

# Where the Minimum Wage Bites Hard: The Introduction of the UK National Minimum Wage to a Low Wage Sector

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## Abstract

Between 1993 and April 1999 there was no minimum wage in the UK (except in agriculture). In this paper we study the effects of the introduction of a National Minimum Wage (NMW) in April 1999 on one heavily affected sector, the residential care homes industry. This sector contains a large number of low paid workers and as such can be viewed as being very vulnerable to minimum wage legislation. We look at the impact on both wages and employment. Our results suggest that the minimum wage raised the wages of a large number of care homes workers, causing a very big wage compression of the lower end of the wage distribution, thereby strongly reducing wage inequality. There is some evidence of employment and hours reductions after the minimum wage introduction, though the estimated effects are not that sizable given how heavily the wage structure was affected.

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## Contents

- I. Introduction
- II. Minimum Wages in the UK and the Care Homes Sector
- III. Data Issues and Descriptive Statistics
- IV. Wages and the Minimum Wage
- V. Employment and the Minimum Wage
- VI. Conclusions

References

Tables

Figures

Appendix 1a: Pre-Introduction Survey

Appendix 1b: Post-Introduction Survey

Appendix 2: Representativeness of the Sample

## I. Introduction

The debate on the economic effects of minimum wages remains a controversial and heavily researched question. In fact there currently appears to be something of a methodological divide amongst economists about what minimum wages actually do to economic outcomes. Some researchers choose to stick to what used to be the orthodoxy, at least since Brown, Gilroy and Kohen's (1982) influential survey of the evidence available up to the late 1970s, that minimum wages are bad for employment, especially teenage employment. Others have been more swayed by the recent 'before and after' micro work (Card, 1992, Card and Krueger, 1994, 1995) which finds it hard to identify any employment effect at all and moves the question on from 'how negative is the minimum wage employment effect?' to 'is there any impact on employment at all?' The vast majority of work used to inform this debate is based upon US data (Brown, 1999). Some fresh evidence, from a different context, probably needs to be cast on these questions.<sup>1</sup> We attempt to offer some evidence of this sort in this paper, where we have a unique design setting induced by the introduction of a minimum wage to a labour market previously unregulated by minimum wage legislation.

In April 1999 a National Minimum Wage (NMW) was introduced to the UK labour market. This is the first time that the UK has had an economy wide minimum wage. Furthermore, because the old industry-based Wages Council system that used to regulate pay in some sectors was abolished in 1993, the NMW was introduced into a labour market with no minimum wage legislation in operation.<sup>2</sup> Given these circumstances one can think of the introduction of the UK NMW as providing a very good testing ground for evaluating the economic effects of minimum wages. In fact one can plausibly argue that it provides a better testing ground than much of the 'before and after' US work on minimum wage effects (see

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<sup>1</sup> Indeed, one of Hamermesh's (2002) prime examples of where international empirical work in labour economics is required to inform the US debate is the research area on minimum wages.

<sup>2</sup> Except in agriculture. The Agricultural Wages Board was not abolished along with the other Wages Councils.

the discussion in Card and Krueger, 1995) as they are all based upon minimum wage increases where a minimum wage floor was already in place.

In this paper we look at what happened when the UK minimum wage was introduced in a low wage sector one can view as being particularly vulnerable to minimum wages, the UK residential care homes industry. Our analysis is based upon a large-scale survey that we carried out before and after the introduction of the NMW. The survey focused upon the whole population of residential care homes in Britain, collecting information on all workers in the homes, and on an array of home characteristics.

We chose to look at this sector for several reasons. First, it contains many low-wage workers, so the minimum wage has real potential to have a noticeable impact on outcomes.<sup>3</sup> Second, we chose this sector because it is not unionised. Thirdly, it consists of large numbers of small firms (average employment being somewhere in the range of 15-20 workers) doing a very homogeneous activity in geographically concentrated markets. The small size of these firms means that monitoring problems are unlikely to be severe because the owner normally also works in the home and also that collection of good quality data on all workers is feasible. Finally, the product market side of this sector is interesting. An important fraction of the residents of these homes have their care paid for by the Department for Social Security (DSS). But, the amount they pay is capped and was not increased when the minimum was introduced.<sup>4</sup> Homes whose residents are paid for by the DSS are then in a situation where they are not able to pass any of their cost increases on to prices: this is likely to increase the scope for identifying employment effects from minimum wage introduction.

