evidence from JobCentre data, in contrast to Lam et al (2006)</p> <p>Weak Multiples of 5p dominate. Some evidence for factor of 4p (ie quarter-hour calculations) from ONS data, none from JobCentre data</p> <p>Weak Some evidence of persistent preferences for rounding</p>
<p>The degree of ad hoc adjustment has varied over time.</p> <ul style="list-style-type: none"> As wages rise, the shrinking proportional gap between focus points gives companies room to manoeuvre Squeezed margins and wage compression give companies less room to manoeuvre 	<p>No</p> <p>n/a</p> <p>n/a</p>	<p>Strong Effect appears to be strongly time-invariant and weakly scale-invariant</p> <p>None</p> <p>None</p>
<p>Ad hoc adjustment is more likely to be found in small firms</p>	<p>Yes</p>	<p>Strong Different statistics support the view that small firms are more likely to round hourly wages.</p>

It should also be recognised that a number of these results have suggested areas where further research may be needed to supply a more definite answer.

3.2 Responding to changes in the NMW

3.2.1 Summary of theory and evidence

Observed behaviour

- There appears to be a delayed reaction to the introduction of the NMW

Theory

- In the early days of the NMW, delayed wage-setting could be optimal as there were no prosecutions nor interest accrued on back payments; but bad publicity and the threat of being an 'example to others' could be important
- Menu costs of introducing NMW changes in the middle of the financial year could cause firms to anticipate the next NMW at the time of salary changes; or,
- Large firms might have invested in business software allowing better fine tuning of wage payments

Hypotheses:

- (H1.4) Those firms not introducing the NMW should decline over time as (a) processes are put in place to deal with it , and (b) compliance is tightened up
- (H1.5) Larger firms are more likely to anticipate the NMW introduction to avoid multiple wage changes
- (H1.6) Small firms are likely to show less compliance

Evidence

- Timing of measurement becomes important
- Evaluations of wage based on ASHE cannot be used to infer compliance with NMW at earlier parts of the year

3.2.2 Evidence of timing effects

Three approaches could be taken to this question:

- Using the Monthly Wages and Salaries Survey (MWSS), is there any indication that wage changes are affected by the introduction of the NMW?
- Using the annual and quarterly LFS and annual ASHE, is there any evidence of lagging and leading behaviour?
- Is there any direct evidence for changes in compliance over time?

Direct evidence of compliance has been extensively studied by other LPC reports, and will not be considered here. Instead the focus is on indicators of how companies prepare or react to the NMW.

The MWSS data contains average wage levels for an organisation. The survey also asks businesses whether the monthly data has been affected by significant changes such as the introduction of annual pay awards. A significant increase in wages around October would provide some evidence that companies are reacting at the last moment to the introduction of the NMW (wage changes are advertised several months in advance).

Analysis of these monthly changes does not however provide any support for this hypothesis. The only noticeable change in wage levels appears in April, if at all. This would imply that the new tax

year is the dominant feature for company wage changes; at any rate, adjustments for the new NMW appear to be subsumed into general wage increases. An alternative explanation is that NMW changes are made in October, but that these make very little difference overall to the company wage bill. This seems to be true for both large and small companies.

The MWSS is designed to provide monthly measures of wage growth across the whole economy; it is dominated by large firms, and contains relatively little supporting information. It is possible that a more complex analysis might show different behaviour in some combination of firm size, location, industry and so on, but the fact that data are provided for a whole business rather than one employee limits the chance of identifying small effects at the bottom of the wage distribution. Accordingly, no further analysis was done on MWSS.

To get a better handle on how companies respond to NMW changes, Table 9 shows the proportions of employees in the LFS being paid the current, next or lagged NMW, across all quarters; all those paid within 50p of the relevant NMW are included, to limit the sample to those for whom the NMW is most relevant. The wage rate used is the stated rate. The new NMW comes into force in Q4 (Oct-Dec), and so from the NMW perspective the year runs Q4 (Year Y), Q1, Q2, Q3 (Year Y+1).

Table 9 Quarterly variation in lagged/leading NMWs

	Quarter	Next year's NMW?	Last year's NMW?	Current NMW?	Other
Stated wage, adult rate	4	2.6%	5.6%	21.0%	70.8%
	1	3.5%	2.0%	25.0%	69.5%
	2	4.3%	0.7%	24.5%	70.5%
	3	4.7%	0.6%	25.8%	68.9%
<i>Chi-square(9) = 1183 (significant variation between quarters)</i> <i>39,753 observations in all quarters and years</i>					
Stated wage, development rate	4	2.3%	6.3%	14.2%	77.2%
	1	2.8%	3.1%	17.3%	76.7%
	2	4.0%	3.3%	23.0%	69.8%
	3	3.8%	1.9%	23.2%	71.1%
<i>Chi-square(9) = 45 (significant variation between quarters)</i> <i>2,471 observations in all quarters and years</i>					

So, in Q1 (Jan-Mar), averaged across all years, 3.5% of those earning within 50p of the current wage would have been paid the NMW due to come in the following October; 2% were being paid a wage which had been made illegal up to six months before; 25% were on the current NMW; and the other 69.5% received some other wage.

It is clear that, over the course of the NMW year, the probability of being paid last year's NMW falls. As Ormerod and Ritchie (2007a) note, the probability of an outdated wage being paid has largely

stabilised by Q2; this is important, as this is when the ASHE data is gathered on which the official NMW statistics are based⁹.

The probability of being paid the next year’s NMW ahead of time increases throughout the year. This supports the view that firms anticipate future NMW increases in their regular pay round, particularly as the NMW changeover date comes nearer.

The same case appears to hold for both the adult and development rate. The chi-square values indicate that the differences between quarters are significant. The small numbers here (particularly for the development rate) prevent more detailed analysis being possible. However, multivariate analysis can help to provide some idea of the other important characteristics of lagging or leading behaviour.

The figures in Table 9 only show the simple relationship between past and future NMWs and the time of year; as such, there could be other confounding factors. To address this, Table 10 gives the results of estimating the probability of a wage rate leading (anticipating the next year’s NMW) or lagging (wages are set at the previous year’s NMW). The analysis was run on both ASHE (using the derived rate) and the Quarterly LFS (using the stated rate), and separately for leading and lagging behaviour. Finally, the analyses were run both on the whole dataset and on a subset of employees with wages within 50p of the NMW.

Table 10 Regression analysis of leading/lagging behaviour

Variable	Anticipation - all		Lagging - all		Anticipation near NMW		Lagging near NMW	
	ASHE	LFS	ASHE	LFS	ASHE	LFS	ASHE	LFS
Q2 Apr-Jun		0		--		0		--
Q3 Jul-Sep		++		--		++		--
Q4 Oct-Dec		0		++		0		++
Hours	0	--	0	--	0	0	--	--
If female	++	++	--	++	++	0	--	0
Age	0	0	--	0	0	0	--	0
FT	--	--	--	--	0	0	0	0
Size 10-49	++	++	--	--	++	++	--	--
Size 50-249	++	++	--	--	++	++	--	--
Size 250+	++	0	--	--	++	++	--	--
Public	--	--	--	--	--	--	++	--

Notes:

1. Year and region dummies also included.
2. Default values are: Q1 Jan-Mar (for Quarterly LFS), male, part-time, 0-9 employees, and private sector.
3. Detailed regression results are included in Annex C, Table C1.

For simplicity, actual coefficients and significance levels are not given; instead “++” indicates a positive and significant effect, “- -” a negative and significant effect, and “0” no significant impact; all

⁹ The persistence of wage rates apparently below the NMW does not necessarily imply non-compliance. Other factors, such as the accommodation offset, which are not available from the LFS could account for below-NMW wages.

significance tests are at the 5% level (that is, there is a 5% chance that the result could have arisen by chance if all the assumptions of the model are correct). So being full-time would appear to be having a negative effect when the analysis is carried out on all employees, but when the analysis focuses on those near the NMW there is no impact.

Two notable effects seem to drive anticipatory behaviour. First, the quarter; anticipation of the next NMW, all other things being equal, only appears to be significant in the third quarter, just before the new NMW comes in. Second, size: large firms are more likely to anticipate the NMW. This suggests that the behaviour in Table 9 masks two impacts: large firms will take the future NMW into account when setting wages; smaller firms will respond as the time for the new NMW approaches.

Lagging behaviour is also affected by size and quarter. Compared to Q1 (Jan-Mar), NMW-lagging is most likely to occur in Q4 (Oct-Dec), and less likely in Q2 and Q3. Bigger firms are less likely to have lagging wages. Overall then the conclusion is that large firms are looking ahead to avoid multiple wage changes, and keeping to the NMW regulations; small firms are leaving adjustment much later, sometimes past the formal point at which change is required.

The public coefficient indicates both less anticipation and, in most specification, less delayed uprating. However it could be argued that the ‘preferred’ specification is to use ASHE data near the NMW, which would indicate that public sector firms are more likely to delay the introduction of the NMW. This is an unusual result which seems to contradict other evidence about the private sector being slower to respond to the NMW changes.

The interpretation of the other variables is not attempted: this is difficult as these are personal rather than business characteristics and have no obvious interpretation in this context..

3.2.3 Responding to changes – summary of evidence

The evidence for the hypotheses of section 3.2.1 is summarised below.

Hypothesis	Support?	Evidence
Not introducing the NMW should decline over time as (a) processes are put in place to deal with it , and (b) compliance is tightened up	n/a	Not checked yet.
Larger firms are more likely to anticipate the NMW introduction	Yes	Strong Univariate and multivariate support
Small firms are more likely to be paying outdated minimum wages	Yes	Strong Univariate and multivariate support

4. Employee behaviour: how are earnings reported?

This section considers how employees view their earnings and hours by looking at responses to the LFS. These are contrasted with ASHE data which is assumed to accurately represent actual hours and earnings.

4.1 Accuracy of employee responses

4.1.1 Summary of analysis of employee wage responses

Observed behaviour

- LFS responses are much more likely to be below the NMW
- LFS reported rates much more likely to be at focus points
- Unlikely values are less likely to be correlated with use of documentation

Theory:

- In the absence of exact information, respondents are likely to give answers which are simple to remember and easy to work with (for example, taking £5 an hour as a good approximation to £5.05)
- Earnings are less likely to be rounded to calculable numbers (modulo 4) and more to 'human' round numbers like 10p and 25p

Hypotheses

- (H2.1) LFS respondents are more likely to round responses than ASHE respondents
- (H2.2) LFS rounding represents measurement error, not employer behaviour
- (H2.3) Rounding correlated with lack of documentation/proxy responses
- (H2.4) Earnings are rounded to focus points appealing to humans, not time calculations

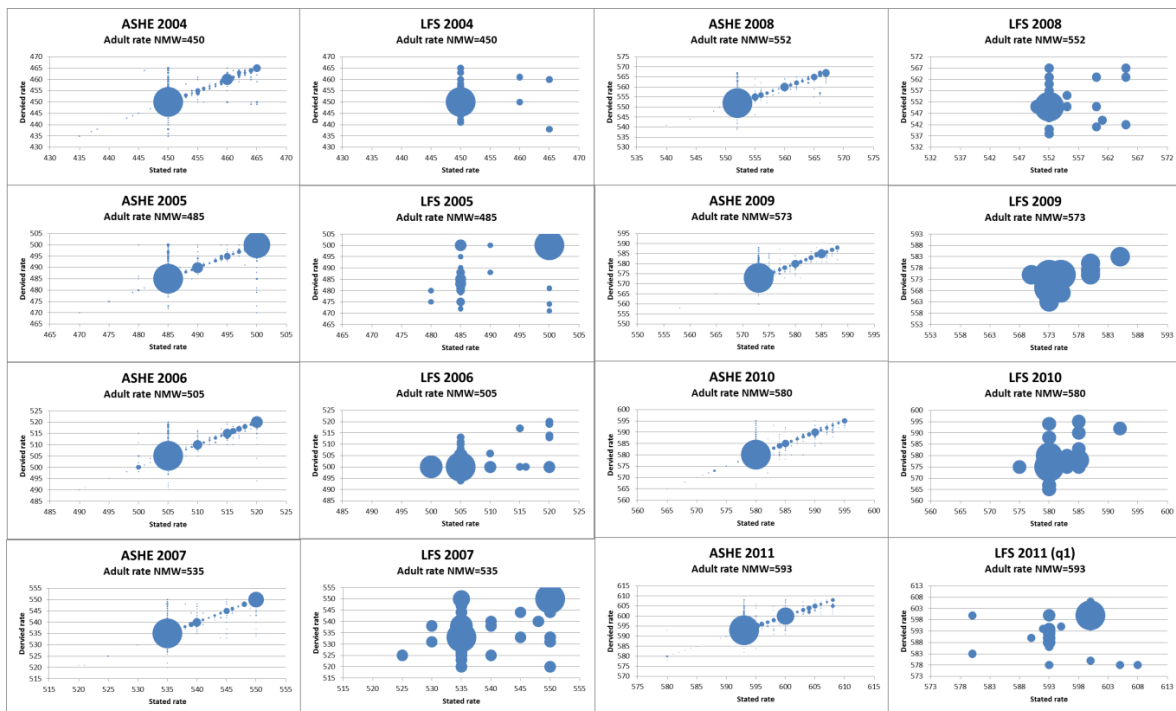
4.1.2 The distribution of employee responses

Section 3.1.3 introduced the 'blobogram', showing how ASHE wages are distributed around the NMW. These are reproduced below, but unlike those of section 3.1.3, the ASHE graphs are not imputed i.e. only those observations with both a derived and stated rate are included. This is because setting stated=derived for missing cases could give a misleading impression about the agreement between the two rates.

The same graphs can be created for the LFS so that the ASHE and LFS response to the NMW can be considered. However, note that in the LFS the 'stated' wage is the key indicator and the 'derived' rate is the subsidiary measure, the opposite of ASHE. Only the adult rate is considered as there are insufficient observations in the LFS for employees on the development rate.

The graphs in Figure 9 have been reduced to allow comparison. At this stage the important issue is how the two distributions compare overall.

Figure 9 Comparison of ASHE and LFS distributions, all years



It is clear that there is very little similarity between the two data sources. Even allowing for problems with the calculation of the LFS derived rate, the dominance of the NMW is much less, and there are substantial and persistent differences between derived and stated rates.

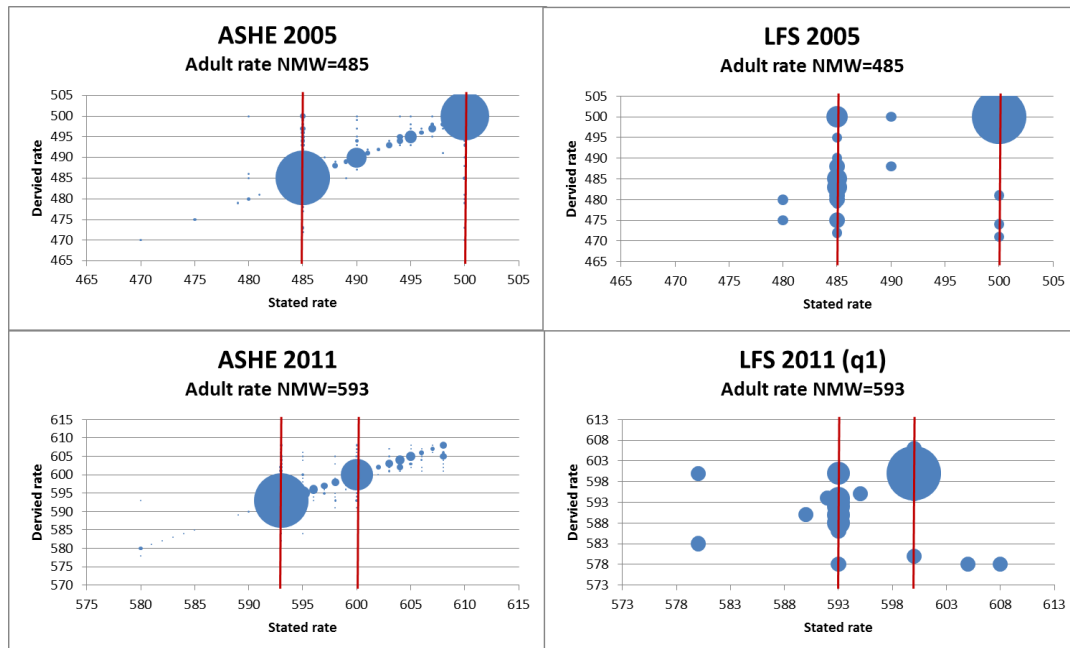
For the LFS, the stated rate appears to take many fewer values than the ASHE data, but there is much more variation in the derived rate. The derived rate is not used in the calculation of official NMW statistics, but it remains an important value. For example, interest in a 'Living Wage' implies knowing the household's total earnings, which are used in the derived rate calculations. If the derived rate is showing unexpected behaviour, this might reflect on the accuracy of the total earnings data.

Although the disparity between the datasets seems random at first glance, some conclusions can be drawn by considering repeated situations: where the NMW is

- just below a focus point
- just above a focus point
- at a focus point
- not near any obvious focus points

Case 1: NMW below but near £1, (2005, 2011)

Figure 10 Comparison of ASHE and LFS just below £1 mark

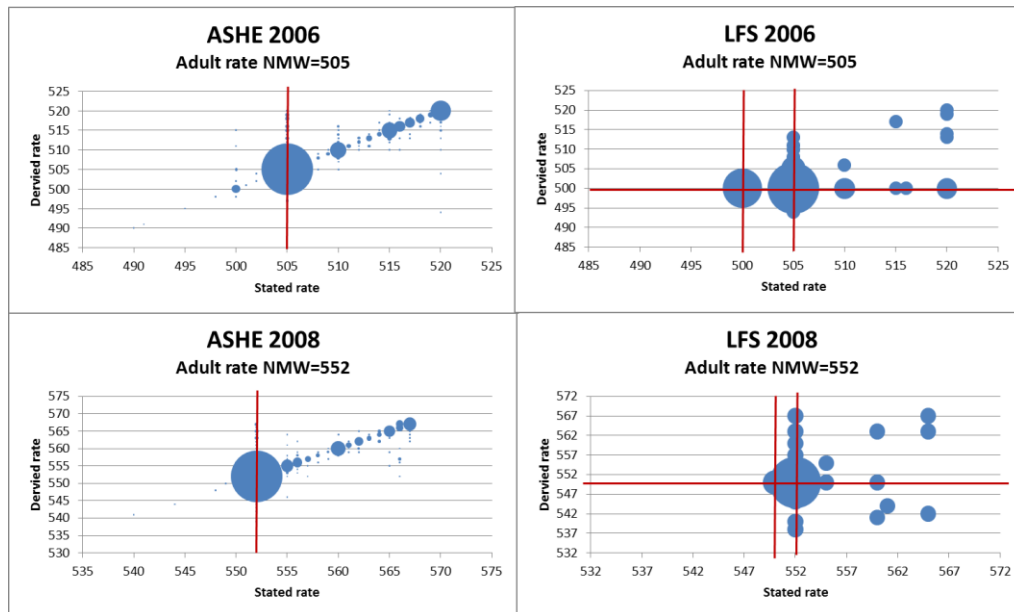


A line has been added to indicate both the NMW and the next £1 point. For ASHE, peak observations are at the NMW, with a second similar peak at the £1 mark, and not much in between. For the LFS, most observations are concentrated at the £1 mark, with a much smaller number at the NMW. The stated wage effectively only has two values, the NMW and the £1 mark. The derived wage shows more variation when the stated wage is at the NMW, but when the stated is £1 so too is the derived value.

In summary, when the NMW is close below a £1 mark (and 15p counts as 'close'), a large number of LFS observations would appear to be misreported. Moreover, they are misreported in such a consistent way that, if only the LFS data were seen, entirely wrong conclusions could be drawn.

Case 2: NMW just above 50p or £1 (2006, 2008)