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<sup>3</sup> This logic is, of course, similar in spirit to Castillo-Freeman and Freeman's (1991) study of Puerto Rico. Focusing on situations where more low paid workers are present obviously heightens the chance of finding employment effects of minimum wages.

<sup>4</sup> One may worry that other regulatory changes occurred at the same time as the introduction of the minimum wage. We were not able to find any such changes so ensuring our before and after analysis of wage and employment effects associated with minimum wage introduction are not contaminated by other coincident policy changes.

There is, of course, one disadvantage to looking at a sector in which minimum wages really ‘bite’, namely that one is more likely to find negative effects of minimum wages on employment. While labour economists have debated the relative merits of perfect competition or monopsony as models to explain the negative, positive or non-existent effects of minimum wages on employment (see, for example, Brown, 1999, for a recent review of this), all models of the labour market predict that a high enough minimum wage will reduce employment. So, one must be careful not to extrapolate from studies of one sector (especially the kind of sector we study) to conclusions about the economy as a whole.

We consider what happened to wages and employment in the care homes sector in the period surrounding the introduction of the NMW. The analysis confirms that the choice of sector is a good one for studying the likely impact of minimum wages. Pay is very low, with the average hourly wage being around £4 just before the minimum wage introduction. Before its introduction around 1 in 3 workers were paid less than the minimum wage. In April 1999 we see a spike in the wage distribution of around 30 percent at the minimum wage. The minimum wage clearly ‘bit hard’ in this sector. It therefore provides a very good environment for looking at the impact of the minimum wage on employment.

We look at the employment effects of the minimum wage by considering what is now a standard technique in the empirical literature on minimum wages and employment. This relates changes in employment before and after the minimum wage introduction to the fraction of low paid workers in the pre-minimum wage period (see, for example, Card’s, 1992, state based study of an increase in the US federal minimum wage in the early 1990s). In summary we find a sizable wage impact, together with moderate employment and hours reductions following the introduction of the minimum wage.

The rest of the paper is structured as follows. Section II presents a brief history of minimum wage legislation in the UK and some summary statistics on employment over time

in the sector upon which we focus. Section III describes our data collection process and presents some descriptive statistics. Section IV reports empirical findings on the wage effects of the minimum wage. Section V then moves on to consider the employment and hours effects, together with a brief investigation of other possible outcomes. Section VI then concludes.

## II. Minimum Wages in the UK and the Care Homes Sector

### *Minimum Wages in the UK*

Unlike many other countries, minimum wages have historically not had a very important role to play in the UK labour market. This is certainly true at the national level where there has never been an economy wide minimum wage floor. But minimum wages used to be a factor in some low wage sectors. There used to be an industry-based system of minimum wage floors, the Wages Councils, which operated from 1909 to their abolition in 1993. These Wages Councils covered around 12 percent of the workforce at the time of their abolition. In some earlier work we have studied the impact of the Wages Councils, concluding that their activities did little to harm employment, but that they compressed the wage structures of the sectors in which they operated (Dickens, Machin and Manning, 1999; Dolado et al, 1996).

Following its election in 1997, Tony Blair's Labour Government was committed to introducing a National Minimum Wage (as the Labour Party had been in earlier elections that they lost). It set up a Low Pay Commission consisting of academics and representatives of employers and workers to report on a suitable form and level (see Low Pay Commission, 1998). Eventually, a minimum wage of £3.60 per hour was introduced in April 1999 for those aged 22 or older, with a lower youth rate of £3 per hour for those aged 18-21 inclusive (those aged less than 18 were not covered). The Low Pay Commission expected that around 9 percent of workers would be directly affected and those workers would, on average, receive a

30 percent boost to their pay (Metcalf, 1999). These numbers have subsequently been revised down, with it seeming more likely that about 6 percent of workers' wages were raised up to the minimum (Dickens and Manning, 2002). This, of course, still amounts to a potentially large impact on the labour market.

Moreover, it is also clear that there is systematic variation in who benefited from minimum wage introduction. Metcalf (1999) also notes the increased importance of the minimum wage for part-time female workers. Of the workers he estimates to be directly affected by the introduction of the minimum wage, around 55 percent were women working part-time. The sector upon which we focus, the care homes sector, and particularly its principal occupation, that of care assistant, is very female intensive and has many part-time workers. Furthermore, as we will see when we describe our data more fully below, the majority of workers in this sector possess few formal qualifications and wages are very low. As such this is very much a sector that had the potential to be hit hard by the minimum wage.

#### *The Labour Market for Care Assistants*

The occupation of care assistant is not only one of the lowest paid occupations<sup>5</sup> but also is an increasingly important one in the UK. Indeed, not surprisingly given the aging of the population, the employment of care assistants has risen in recent years in the UK. One can gain some idea about the aggregate picture from looking at the number of care assistants in the quarterly Labour Force Survey (LFS). Figure I shows total employment of care assistants in the private sector between 1994 and 2001.<sup>6</sup> The vertical line on the Figure refers to the date of minimum wage introduction.

The Figure shows a rise in the number of private sector care assistants from around 220000 in 1994 to 330000 by 2001. But closer scrutiny of the Figure shows that, according to

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<sup>5</sup> Taking a look at the occupational breakdowns in the published New Earnings Survey Tables each year normally finds the lowest paid occupation in the UK to be either hairdressers or care assistants.



these aggregate numbers, there appears to be a moderate slowing down of employment growth in the later time period after minimum wage introduction. Of course, this can only be suggestive as business cycle factors may be at play here. However, looking at the temporal pattern of residuals from a regression of care assistant employment on the aggregate unemployment rate (or on GDP) still reveals the slower increases occurring post-minimum wage introduction (especially into the year 2000).<sup>7</sup>

This is illustrative of general employment trends for care assistants.<sup>8</sup> However, to properly consider the question of employment effects of minimum wage introduction in a more systematic and rigorous fashion one really requires micro-data on a big enough sample of care assistants before and after minimum wage introduction. This is therefore what we turn to next.

### III. Data Issues and Descriptive Statistics

Most existing UK data sources are really not well suited to carrying out a detailed before and after evaluation of the economic impact of the introduction of the UK minimum wage.<sup>9</sup> We therefore decided to collect our own data. We wanted to focus on a situation where the

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<sup>6</sup> Each point on Figure corresponds to the mid-month of each LFS quarter (which respectively cover the months March-May, June-August, September-November, December-February).

<sup>7</sup> Separate regressions of the log of the number care assistants on  $\log(\text{unemployment rate})$  and  $\log(\text{gdp})$  produced coefficients (standard errors) of  $-.68 (.04)$  and  $1.18 (.07)$ . Both regressions had an R-squared of  $.91$ .

<sup>8</sup> It also squares up with the demand side in that the size of the older age population was trending upwards as well. For example, the number of people aged 75 and over in the UK rose steadily year on year from 1996 onwards as follows: 1996 – 4.17 million; 1997 – 4.24 million; 1998 – 4.29 million; 1999 – 4.33 million; 2000 – 4.36 million (Source: Office for National Statistics).

<sup>9</sup> For example the survey containing the best wage data, and which covers the largest sample of workers, is the New Earnings Survey (NES). This has several serious shortcomings if one wished to try and evaluate the impact of minimum wage introduction. First, it is carried out in April of each year which is unfortunate as the minimum wage was introduced in April 1999. Wages contained in the survey are therefore a mish mash of pre- and post-introduction wages. Second, and even more important, it undersamples low wage part-time workers (as workers below the National Insurance weekly earnings lower limit are not well picked up). The other commonly used micro-data suffer from other problems. First most (like the General Household Survey or the Family Expenditure Survey) simply do not contain enough low wage workers. Second as they are employee, rather than employer, surveys they are likely to be characterised by measurement errors in wages (see Dickens and Manning's, 2002, analysis of Labour Force Survey data).

minimum wage had the potential to have an important impact and so chose to collect data on employers and workers in residential care homes.