Figure 11 Comparison of ASHE and LFS just above 50p mark



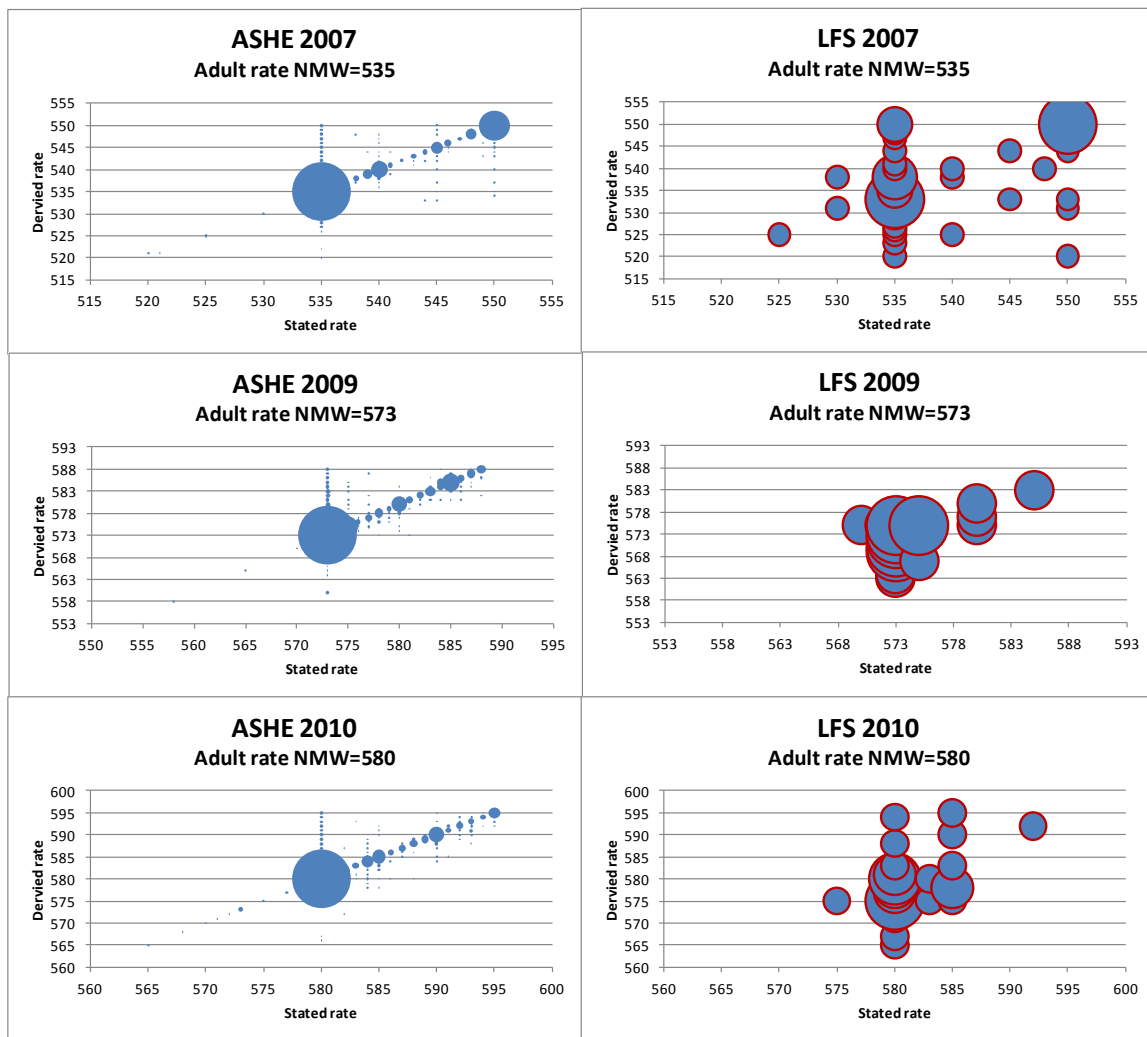
ASHE shows almost all observations concentrated at the NMW. The LFS shows concentration of the stated rate, although the 50p point below the NMW also has a significant number of 'stated' observations. However, the LFS derived data show almost total concentration on the 50p mark, as shown by the horizontal line.

Ormerod and Ritchie (2007a) analysed this set of data in some detail, including looking at individual data points for hours and earnings in 2006 to try to ascertain how the derived rate could so consistently come down to £5.00. They suggested that the only feasible explanation was that respondents chose the hours worked and then multiplied up by £5.00 to get total earnings; this was then divided by hours by ONS to get the 'derived' rate.

Case 3: NMW in 'no-man's land' (2007, 2009, 2010)

In this case the LFS data have been given borders so that the data bubbles can be more clearly identified.

Figure 12 Comparison of ASHE and LFS in 'no-man's land'



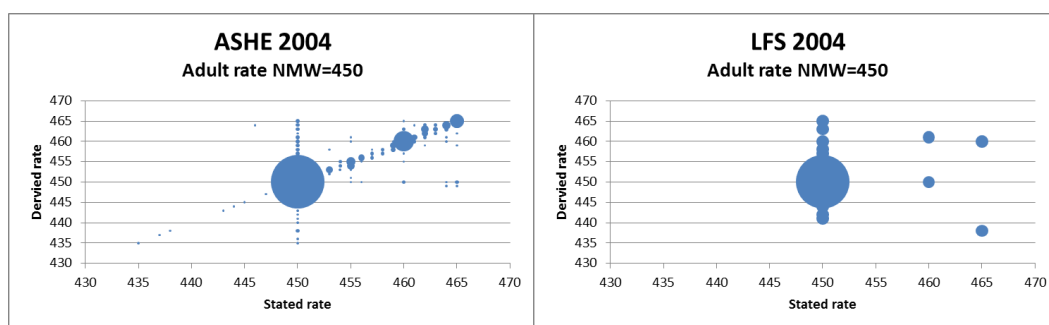
There are relatively few observations in 2010, and so the size and apparent concentration of the bubbles may be misleading. These graphs show the stated wages mainly concentrated on the NMW, although there are some popular wages just above the NMW in 2009 and 2010; neither of these are reflected to the same extent in the ASHE data.

Once again, the derived wage varies considerably; of some concern, in 2009 and 2010 the derived wages are mostly at or below the NMW. This does not seem to occur in other years.

Case 4: NMW on focus point (2004)

In contrast to the above, Figure 14 shows what happened in the one year that the adult NMW was set on a 50p focus point.

Figure 13 Comparison of ASHE and LFS at a focus point



Unusually, ASHE and LFS are in agreement: the NMW dominates; the only other notable points are 10p and 15p over the NMW, but these have much fewer numbers. The LFS derived still shows some variation, but relatively little compared to other years.

In summary, the absolute level of the NMW clearly affects the reporting of both stated and derived wages in the LFS. If ASHE is taken as the accurate representation of the wage distribution, then these results show that the LFS data may be subject to considerable measurement error; but that this error also appears to be relatively predictable.

The LFS contains several variables which may shed light on this source of error. However, it is difficult to identify ex post which specific observations are erroneous (as opposed to the unlikely overall distributions). A crude approximation can be given by assuming that some observations are more likely to be erroneous; for example, a £5.00 wage in 2006 (when the NMW was £5.05). Comparing the factors associated with these wages against other wages might highlight differences.

In Table 11 below, the results of estimating the probability of wages being 'suspicious' are given. A 'suspicious' wage is one in which the derived wage is £5.00 in 2006 or £6.00 in 2011; a 'doubly suspicious' wage is one where the derived rate is both 'suspicious' and different to the stated wage. The reason for using the derived wage rather than the stated wage is that unlikely results seem more prominent in the derived wage; as the interest is in the characteristics of individuals who report erroneous wages, this is a better source of information.

Table 11 Factors influencing 'suspicious' values

Explanatory variables	Prob. ('suspicious')		Prob. ('doubly_suspicious')	
	Coefficient	p-value	Coefficient	p-value
stated wage	-0.0055	0.000	-0.0046	0.000
basic hours	-0.0161	0.000	-0.0106	0.015
female	-0.0236	0.758	0.0146	0.872
age	-0.0010	0.687	-0.0005	0.849
if full time	0.0018	0.986	-0.0225	0.847
employer size 10-49	-0.1479	0.039	-0.0907	0.284
employer size 50-249	-0.1598	0.075	-0.0367	0.723
employer size 250+	-0.4796	0.000	-0.2602	0.048
public sector	-0.0193	0.864	0.0700	0.579
proxy response	0.0651	0.414	-0.0526	0.587
used documentation	-0.1941	0.013	-0.0916	0.298
Observations		3719		3719
R ²		0.0805		0.0583

Notes:

1. Additional variables: year and region dummies.
2. Default values: male, part-time, company size 0-9, private sector. Direct response, did not use documentation
3. Significant coefficients are highlighted in **bold**.

As wages are assumed to be 'suspicious' when they could be valid, the p-values (the measures of significance of the results) are understated. However, there is only one borderline case where the p-value approaches the 0.05 value identifying significant results, so the results may be robust enough for interpretation.

Three variables are of particular interest. The negative coefficient on company size suggests that the larger the company, the less likely the respondent to report suspiciously rounded numbers (and, to a lesser degree, to have differences between stated and derived wages). This is difficult to interpret as the focus here is on the perceptions of the individual rather than the company; however, it may be that employees of larger companies have more consistent hours and earnings information and so are better able to recall their data.

The negative coefficient on the 'used documentation' dummy variable indicates that documentation lowers the probability of rounded derived wages; this was also reported by Ormerod and Ritchie (2007a) who carried out a more detailed study on the 2006 LFS data. Unlike that paper, there appears to be no significant difference whether the response was direct or by proxy. This could mean two things: either the proxy accurately represents the recall of the target respondent, including any rounding activity; alternatively, the proxies apply rounding rules which does no better or worse than that of the target respondents, and which are completely independent of the target respondents. In other words, if, in the absence of documentation, everyone does their own thing, then there is no reason to suppose that proxies will be any more or less inclined to round numbers than the target respondents. Note that this is not saying that proxies are as accurate as direct

responses; it is merely arguing that the behaviour of proxies under uncertainty is, overall, as predictable as direct responses.

4.1.3 Do employees round wages like employers?

Table 12 below provides the counterpoint to the ASHE data presented in Table 2. The basis is the same: gross frequencies for all wages within the range (NMW < wage < NMW+£1).

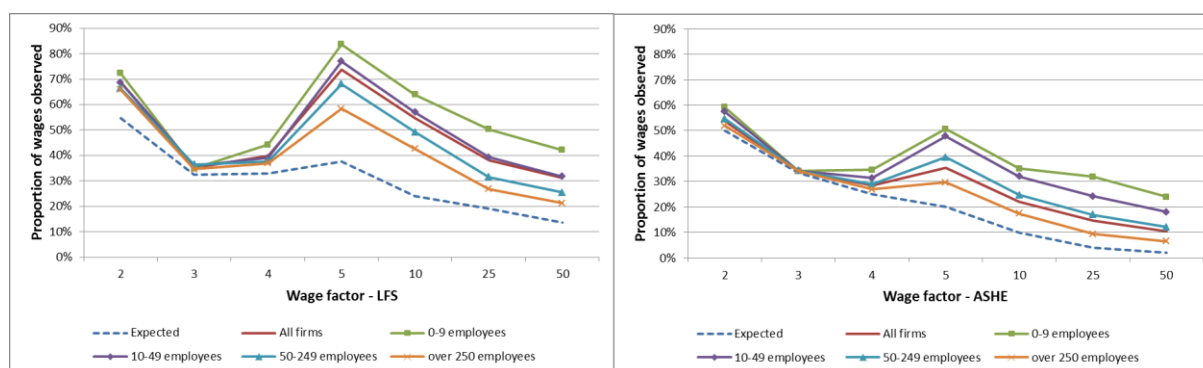
Table 12 Factors for LFS stated wages, NMW<wage<NMW+£1, all years

		Absolute wage						Relative wage		
		2	3	4	5	10	25	50	5	10
Factors, in pence		2	3	4	5	10	25	50	5	10
Expected frequency		50%	33%	25%	20%	10%	4%	2%	20%	10%
Observed frequency	All size bands	69%	35%	40%	74%	55%	38%	31%	62%	37%
	0-9 employees	72%	35%	44%	84%	64%	50%	42%	65%	38%
	10-49 employees	69%	36%	39%	77%	57%	39%	32%	61%	36%
	50-249 employees	66%	36%	38%	68%	49%	32%	25%	52%	29%
	250+ employees	66%	35%	37%	58%	43%	27%	21%	49%	28%
Relative variation	All size bands	1.37	1.05	1.59	3.68	5.46	9.56	15.55	3.10	3.67
	0-9 employees	1.45	1.05	1.77	4.19	6.39	12.59	21.10	3.25	3.77
	10-49 employees	1.37	1.08	1.56	3.85	5.70	9.81	15.91	3.03	3.63
	50-249 employees	1.33	1.09	1.51	3.41	4.92	7.88	12.72	2.61	2.93
	250+ employees	1.32	1.04	1.48	2.92	4.26	6.71	10.62	2.45	2.83

The LFS data displays the same characteristics as the ASHE data: there is more rounding to higher factors than would be expected; and this is associated with the size of the employer, with larger employers less likely to round. Wage rounding is much more common in LFS, and, perhaps surprisingly, rounding a relative distance from the NMW is also more likely. This latter effect may be because most LFS respondents round to 5p, and for most of the period under study the NMW also has a 5p factor.