As already noted, there are several compelling reasons for choosing this sector. First, it is a leading employer of many low wage workers. As already noted, the principal occupation, care assistants, is one of the lowest paid occupations in the UK. Second, most homes are reasonably small (average employment size < 20; median employment size = 15) and this enables us to collect data on all workers within the homes. Third, there are basically no trade unions to distort wage-setting procedures in this sector.

### *Sample Design*

Our sample design was to sample the population of UK care homes before and after the introduction of the minimum wage. We obtained lists of all homes from the Yellow Pages Business Database in July 1998 (for the pre-minimum sampling) and in May 1999 (for the post-minimum sampling). There were 11635 care homes in the former and 11036 homes in the latter. As one of the things one might be interested in is the extent to which employers adjusted wages before the minimum wage introduction we sampled (based on area stratification) one-ninth of the homes in each of the nine months before minimum wage introduction, and then we re-sampled the homes (including new homes), again one-ninth at a time, in the nine months following the introduction of the wage floor. We also identified home closures that occurred over this time period.

The questionnaire was mailed to the manager of the care homes and asked a range of questions about the home and about the views managers (who are often home owners) had about the minimum wage. For obvious reasons, the precise nature of the attitudinal questions was different for questionnaires sent out before and after the introduction of the minimum wage.<sup>10</sup> Managers were also asked to provide data on job title, sex, age, length of service, possession of a nursing qualification, weekly hours and hourly wages for all workers.

For a postal survey we achieved a reasonable response rate (of the order of around 20 percent). One may however worry about the representativeness of the achieved sample. The Appendix therefore compares the sample we analyse with data on care assistants from the Labour Force Survey. The correspondence is reassuringly very close, giving a lot of confidence that the responses we received are representative, at least in terms of the variables we compare (age, hours, tenure and wages). One should also note that in a small number of homes managers were less likely to complete all the information on worker characteristics. In these cases where there was missing information on hourly wages and/or hours we imputed them using the average for that job within that firm. We report both results including and excluding imputed figures below.

### *Descriptive Statistics*

Some features of the sample are described in Table 1. The first two columns show the characteristics of the total sample of workers and homes pre and post minimum wage introduction, the middle two for all homes that we obtained some responses on worker characteristics in both sampling periods (the balanced panel of homes) and the final two columns further exclude homes where worker information supplied was very patchy.<sup>11</sup>

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<sup>10</sup> The actual questionnaires are available on request from the authors.

<sup>11</sup> More specifically we exclude homes where less than half of the workers have missing hours or wage information.

The Table reveals a number of pertinent features of the labour market under study. First, and probably most striking, wages really are very low in the care homes sector. Before the introduction of the minimum wage average wages were about £4 per hour (whether or not we include imputed wages does not make much difference). This sector therefore clearly satisfies one of the criteria we wanted to emphasise in a study of the impact of minimum wage introduction, namely that the imposition of the minimum wage floor had the potential to affect a large number of workers.

The second clear feature of the wages data is that they rose sharply after minimum wage introduction. Average wages went up by somewhere around 24 pence per hour (or by around 6 percent). We consider this in much more detail in the next Section where we discuss the ‘bite’ of the minimum wage introduction. Of course, the requirement that the minimum wage introduction significantly affected wages and their distribution is a pre-requisite for going on to look at employment effects.

The Table also documents other characteristics of the sample. Average home size is fairly small, both in terms of workers and residents. Mean employment is in the range of 16 to 17 workers, and the average number of residents is around 17 to 18 per home. They both remain fairly constant before and after the minimum wage introduction.

As stated earlier the principal occupation in this sector is care assistants. This occupational group comprises over 60 percent of the workers in the sample. The workers are typically older workers (average age about 40), overwhelmingly female, working an average of 25 hours per week. Only around 1 in 10 possess a nursing qualification (other educational qualifications are not relevant in this sector).

Finally, we have collected other home level information on the occupancy rate of beds and, since the sector has price regulation operating through local authorities, on the percent of residents who pay local authority prices for beds. This latter feature of the sector is, of course,

very interesting in the context of minimum wage effects. One argument sometimes put forward in the literature is that one may not observe employment responses to minimum wages if employers are able to pass minimum wage increases on to consumers in the form of higher prices. This seems unlikely to happen in the care homes sector as prices are, in many cases, regulated by local authorities. We return to look at possible price responses later, after considering the wage and employment effects of the minimum wage introduction.