Figure 15 shows the data in Table 12 graphically, and compares it to the ASHE results presented in Figure 2, rescaled so that the axes are the same:

Figure 14 Frequency of wage factors - employees and employers



It can be seen that, while the patterns of rounding are the same in both datasets, the frequency is much higher in the employee responses.

A major difference between ASHE and LFS occurs when the most popular wages are studied. Table 13 reproduces Table 4 for the LFS data.

Table 13 LFS frequencies near NMW

		NMW	Modal wage	2nd most popular	3rd most popular	4th most popular	Major wage	Minor wage
Stated wage	2002	410	NMW	450	420	460	420	400
	2003	420	NMW	450	460	430	450	425
	2004	450	500	NMW	480	460	NMW	NMW
	2005	485	500	485	525	520	NMW	NMW
	2006	505	NMW	550	525	500	500	500
	2007	535	NMW	550	575	560	550	550
	2008	552	600	NMW	560	575	NMW	NMW
	2009	573	600	NMW	575	585	NMW	NMW
	2010	580	NMW	600	585	620	585	585
	2011	593	NMW	600	610	620	600	595
Derived wage	2002	410	400	NMW	460	433	417	NMW
	2003	420	450	400	420	460	420	NMW
	2004	450	500	NMW	400	460	NMW	NMW
	2005	485	500	480	450	520	.	NMW
	2006	505	500	550	525	540	550	NMW
	2007	535	500	550	533	575	533	NMW
	2008	552	600	550	575	513	550	550
	2009	573	600	575	550	578	575	NMW
	2010	580	600	625	575	578	578	NMW
	2011	593	600	625	575	578	575	594

The most noticeable element is that the NMW is only the modal wage half the time for the stated rate, and never for the derived rate. The NMW is generally at least the second most popular wage,

but in 2006 the NMW of £5.05 appears nowhere in the lists - £5.00, £5.25, £5.20 and £4.85 (the previous year's NMW) are all more likely wages. As for ASHE the top two wages are either the NMW or on a 50p boundary. Beyond that, the LFS seems to show slightly more variety than ASHE, except for the fact that every stated non-NMW LFS wage is on a 5p mark.

The derived data are more dubious; in 2008 and 2011 the NMW does not appear anywhere, meaning that those earning the NMW account for less than 10% of the numbers claiming the wages of £6.00 per hour. This is despite the fact that the LFS stated wage data (and ASHE) suggest that the former group are much more numerous.

Overall then, employees would seem to be rounding in a similar way to employers, but in a more attenuated fashion. Prediction of stated wage responses seems feasible, but prediction of derived wage outcomes is much less so.

4.1.4 Summary of findings on employee wage reporting

The evidence for the hypotheses advanced is summarised below.

Hypothesis	Support?	Evidence
LFS respondents are more likely to round responses than ASHE respondents	Yes	Strong Repeated evidence that stated wages follow focus points; derived wages slightly more variable
LFS rounding represents measurement error, not employer behaviour	Yes	Strong (on the assumption that the ASHE data are accurate) The distribution of LFS data differs notably; the difference is persistent and predictable, suggesting this is not a random fluctuation due to sample variation but reflects the nature of the sources
Rounding correlated with lack of documentation/proxy responses	Partially	Weak Some evidence of a link to documentation, none for link to proxy responses
Earnings are rounded to focus points appealing to humans, not time calculations	n/a	Weak LFS responses are much more likely than ASHE to be rounded to all absolute factors save 3p; the relative distance may be important, but this may be an artefact of NMW levels

4.2 Rounding of hours data

It could be argued that the variability of the derived rate occurs because hours are being rounded as well as earnings. Briefly two hypotheses may be considered:

- (H2.5) Hours are rounded
- (H2.6) Respondents round some element of rates:
 - Rates are rounded to give total earnings at round numbers (H2.6a)
 - Earnings are rounded to give rates at round numbers (H2.6b)

Table 14 describes the distribution of hours in the LFS by whole, half or quarter hours reported. Hours with more than two decimal places were assumed to be imputed figures and so are omitted.

Table 14 Reporting of full and partial hours

Hours reported in...	ASHE		LFS	
	Full-time	Part-time	Full-time	Part-time
whole hours	77%	73%	83%	86%
half-hours	19%	17%	16%	12%
quarter hours	4%	10%	1%	2%

There is a higher probability of complete hours being recorded in the LFS, which might be expected if respondents are asked to recall outcomes rather than extracting the information from pay documents. The number of partial hours is likely to be overestimated in LFS, as our check for imputation may allow through those numbers which coincidentally give quarter or half hours.

A first question may be whether rounding of hours is associated with other rounding behaviour. Table 15 describes the association between whole numbers being reported and the ‘suspicious’ wages defined in the previous section.

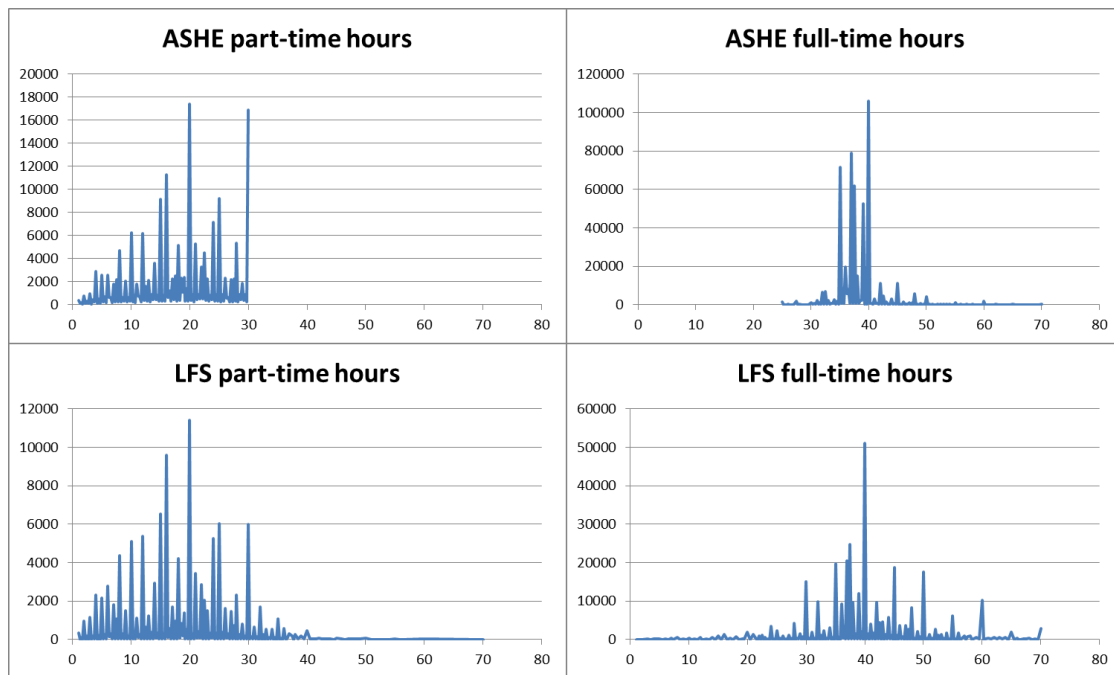
Table 15 Rounded hours and suspicious wages

		'Suspicious'		'Doubly suspicious'	
		No	Yes	No	Yes
Hours	Not rounded	626	26	633	19
	Rounded	4,091	400	4,290	201
<i>Chi-square (1)</i>		<i>18.13</i>		<i>3.39</i>	

The chi-square indicates that there might be a relationship between rounding of hours and earnings, although the test is a weak one as both ‘suspicious hours’ and ‘rounded hours’ are likely to be overestimated.

Figure 16 shows the distribution of hours data in ASHE and the LFS. Hours with less than 10 observations have been removed for disclosure control purposes.

Figure 15 Part-time and full-time hours in ASHE and the LFS



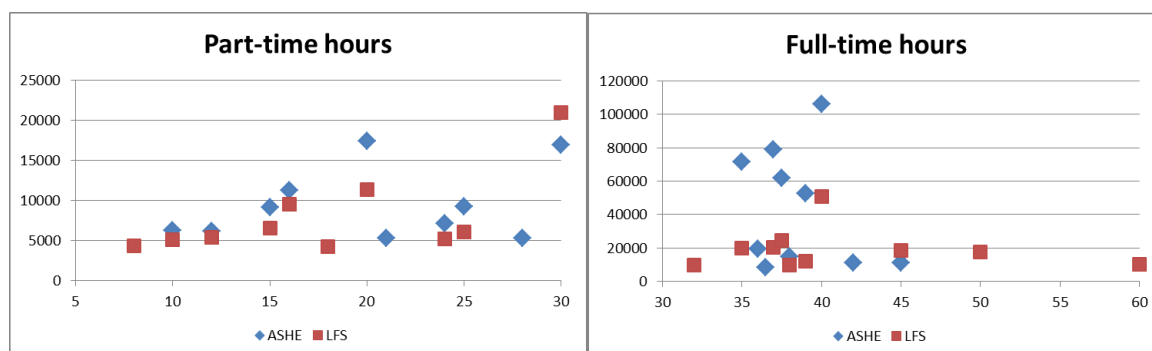
The LFS hours response are clearly more widely distributed than the ASHE data for full timers; for part timers the distribution is more similar. Ormerod and Ritchie (2007b)'s fusion analysis came to a similar, if more formal conclusion. It should be noted that ASHE has a sharp line between part-time and full-time hours as the number of hours and the occupation is used to determine which category the employee falls into. The LFS asks the respondent, and so a full-time employee can report one hour's work and a part-timer sixty hours.

The concentration of full-timers at 40 hours per week is more noticeable in ASHE. Table 16 gives the 'top ten' hours responses, displayed graphically below in Figure 17. Note that 30 hours per week is significant in both the part-time and full-time groups for the LFS, so for comparability with ASHE the 30-hours observations have been included in the LFS 'part-time' group.

Table 16 'Top ten' recorded hours in ASHE and LFS

Part-time				Full-time			
ASHE		LFS		ASHE		LFS	
Hours	Count	Hours	Count	Hours	Count	Hours	Count
10	6228	8	4362	35	71502	32	9846
12	6197	10	5103	36	19619	35	19693
15	9167	12	5370	36.5	8243	37	20512
16	11272	15	6537	37	78852	37.5	24680
20	17408	16	9578	37.5	61743	38	9649
21	5260	18	4226	38	15033	39	11981
24	7118	20	11396	39	52474	40	51036
25	9230	24	5253	40	106014	45	18723
28	5326	25	6035	42	10968	50	17537
30	16893	30	20982	45	11134	60	10289

Figure 16 'Top ten' reported hours



Both datasets show peaks at similar points: 10, 15, 16 (where benefit rules change), 20, 24 and 30 hours for part-timers; and 35, 37, 37.5, 40 and 45 hours for full-timers. The appearance of fifty and sixty hours per week in the LFS top ten is surprising, particularly as these are supposed to reflect 'basic' hours (without overtime).