#### IV. Wages and the Minimum Wage

Before considering the employment consequences of minimum wage introduction, one clearly needs to establish that the minimum wage had the effect one expects on wages and the distribution of wages. As noted above, confirming that the minimum wage introduction had real ‘bite’ and affected the wages of low wage workers in the expected direction is clearly a prerequisite before one goes on to look at the impact on employment.

##### *The ‘Bite’ of The Minimum Wage Introduction*

The UK National Minimum Wage was introduced in April 1999 at £3.60 per hour for workers aged 22 or more, and at £3.00 per hour for 18-21 year olds. When presenting measures of the impact of the minimum wage we sometimes use these age-specific minimum wages and sometimes just the adult minimum: the reason for this is that there is a spike in the youth wage distribution at the adult minimum after the introduction so that one could argue that the adult minimum is the effective minimum.<sup>12</sup>

Table 2 reports on our investigations of the impact of minimum wage introduction on wages. The numbers in the Table demonstrate a clear importance of minimum wage introduction for care home workers. The Table shows the percentage of workers paid less than the minimum wage prior to its introduction, how far wages would have to be increased if

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<sup>12</sup> See Katz and Krueger (1992) for evidence that in the US the youth sub-minimum is rarely used.

these workers' wages were raised to the minimum and the percentage paid at exactly the minimum (the size of the minimum wage spike in the wage distribution). As with Table 1 statistics are reported for all care homes, for the balanced panel and then for the balanced panel that excludes homes with limited worker information.

The first thing to notice in the Table is that the sector we are studying is one that, conditional on the minimum wage introduction being binding, had the potential to be very heavily affected by the national minimum wage. Around 32 percent of workers were paid below the (age-specific) minimum wage before it was introduced. Around 38 percent were paid below the adult minimum rate.

Table 2 also presents measures of the 'wage gap', namely the average increase in wages needed to bring workers beneath the mandated minimum up to the minimum. The

wage gap in firm  $i$  is computed as 
$$GAP_i = \frac{\sum_j h_{ji} \max(W_{ji}^{\min} - W_{ji}, 0)}{\sum_j h_{ji} W_{ji}}$$
 where  $h_{ji}$  is the weekly

hours worked by worker  $j$  in firm  $i$ ,  $W_{ji}$  is the hourly wage of worker  $j$  in firm  $i$ , and  $W_{ji}^{\min}$  is the minimum wage relevant for worker  $j$  in firm  $i$  (this might be the age-specific or the adult minimum). Table 2 shows that the wage gap averages 4 percent using the age-specific minimum and 4.7 percent using the adult minimum. Again this confirms a potentially very large impact of the minimum wage introduction on the sector.

That the minimum wage impacted hard on the wage structure of care homes is borne out by looking at the post-minimum columns of the Table. First, there seems to be very little under-payment (around 1 percent for all homes or slightly lower in the balanced panels). However, something one might be concerned about here is that firms that subsequently pay illegally below the minimum wage do not respond to our survey. But were this to be true we would expect to see the initial wage levels in our sample as a whole being below those in the balanced panel as the latter homes respond to the survey both before and after the minimum

wage was introduced. However, Table 1 shows initial pre-minimum wage introduction wages to actually be slightly higher in the full sample as compared to the balanced panel, so there is no evidence that this is the case.<sup>13</sup>

The second feature of Table 2 that shows the minimum wage ‘bit’ hard is the very noticeable spike at the minimum after April 1999. Something like 28 or 29 percent of workers were paid the age-specific minimum after introduction and around 30 to 31 percent were paid the adult minimum. One should notice here that the spike is measured at exactly the minimum wage (not as plus or minus a small range around the minimum as in some other studies).