Overall the hours data seem reasonably consistent – in the sense that they do not seem likely to generate significant differences between ASHE and LFS data. It could that further analysis would show more variation – for example, total wages might also concentrate at focal points, partial hours at wages divisible by four, employees might forget to include lunch breaks, and so on. Because the hypotheses in this section require substantial analysis without any obvious target, and because this is now moving away from minimum wage rates into 'living wage' territory, these will be left to future research. Accordingly, no further work has been carried out on this.

5. Impact

The previous two sections described observed behaviour for employers and employees. This in itself does not mean that this behaviour is problematic; this section therefore considers whether there is any significant impact on either the labour market or policy goals. The section continues the practice of separating out the impacts of employer behaviour (which affects real labour market outcomes as well as analysis) and employee behaviour (which only affects the analysis of the NMW).

5.2 Employer behaviour

5.2.1 Summary and analysis of behaviour

The findings of section three can be summarised as follows:

<i>The numerical characteristics of the NMW have a real effect on wage setting</i>	That is, minimum wages set at £6.40, £6.49, £6.51 and £6.60 will elicit wage-setting responses by employers out of proportion to their numerical values; for example, the next most popular wages for those NMWs would be £6.50, £6.50, £7.00 and £7.00, respectively
<i>This is independent of the actual value of the NMW</i>	The level of the NMW and the state of the economy affect the numbers being paid at the minimum wage, for example in the concentration of numbers at the NMW (see also LPC, 2012); but in addition to these broad effects, employers are making marginal adjustments based up on the numerical characteristics of the NMW
<i>This is persistent over time and scale</i>	For any given penny value of the NMW, the concentration of wages above the NMW can be predicted with some accuracy; and the same NMW observed at different times has the same effect
<i>The NMW is a 'hard' boundary</i>	Employers are not recorded as paying below the NMW in any significant numbers, once data are rounded to the nearest penny.
<i>The behavioural response is widespread, but most noticeable in small firms</i>	A persistent outcome from various estimates is that the smaller the firm, the more likely it is to round numbers; it also seems that private sector firms are more likely to round
<i>Firms anticipate the introduction of the NMW</i>	At the time of the ASHE survey, notable numbers of companies are paying an NMW which is not legally required for another six months; this is more noticeable in large firms

Overall, these present a picture of firms which take into account a range of 'human' factors when setting wages. This differs significantly from the classical economist's perspective of the labour market, where wages are decided on a strictly rational cost basis. There are a number of reasons that may be advanced for this, which can be broadly grouped into 'signalling' and 'convenience' camps:

- Wages may have a 'signalling effect': a premium is paid to indicate that this is a good employer, and the actual wage is less important than the fact that the employer is paying over the NMW; there may be 'going wages' for a job, or there might be pressure to offer 'fair' wages

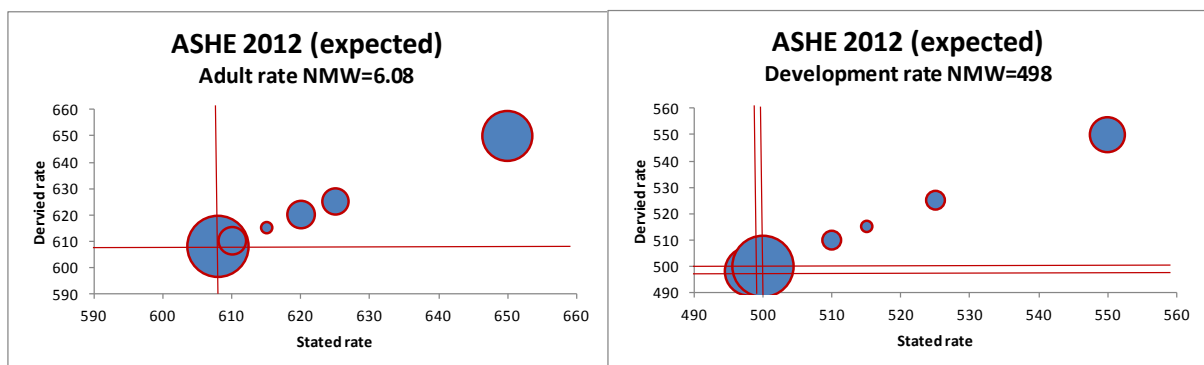
- Wage calculations may be complex and negotiations over very small variations may be costly, so selecting values which are easy to understand, manipulate and market may be an effective way to trade administrative time against wage costs

The first is most relevant for wage setting at focal points, and the latter for wages with convenient rounding factors. These are complementary explanations, and both may be relevant. It could be argued that the ‘signalling effect’ is more important for large companies (whose systems can handle complex payroll systems, and for whom executive time needed to set wages can be offset against a large wage bill). In contrast, small employers might value simplicity more. The evidence presented here cannot distinguish between these different explanations. Nevertheless, the observed outcome is clear and robust: for those employers who choose to pay over the NMW, factors other than the direct wage cost play a significant role in wage setting.

5.2.2 Predictability of behaviour

This behaviour by employers is reasonably predictable. For 2012, the NMW is set at £6.08 for adults and £4.98 for the development rate. Based on previous analysis, the authors predicted in April 2012 that the ASHE results for 2012 would show the pattern in Figure 18. The actual NMWs and major focal points are indicated by the red lines.

Figure 17 Predicted employer responses 2012



The expectations are that:

- For adult workers, most will be paid at the NMW as it is just over the focus point. Beyond that, there are no obvious focus points, and so while there may be some clusters of wages at £6.10, £6.20 and £6.25, these will be relatively small.
- For those on the development rate, more workers will be paid £5.00 than £4.98 largely because of its analytical convenience. This will mean that, for the first time since the NMW was introduced, the NMW will *not* be the most likely wage rate in any wage band.

These predictions are made purely on the basis of the numerical characteristics of the NMW: they take no account of the state of the economy, the size of the increase in the NMW, or other ‘real’ impacts. They do however reflect the experience of 2006, when an adult NMW of £5.05 led to the next popular wages occurring at, in order of popularity, £5.50, £5.20 and £5.35 (see Table 4).

5.2.3 Impact of NMW on behaviour and vice-versa

The behaviour exhibited by firms demonstrates that employers’ marginal decisions on wages are not taken on the simple basis of wage costs. Consider the advantages and disadvantages of paying £5.00 to someone eligible for the £4.98 development rate:

- | | |
|---------------|---|
| Advantages | <ul style="list-style-type: none"> • Simple calculations for this wage • Simpler calculation for setting relative wage rates • Simple message to employees • Can claim to be paying 'over the minimum wage' |
| Disadvantages | <ul style="list-style-type: none"> • Additional wage costs of £0.80 (plus employer costs) on a 40-hour week • Policy may be to always pay NMW to avoid setting precedent |

The financial cost of the 2p additional wage would seem to be relatively unimportant. Indeed, the LPC reports suggest that firms' main concern with the NMW is that it sets a fixed minimum cost on the hiring of new workers or on hourly wages. Overall, the evidence suggests that a variation of less than one percent at the margin is neither here nor there.

This does however emphasise the signalling effect of the NMW. Firms choose to pay either the minimum wage or some greater amount. If the latter then the pattern of ASHE responses suggests that firms often choose roughly the amount of the wage (" +25p", "next 10p above NMW"), and then 'snap' to the nearest focal point. This pattern of activity is most noticeable amongst small firms.

In this context, the level of the NMW affects wages but the specific value is less important unless it crosses a focal point. In Figure 18 above, the adult NMW of £6.08 leads us to make predictions of 'popular' wages at £6.10, £6.20 and £6.25. An NMW at £6.07 or £6.09 would have made no difference to this prediction. However, had the NMW been set at £6.10, those wanting to pay 'above the NMW' no longer have the option of £6.10; it is likely that £6.15 would have been more important in the prediction above.

Therefore, there is a gaming effect. Employers' preferences for round numbers suggest that the LPC should set minimum wages on these numbers. Firms who pay significantly more than the NMW (say 20p plus) are unaffected, although this might make easier the calculations of which focus point to 'snap to'. However, those employers who pay just over the NMW now find themselves faced with the choices of a bigger jump to the next round point, setting the wage at an 'awkward' number, or dropping down to the NMW. For those employers, setting the NMW on a round number reduces their freedom to 'game' – or increases their cost of doing so.

5.2.4 Impact of behaviour on analysis

Employers' preference for round numbers produces a 'concertina effect' on numbers around the NMW. When the NMW is increased, there is evidence that some of those earnings below the upcoming NMW will now only be paid the NMW. Where the NMW crosses a significant focal point, a larger number of individuals are likely to be included. For example, in 2012 adult NMW crossed one of the 'big' marks, £6. Hence, it is likely that the numbers at the NMW will increase this year, just due to that factor. A similar result occurred in 2006; this was followed by three years of relatively little change in the numbers at the NMW, when the NMW was not set below obvious focus points.

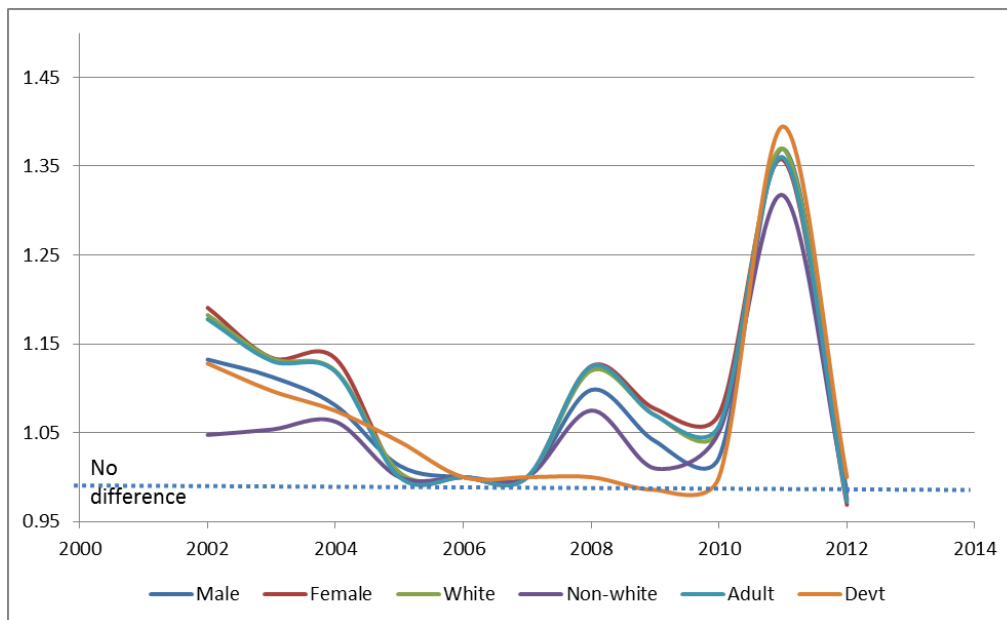
This analysis might be mistaken: 2006-2008 was a period of growth in the economy when the numbers at the NMW might be expected to stay down, and was the only period studied when the total numbers at the 'top four' wages stayed roughly constant (author's calculations; not shown here). The increase in the NMW from £6.08 to £6.19 in 2013 will therefore provide a form of natural experiment as to the relative importance of the level and location of the NMW.

A second issue relates to the definition of 'low paid'. The LPC defines a 'minimum-wage worker' as 'earning up to five pence above the NMW'. This definition therefore includes those who are not technically being paid the NMW but in practice are on the minimum wage.

If this definition is primarily to allow some leeway for measurement error, then it serves its purpose as far as employer data is concerned. However, if it is intended to represent 'NMW and those just above it', then an alternative definition might be more appropriate: "those earning up to the first 10p point after the NMW". The logic for this definition is that very few wages are paid at just above the NMW. In practice the next 10p point is the effective 'post-NMW minimum wage'; that is, for those who want to pay above the NMW, this is the minimum wage most employers will consider.

Figure 19 shows the impact of the alternative definition by calculating the ratio between the "NMW to next 10p" and "NMW+5p" definitions for various employee classifications. The 'no difference' line represents a ratio of 1:1. This is where the NMW fell on a 5p boundary and so the two measures coincide.

Figure 18 Alternative definitions of 'minimum-wage worker'



Notes:

1. Source data taken from LFS
2. Counts are unweighted

The figure shows that in most years, the "up to 10p" leads to around 10% higher numbers of 'low paid'. This is expected: the 10p boundary is usually further away from the NMW, and is usually a popular marker. When the "NMW+5p" would create a wider gap (development NMWs of £4.77 in 2009 and £4.98 in 2012), there is still little difference. This is because the 10p marker is the dominant wage in that region: there are almost no wages paid at £4.81 or £4.82 in 2009, or £5.01-£5.03 in 2012.

There is a very large difference in 2011 on all measures. This is because applying the "NMW+5p rule" to the adult and development NMWs of £5.93 and £4.92 just misses the major focal points of £6.00 and £5.00.

5.2.5 Implications for setting of NMW

The overall conclusion of the employer analysis is that firms have some freedom to adjust wages at the margin: the signalling factor and/or psychological or practical convenience of wages at round numbers outweighs very small cost impacts. This would suggest that setting the NMW at round numbers (for example on 5p or 10p boundaries) would align the NMW with employer preferences. If the NMW were increased over time along these borders this might also help to reduce the ‘concertina effect’ on counting the numbers of low paid.

There are three objections to this. First, setting the NMW at round numbers may limit discretion for some employers: those who want to pay at round numbers just above the NMW might need to offer a larger wage, and who then might stick with the NMW. The evidence shows that increasing numbers of wages are being paid at the NMW; but more wages are also being paid at other round numbers. The trend indicates that increasingly only the NMW and round numbers will be paid.

Related to this, a rounded NMW reduces the ability of LPC to ‘game’ the data: setting the wage just below some level deliberately to encourage firms to pay above the NMW. Ormerod and Ritchie (2007a) noted in 2006 that the simplest way to reduce the numbers being paid at the minimum wage would be to set it at £5.99. The ASHE data for 2012 (development rate of £4.98) will show whether this contention is true or not. Overall, this supports the idea that the marginal value of the NMW is more important for signalling purposes than as a cost factor.

The second objection is that the LPC considers the proportional increase in the NMW when making its decisions. Adjusting the NMWs to be round numbers would distort this calculation. For example, a development rate of £4.98 implies a 1.22% increase on the previous rate, whereas £5.00 is the noticeably larger 1.63%; on the other hand setting the 2007 adult rate to £5.50 instead of £5.52 would have meant a 2.80% increase instead of 3.18%. Again, the evidence would suggest this makes no practical difference to employers; however, the NMW is a highly visible and politically sensitive variable and so perceptions of changes do matter.

The third objection is that this does not address the issue of major focal points. An NMW of £5.90 or £5.95 is likely to have the same impact as £5.93, because all are dominated by the £6.00 marker. Similarly, an increase to £6.05 or £6.10 would show a similar impact as £6.08 as the NMW crosses the £6.00 boundary. There seems to be little that can be done about this other than to show an awareness of the fact.

5.3 Employee behaviour

5.3.1 Summary of behaviour

The findings of section four can be summarised as follows:

<i>There is severe measurement error in household responses on wage rates</i>	That is, the accuracy of the LFS data near the NMW can be questioned
<i>Focal points dominate the NMW</i>	Employees are more likely to report rounded numbers than true values, even when at the NMW
<i>Wage distributions are much</i>	Compared to the employer data, household responses are much

<i>more attenuated</i>	more likely to be on focal points and round numbers
<i>Stated and derived wages differ</i>	Stated wage rates are more likely to report the NMW; calculations for what people actually earn are far more likely to show rounded values.
<i>The error is symmetrical</i>	Employees are just as likely to round down to a focus point (eg £5.05 reported as £5.00) as they are to round up (£5.93 reported as £6.00)
<i>The error is related to documentation but not to proxy responses</i>	Using wage slips or other documentation reduces the likelihood of erroneous responses; but without documentation proxy responses are just as likely to round as the target employee

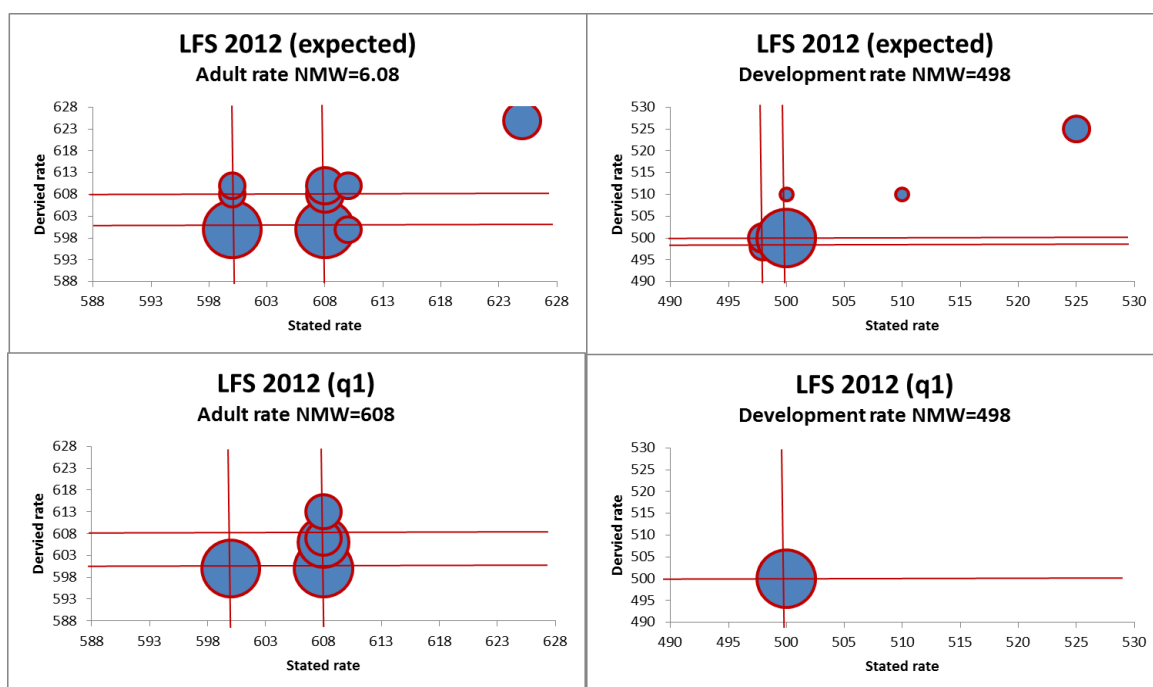
Questions over measurement error in the LFS have been around for a long time (eg Ormerod and Ritchie, 2007b). In much labour market analysis this can be ignored, by assuming that the errors are normally distributed and uncorrelated with other factors. On this basis, analysis of the labour market will produce accurate outcomes, albeit with less powerful statistical tests.

The problem with low pay is the minimum wage is an on-off mechanism; measurement error therefore increases the likelihood of employees being reported as earning under the NMW. For example, suppose the NMW is £5.05 and two employees on the NMW report wages of £5.00 and £5.10 respectively. The mean wage is correct, but a count would incorrectly show one person earning below the NMW. This is the typical concern but the example illustrates a second case: one person is reported as being paid above the NMW. In other words, the measurement error leads to over-estimation of employees below and above the NMW.

5.3.2 Predictability of behaviour

The good news from the LFS analysis is that the measurement error is extremely predictable. Figure 20 below shows predictions made in April 2012 about the expected impact of the 2011 NMWs of £6.08 and £4.98. Below are the outturns from Q1 2012, the latest data available at the time of writing. The relevant NMW and the major focal points are indicated by the bars.

Figure 19 Predicted employee responses 2012



In general, the difference between the predicted and actual data is that the latter are more attenuated (very small numbers are removed from the actual data for disclosure control). In particular, the only wage being paid to the 18-20 year olds appears to be £5.00. Until the ASHE data for this period is released it cannot be stated whether this is genuine or the result of approximation but it supports the notion that the 2p difference is meaningless for practical purposes.

5.3.3 Impact of behaviour on analysis

LFS data is essential for the LPC's evidence base. It is the only large-scale source of information on the more personal characteristics of workers: ethnicity, disability, citizenship, health and so on. It complements the employer data by widening the range of potential; in particular it is used to identify disadvantaged groups.

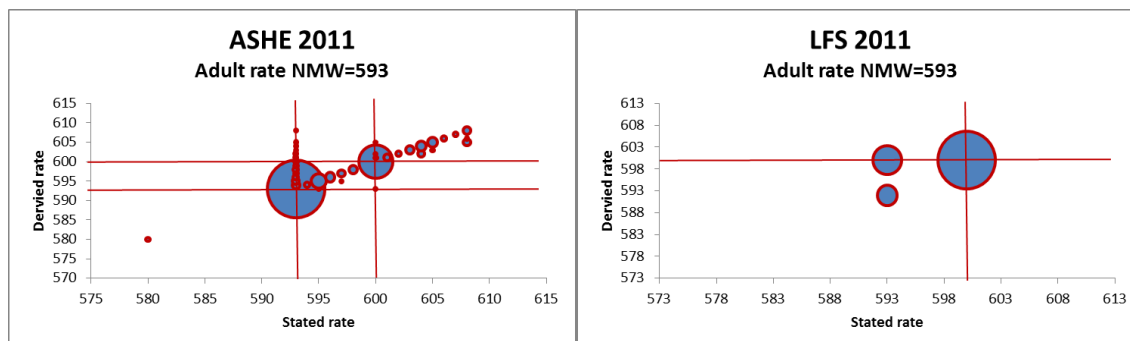
The employee responses pose a problem for analysis. In employer data, jumps to focal points and round numbers reflected real effects, and so the concern was to make sure that responses to the NMW are recognised as being partly behavioural. For employee data, there is the additional complication of trying to ascertain what the true response should be.