Not surprisingly the minimum wage introduction therefore had a sizable impact on wage dispersion. The gap between the 50<sup>th</sup> and 10<sup>th</sup> percentiles of the log(hourly wage) distribution narrowed from .21 to .09. At the same time the upper half of the distribution was unaffected with the gap between the 90<sup>th</sup> and 50<sup>th</sup> percentiles of the distribution not changing. The 90-50 gap was .34 in both pre- and post-minimum time periods.<sup>14</sup>

#### *Minimum Wage Introduction and Care Home Wages*

The numbers in Table 2 show a strong impact of minimum wage introduction on the care homes wage distribution. But, for our empirical analysis, we would also like evidence that the homes we would most expect to be affected were, indeed, the most affected. This is the purpose of this sub-section. More specifically the basic wage change equations we estimate are of the form:

$$\Delta \ln W_{it} = \alpha_1 + \beta_1 \text{MIN}_{i,t-1} + \delta_1 X_{i,t-1} + \varepsilon_{it} \quad (1)$$

where  $\Delta \ln W_{it}$  is the change in wages for home  $i$  in the period surrounding minimum wage introduction ( $t-1$  denotes the period before,  $t$  the post-minimum period),  $\text{MIN}_{i,t-1}$  is a measure

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<sup>13</sup> We also investigated whether the sample response rates fell disproportionately in the low-wage regions where the minimum wage had more bite. There was no evidence of this either.

of the importance of the minimum wage for home  $i$  (defined below),  $X_{i,t-1}$  is the  $(t-1)$  level home and worker characteristics<sup>15</sup> and  $\varepsilon_{it}$  is an error term. The key parameter of interest is  $\beta_1$  which measures the relation between wage changes and the minimum holding constant the other factors we control for.

There are some practical concerns with this kind of equation. The first issue is how one measures  $\text{MIN}_{i,t-1}$ . We use the two measures of the impact of the minimum wage already discussed in Table 2: the proportion of workers paid less than the minimum wage in the period before its introduction, and the wage gap. It is not clear which is the better measure. For example, if the minimum wage caused all workers initially paid below it to lose their jobs, then the headcount might be the better measure, but if it is more difficult to raise the productivity of those a long way below the minimum wage than those near it, then the wage gap measure might be better.

The second main modeling issue concerns identification. Because the minimum wage introduction in the UK was at national level the variation across homes in the impact of the minimum wage all comes from variation in the initial level of wages.  $\beta_1$  is then only a true measure of the impact of the minimum wage if, in the absence of the minimum wage, there would be no relationship between the initial level of wages and the change in wages (i.e. if wages follow a random walk). This is the implicit identification assumption in using an equation like (1) to estimate the impact of the minimum wage.

We test this identifying assumption in two related ways that consider whether the relationship between wage changes and their initial level shifted in the period surrounding minimum wage introduction relative to an earlier period when no minimum wage was in

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<sup>14</sup> See Dickens and Manning (2002) for an in-depth analysis of the impact of minimum wage introduction on wage inequality in the UK.

<sup>15</sup> We also considered models where, rather than entering the initial period home and worker characteristics as controls, the change in  $X$ ,  $\Delta X_{it}$ , was entered. This made very little difference to the reported pattern of results throughout our analysis.



place. We first look at the relationship between wage changes and initial wages in the minimum wage introduction period (1998/99) as compared to the relationship estimated from some data we collected in an earlier time period (1992/93) for care homes on the south coast of England.<sup>16</sup> Second we consider whether the relationship between wage changes and the minimum wage variable altered across these two time periods by constructing a counterfactual minimum wage variable (placing the minimum at the same percentile point of the initial wage distribution<sup>17</sup>) in the earlier non-minimum wage time period. We do this for both the headcount and wage gap measures. The two approaches thereby enable us to consider whether one observes a different association in the period surrounding minimum wage introduction as compared to an earlier time period where no such policy was in place.

#### *Estimates of Wage Change Equations*

Table 3 reports estimates of home-level wage change equations for hourly wages (upper panel) and for weekly wages (lower panel) in the period surrounding minimum wage introduction. Four specifications are reported in each case. Rows (1) and (2) present estimates of wage equations including the initial low pay proportion to measure  $MIN_{i,t-1}$ . They differ in that the first specification excludes and the second specification includes a set of control variables. Rows (3) and (4) then present analogous specifications using the wage gap measure as an independent variable.