To some extent, earnings below the NMW are easier to deal with. As ASHE demonstrates, very few employees earn below the NMW. Employee responses below the NMW always cluster around focal points; it therefore seems likely that these represent employees who are earning the NMW but who round down in reporting. To correct for measurement error simply involves placing these employees on the NMW. This is indeed what much analysis does.

One problem with this is that it assumes only those on the NMW round down, whereas rounding appears to be a widespread phenomenon in the LFS. For example, the large numbers reporting £5.00 in 2006 may be mostly those on the NMW of £5.05, but could also include those earning £5.10 or £5.25. This is unknowable from current data sources.

Rounding up to a wage above the NMW presents far more problems, because it is not known who is rounding up and who is genuinely being paid the higher wage. Consider 2011, reproduced again in Figure 21 in simplified form.

Figure 20 2011 ASHE and LFS at NMW and £6.00



LFS data indicates that almost all employees get £6.00 per hour. ASHE data indicates that only around two-thirds of employees get the NMW, and one-third get £6.00 per hour. Clearly then most of the LFS data are inaccurate – but not all.

One response is to consider whether the inaccuracy affects another analysis. A simple analysis was run on the probability of being paid at the NMW; Table 17 summarises (details in Annex C).

Table 17 Probability of being at NMW

Variable	Significance							
	2004	2005	2006	2007	2008	2009	2010	2011
female	pos	pos	pos	pos	pos	-	pos	pos
age	neg	neg	neg	neg	neg	neg	neg	-
if full-time	neg	neg	neg	neg	neg	neg	neg	neg
size 10-49	neg	pos	-	-	-	-	-	-
size 50-249	neg	neg	-	-	neg	neg	-	-
size 250+	neg	neg	neg	neg	neg	neg	neg	neg
public sector	neg	neg	neg	neg	neg	neg	neg	neg

Notes:

1. Models estimated for each year individually
2. Regional dummies included
3. Default values: male, part-time, company size 0-9 and private sector

Only the sign and significance are recorded; so, for example, being female generally has a significant positive probably on the likelihood of being paid the NMW; working full-time reduces the likelihood; and working for a small company does not appear to differ much from working for a micro company. Overall the results are reasonably consistent over time.

Now consider directly adjusting the LFS data to reflect a more feasible distribution of data. In three years (2006, 2008, 2011) the LFS distribution is clearly inaccurate:

- 2006: NMW £5.05; most responses at £5.00 (under NMW)
- 2008: NMW £5.52; most responses at £5.50 (under NMW)
- 2011: NMW £5.93; most responses at £6.00 (over NMW)

In 2006 and 2008, all wages below the NMW were set at the NMW. In 2011, ASHE was used to calculate the ‘true’ proportion of wages at £5.93 and £6.00. A random selection of observations at £6.00 in the LFS were then reset to £5.93, so that the distribution of ASHE and LFS was similar. The results of running the unadjusted and adjusted probability models are detailed in Table 18.

Table 18 Adjusted probability analysis

Variable	2006 Focus below NMW		2008 Focus below NMW		2011 Focus above NMW	
	unadjusted	adjusted	unadjusted	adjusted	unadjusted	adjusted
female	pos	pos	pos	pos	pos	pos
age	neg	neg	neg	neg	neg	-
if full-time	neg	neg	neg	neg	neg	neg
size 10-49	-	-	-	-	-	-
size 50-249	-	neg	neg	neg	-	neg
size 250+	neg	neg	neg	neg	neg	neg
public sector	neg	neg	neg	neg	neg	neg

Notes: see Table 17

There is relatively little impact. Even in 2011 when effectively fiddling the figures might be expected to have some effect, there are no changes in sign and most of the coefficients remain significant. The sizes of coefficient do change (details are in Annex C) but qualitatively the results seem quite robust to variations in definitions of ‘at the NMW’.

This analysis is extremely simplistic, taking no account of, for example, differences between industrial sector or occupation. Nevertheless, it is interesting to note that Wilkinson et al (2012), in their study of compliance, tried a similar ad hoc approach to adjusting the data based upon identifying focus points, and found no significant impact.

From an analytical perspective, then, it may be that the inaccuracy in the LFS is less important than supposed – the low paid are more similar than different.

6. Recommendations

6.1 NMW setting

The choice of the NMW is based on a range of factors, not all of them economic or statistical, which the LPC is obliged to consider. This report does not help the LPC to set the general level of the NMW. However, we believe that the evidence shown and arguments advanced in this report suggest a number of factors which the LPC should consider when setting the specific level of the NMW.

Recommendations for LPC	Rationale
<i>Acknowledge the real effect that any particular value of the NMW will have.</i>	The behaviour of both employers and employees near the NMW is predictable; therefore, the likely consequences of any candidate value for the NMW can be evaluated with some accuracy.
<i>Set NMW on at least 5p boundaries</i>	This aligns with employer practice. There is no evidence to suggest employers are significantly affected by the cost consideration of variations of pennies around the NMW. At the margin, simplicity and the signalling effect appear more important.
<i>Increase the NMW in similar steps each year</i>	This is intended to limit the ‘concertina effect’
<i>Avoid setting the NMW just below focus points</i>	This is unavoidable at some point but can be used to limit the ‘concertina effect’

6.2 Description and analysis

The LPC Annual Report is easily the most important reference point for research studying the low paid labour market. As such the LPC can have a major influence in providing the context for all other analysis. The first two recommendations below therefore refer to the LPC’s formal outputs. The second two relate to all researchers’ analysis of the low paid.

Recommendations for LPC	Rationale
<i>Redefine ‘minimum-wage worker’ as ‘those earning up to the next 10p over the NMW’, rather than ‘those earning the NMW+5p’.</i>	This reflects behaviour in the labour market and is less arbitrary than the ‘NMW+5p’ rule. Note that this rule will cause an increase in the number of ‘minimum wage workers’.
<i>Produce ‘blobograms’ in the neighbourhood of the NMW, for both ASHE and LFS</i>	The ASHE blobograms give an instant impression of the concentration of wages around the NMW, allowing the ‘concertina effect’ to be identified. Comparison of the ASHE and LFS blobograms allows the capacity for measurement error in the LFS to be quickly assessed.
Recommendations for all researchers	Rationale
<i>Test for the ‘concertina effect’</i>	Some apparently economic effects might be attributable

	just to the relationship between the NMW and focus points.
<i>Run robustness checks on LFS values around the NMW</i>	The predictability of LFS errors can be used to define alternative scenarios

6.3 Further research

The analysis presented in this report is subject to a number of flaws: principally, in decreasing order of importance, that it

- has not studied submarkets eg regions, or the low-paying industrial sectors identified by the LPC
- has not studied the increasing attenuation of the distribution at focus points and the NMW
- has focused on the base wage rate, rather than total earnings (which may be the source of the rounding error) and additional payments
- has only provided superficial multivariate analyses of the impact

The latter is of least importance as assessing the multivariate impact of measurement error can only be carried out in the context of the specific analyses, and so is more efficiently reviewed as part of other analyses.

The potential for rounding in the total earnings, both in itself and as a source of below-NMW earnings, is of some interest. It is likely that ‘living wage’ proposals would run into the same boundary effects as are seen on wage rates.

However, the first two areas may be the most productive for future research. The analysis above suggests that, overall, firms do have flexibility in responding to the NMW, and therefore the LPC has more leeway in the NMW that it sets. This may not be true for some low-paying sectors, for example. Second, the increasing concentration of wages at the NMW and subsequent focus points has been mentioned but not explicitly reviewed. This would help to inform discussion of the bite, and would be useful information if the ‘minimum wage worker’ were to be redefined on a more behavioural basis.

Finally, it is worth noting that maintaining the development rate NMW at £4.98 will provide a natural experiment and can be compared against the youth rate being kept at £3.00 in 2004 and 2005. This paper has argued that the penny value is more important than the scale in determining how firms react. This can be reconsidered, particularly in the light of macroeconomic background.

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Annex A JobCentrePlus search results

This is the full set of data collected from the JobCentrePlus website. Some information about the job was also collected but not used.

Annex Table A 1 JobCentrePlus data

Basingstoke			Cardiff		
"At NMW"	20	17%	"At NMW"	34	26%
"Exceeds NMW"	9	8%	"Exceeds NMW"	18	14%
£6.08	7	6%	£6.08	17	13%
£6.15	1		£6.20	1	
£6.25	4		£6.25	2	
£6.35	1		£6.27	2	
£6.40	1		£6.30	1	
£6.47	1		£6.40	3	
£6.50	10		£6.50	2	
£6.65	1		£6.58	2	
£6.75	1		£6.70	4	
£6.81	1		£6.80	1	
£6.82	1		£7.00	7	
£6.90	1		£7.20	2	
£7.00	8		£7.50	3	
£7.10	1		£7.54	1	
£7.45	1		£7.69	1	
£7.50	4		£7.75	1	
£7.54	1		£7.76	1	
£8.00	17		£7.80	1	
£8.22	2		£8.00	1	
£8.50	5		£8.45	2	
£9.00	7		£8.50	4	
£9.05	1		£8.60	1	
£9.35	1		£8.65	1	
£9.50	2		£8.80	1	
£10.00	7		£9.00	6	
			£9.50	2	
			£9.65	2	
			£10.00	5	
Total	116			129	

Source: JobCentrePlus website accessed 22nd May 2012

Annex B NMW-blobograms

This annex contains the full set of blobograms covering the period studied, for ASHE (adult and development rate) and LFS (adult rate only). There are insufficient observations for meaningful graphs of the other data source/NMW combinations.

The ASHE values are fully imputed: where a stated rate is not present, this is set to the derived rate. LFS graphs use the reported stated and derived rates; the stated rates may have been imputed.