In all cases there is evidence of bigger wage increases in homes with more low-wage workers in the pre-minimum wage period. The associations are strong in statistical terms and are sizable. They also look rather similar for hourly and weekly wages. For example,

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<sup>16</sup> See Machin, Manning and Woodland (1993) for more detail on this earlier survey and Machin and Manning (2002) for an analysis of wage structure in care homes in the earlier time period. This 1992/93 survey was carried out for the same reason as the current one, namely to evaluate the impact of minimum wage introduction on care homes. The first wave of the survey was carried out before the April 1992 election as the Labour Party manifesto had committed to introduce a minimum wage if they were elected. Their loss of the election meant our plan to carry out a before and after analysis of minimum wage introduction was scuppered. We still, however, collected data after the election period and so can look at before and after changes with these data as well.

according to row (2) of the upper panel of Table 3 a home with one third of its workers paid less than the minimum saw average wage growth of 3.3 percent higher than one which had one tenth of its workers paid less than the minimum.<sup>17</sup> This is large given that average wage growth was around 6 percent in this time period

These results appear to establish an important impact on wages of the minimum wage but, as noted above, it may merely be because there has always been a link between wage growth and initial low pay. So we investigate this in some detail in Table 4. We do so in the two main ways already mentioned above. First, we estimate equations relating wage change to the initial period average wage in the periods surrounding minimum wage introduction and in the earlier 1992/93 time period for which we have data where no minimum wage was in place. This equation takes the form:

$$\Delta \ln W_{it} = \alpha_2 + \beta_2 \ln W_{i,t-1} + v_{it} \quad (2)$$

where the focus is now on estimating the association between wage changes and the initial average wage, namely the parameter  $\beta_2$  ( $v$  is an error term).

The second way in which we benchmark our results against the earlier time period is to return to equation (1) and specify a counter-factual minimum wage in the earlier non-minimum wage period so as to compute measures of the initial low pay proportion and wage gap variables. We do so by placing this counter-factual minimum at the same percentile point of the wage distribution.

Table 4 reports these results for hourly wages. For all three specifications there is a clear shift in the relationship between wage changes and the initial wage measures in the period surrounding minimum wage introduction as compared to the earlier time period. The significantly negative coefficient on the initial wage in the 1998/99 model in row (1) of the

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<sup>17</sup> This corresponds to £2.75 per hour.

<sup>18</sup> The calculation is  $.145 * (.33 - .10) = .033$ .

Table demonstrates very clearly that, in the period surrounding minimum wage introduction, wage growth was higher in firms with lower wages in the initial period. In the earlier non-minimum wage period (1992/93) there is also a negative coefficient on the initial wage, but it is clear that its magnitude is much smaller (in absolute terms) than in 1998/99. The final column reports the gap between the two and it is very clear that the relationship shifted markedly between the two time periods.

Some graphs also serve to make the same point. Figure 2a plots the relationship between average wage growth and the initial log wage in 1998/99 and Figure 2b does the same for the 1992/93 data. While it is very clear that there is a negative relationship in both periods, the strong diagonal effect on homes with initial low wages is very apparent in the 1998/99 data. This reveals a clear impact of the minimum wage.

In rows (2) and (3) of Table 4 we also report results of wage growth equations including the initial minimum wage variables for the 1998/99 data and the counter-factual initial minimum wage variables for the 1992/93 data. These very much reconfirm the pattern from the row (1) models. There is a marked shift between periods for both measures as one can see a much stronger positive impact of the initial minimum wage variables in the period surrounding minimum wage introduction. Indeed, there is no relationship between wage changes and the initial low pay proportion in the earlier non-minimum wage period and a much smaller association with the initial wage gap measure. This shift is borne out by the positive, statistically significant gaps given in the final column of the Table.

All in all, the evidence of this Section has established a clear and important effect of minimum wage introduction on care home wages. We turn to investigate the possible employment effects in the next section.

## V. Employment and the Minimum Wage

We analyse the employment consequences of the minimum wage introduction using the same kind of methodology as the wage analysis. We estimate home-level equations that relate changes in employment or hours in the period surrounding minimum wage introduction to headcount and wage measures of the extent of initial low pay. And, because of the identification questions already raised, we look at the relationship between changes in employment and initial wage levels in the period of minimum wage introduction and the period where no minimum wage was in place. We begin with the latter in the next subsection, and then move on to the former after that.