Figure B 1 ASHE blobograms, adult rate

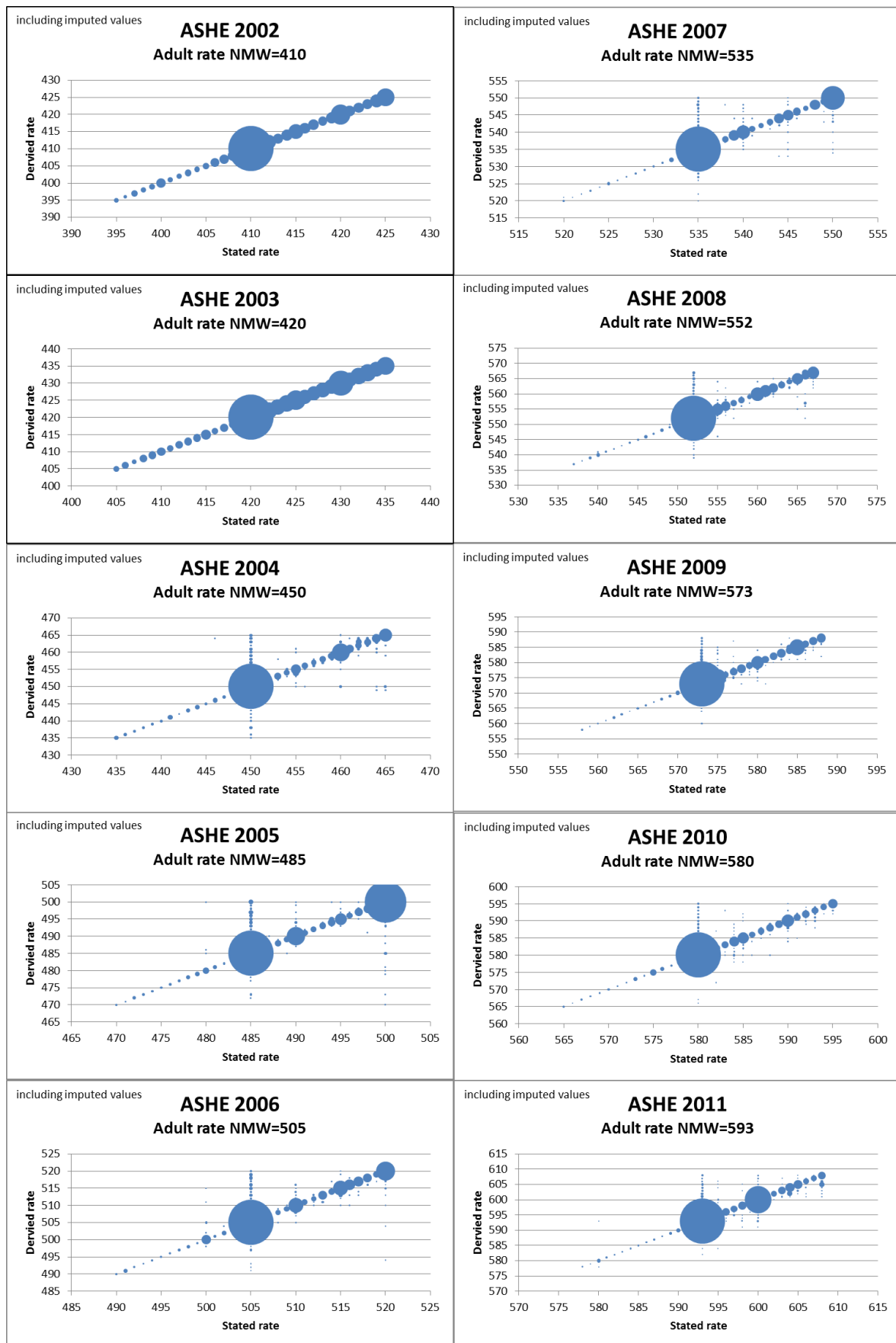
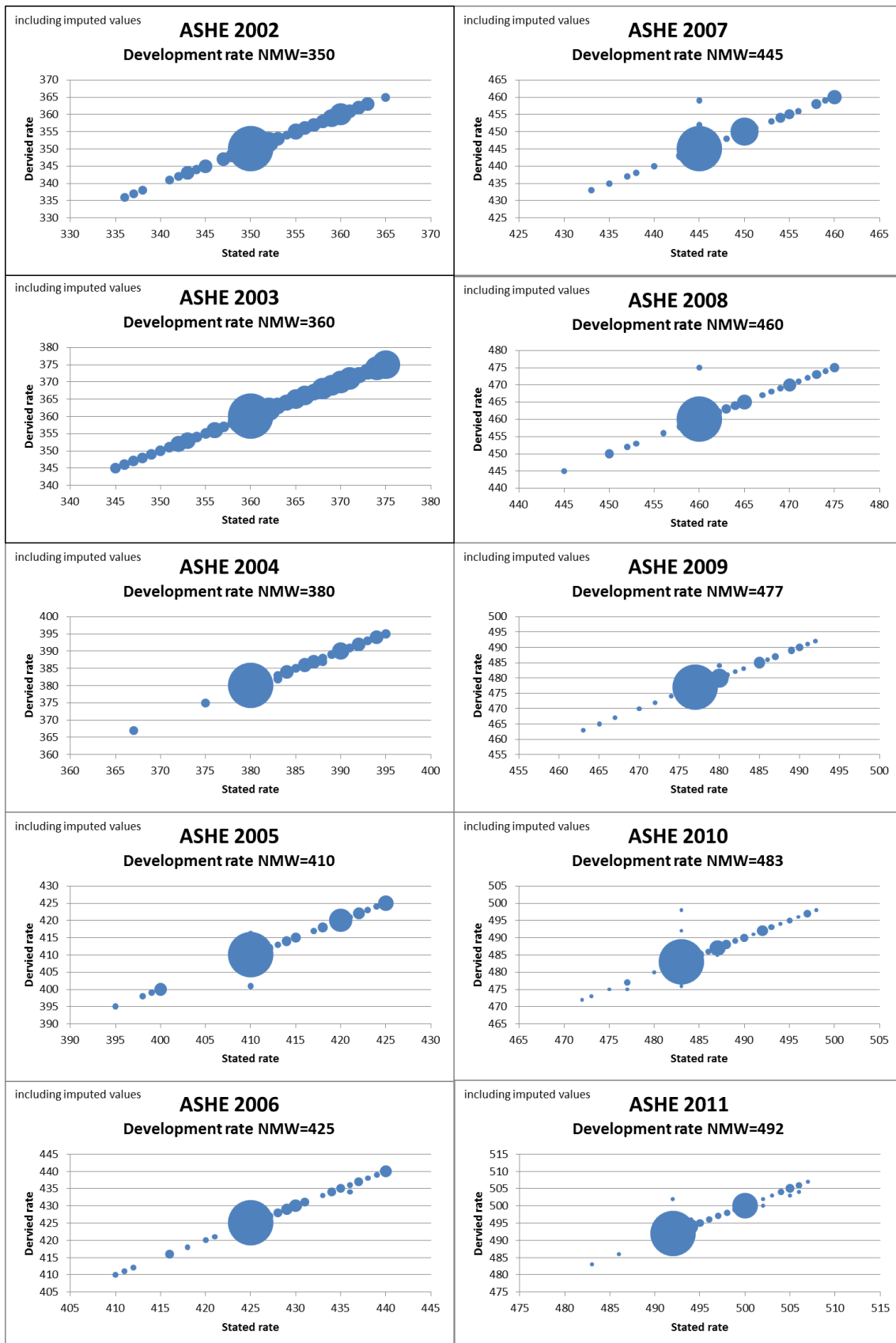


Figure B 2 ASHE blobograms, development rate



Annex C Full regression results

These results were summarised in Table 10

Table C 1 Anticipatory/lagging regression results

Variable	Anticipation				Lagging			
	ASHE		LFS		ASHE		LFS	
	Coefficient	<i>p-value</i>	Coefficient	<i>p-value</i>	Coefficient	<i>p-value</i>	Coefficient	<i>p-value</i>
All observations								
Q2			0.023	0.539			-0.318	0.000
Q3			0.120	0.001			-0.347	0.000
Q4			-0.018	0.644			0.321	0.000
Hours	0.000	0.648	-0.005	0.000	-0.002	0.296	-0.008	0.000
If female	0.181	0.000	0.196	0.000	-0.087	0.007	0.099	0.000
Age	-0.001	0.363	0.001	0.268	-0.012	0.000	0.000	0.610
If full-time	-0.469	0.000	-0.299	0.000	-0.310	0.000	-0.353	0.000
Size 10-49	0.077	0.021	0.165	0.000	-0.296	0.000	-0.057	0.037
Size 50-249	0.175	0.000	0.115	0.003	-0.384	0.000	-0.210	0.000
Size 250+	0.156	0.000	-0.032	0.468	-0.545	0.000	-0.382	0.000
Public sector	-1.143	0.000	-0.628	0.000	-0.520	0.000	-0.555	0.000
Observations	1294275		1270478		1294275		1270478	
R-squared	0.106		0.113		0.094		0.150	
Near NMW								
Q2			0.062	0.241			-0.398	0.000
Q3			0.216	0.000			-0.430	0.000
Q4			-0.063	0.236			0.444	0.000
Hours	0.000	0.980	0.000	0.887	-0.005	0.043	-0.006	0.001
If female	0.106	0.000	0.041	0.351	-0.171	0.000	-0.058	0.141
Age	0.000	0.559	0.000	0.925	-0.010	0.000	-0.001	0.465
If full-time	-0.042	0.217	0.017	0.752	0.123	0.075	-0.014	0.791
Size 10-49	0.097	0.017	0.162	0.000	-0.327	0.000	-0.139	0.000
Size 50-249	0.207	0.000	0.185	0.001	-0.442	0.000	-0.293	0.000
Size 250+	0.197	0.000	0.146	0.021	-0.603	0.000	-0.366	0.000
Public sector	-0.467	0.000	-0.225	0.005	0.181	0.133	-0.190	0.007
Observations	109347		30929		109347		30929	
R-squared	0.036		0.073		0.579		0.102	

These are the regression results underlying Tables 17 and 18.

Table C 2 Probabilities of being paid at NMW

	2004		2005		2006		2007		2008		2009		2010		2011	
	Unadjusted probit															
Variable	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>	Coeff.	<i>p-value</i>
If female	0.269	0.000	0.342	0.000	0.236	0.000	0.102	0.046	0.199	0.002	0.078	0.262	0.137	0.022	0.205	0.001
Age	-0.006	0.005	-0.004	0.039	-0.005	0.022	-0.005	0.012	-0.007	0.002	-0.010	0.000	-0.008	0.000	-0.003	0.223
If full-time	-0.481	0.000	-0.508	0.000	-0.553	0.000	-0.674	0.000	-0.584	0.000	-0.534	0.000	-0.514	0.000	-0.556	0.000
Size 10-49	-0.120	0.035	0.122	0.033	0.092	0.136	0.022	0.675	0.102	0.099	-0.026	0.714	0.013	0.840	0.015	0.819
Size 50-249	-0.221	0.001	-0.151	0.041	-0.098	0.198	-0.061	0.330	-0.227	0.007	-0.260	0.005	-0.031	0.672	-0.155	0.054
Size 250+	-0.515	0.000	-0.616	0.000	-0.271	0.002	-0.282	0.000	-0.479	0.000	-0.358	0.000	-0.369	0.000	-0.452	0.000
Public sector	-0.750	0.000	-0.868	0.000	-0.883	0.000	-0.816	0.000	-0.843	0.000	-0.782	0.000	-0.771	0.000	-0.750	0.000
	Adjusted data															
If female					0.181	0.001			0.106	0.042					0.183	0.002
Age					-0.004	0.018			-0.007	0.000					-0.002	0.273
If full-time					-0.627	0.000			-0.715	0.000					-0.583	0.000
Size 10-49					-0.006	0.910			0.042	0.412					0.037	0.526
Size 50-249					-0.183	0.004			-0.288	0.000					-0.166	0.024
Size 250+					-0.380	0.000			-0.557	0.000					-0.415	0.000
Public sector					-0.650	0.000			-0.735	0.000					-0.733	0.000