### *Changes in Employment and Initial Wages*

As before, the implicit identification assumption here is that, in the absence of the minimum wage, there would be no relationship between employment growth and the initial level of wages. It is not obvious this is the case (e.g. homes that are doing less well might pay lower wages and have lower employment growth) so we start by investigating the relationship between employment growth and initial wages.

Table 5 reports the results of carrying out this exercise for the period surrounding minimum wage introduction (1998/99) and for the earlier period (1992/93) where no such policy intervention occurred. The upper panel of the Table reports models where changes in log total employment are related to the initial period wage measures, whilst the lower panel reports results where the dependent variable is the change in log total hours.

The first thing to note is that the correlations of employment changes with initial wage measures tend to be weaker than the correlations with wage changes considered earlier. That said, there is some evidence (of varying strength depending on specification) of shifts occurring between the ‘policy on’ and ‘policy off’ time periods. In all cases but one, the sign

of the relationship switches between periods, revealing a tilt in the relationship so that, in the period surrounding minimum wage introduction, employment growth tended to be reduced in homes that were impacted more by minimum wage introduction. And some of the gaps in the final column are statistically significant (or on the borders of significance, the one exception being the initial period low proportion in the upper panel of the Table). We take this as some preliminary evidence that the relationship between employment and low wages may have shifted in the period surrounding minimum wages.

#### *Changes in Employment And Initial Minimum Wage Variables*

In this sub-section we consider in more detail the relationship between home-level employment and hours changes and the minimum wage variables in the period surrounding minimum wage introduction. Figures 3 and 4 plot the basic data we use to look at these. The change in log total employment is plotted against the initial proportion low-paid in Figure 3a and against the initial wage-gap in 3b. Figures 4a and 4b do the same but with the change in log total hours on the left-hand axis. Eyeballing these scatterplots does not reveal any distinct pattern, despite the very clear wage evidence presented earlier.

In the first instance we estimate reduced form employment change equations of the form:

$$\Delta \ln N_{it} = \alpha_3 + \beta_3 \text{MIN}_{i,t-1} + \delta_3 X_{i,t-1} + \zeta_{it} \quad (3)$$

Various estimates of equation (3) are given in columns (1) through (6) of Table 6, for changes in total employment in the upper panel and for changes in total hours in the lower panel of the Table. In the final two columns of the Table we also present structural estimates of labour demand equations from a simple structural model of the following form (equation (1) is reproduced from above):

$$\Delta \ln N_{it} = \alpha_4 + \beta_4 \Delta \ln W_{it} + \delta_4 X_{i,t-1} + \omega_{it} \quad (4)$$

$$\Delta \ln W_{it} = \alpha_1 + \beta_1 \text{MIN}_{i,t-1} + \delta_1 X_{i,t-1} + \varepsilon_{it} \quad (1)$$

We are able to estimate  $\beta_4$ , the wage elasticity of labour demand, by using  $\text{MIN}_{i,t-1}$  as an instrumental variable for the wage change (equation (1) can thus be thought of as the first stage regression in the IV procedure). It is also straightforward to see how this relates to the reduced form models (1) and (3) where the labour demand elasticity  $\beta_4$  is given by  $\beta_3/\beta_1$ .

Turning to the results in the Table, columns (1) and (4) report the coefficient on the initial low pay proportion and the initial wage gap respectively in a regression where the dependent variable is the change in log employment or log hours and there are no other controls. In these basic models the estimated impact of the minimum wage is negative, though not significantly different from zero. However the addition of controls and restriction of the sample to those with relatively complete information on worker characteristics (columns (2) and (3) for the headcount, columns (5) and (6) for the wage gap) makes the coefficients both larger in absolute terms and more significant. In these specifications we are able to pin down a significant negative effect on employment growth.

The Table also reports implicit elasticities calculated on the basis of a minimum wage increase of 40p (the adult rate going from £3.60 to £4.00). These ask the question: what would the additional effect on employment have been if the minimum wage had been introduced at a higher level? In the models with controls these elasticities are in the range of  $-0.15$  to  $-0.40$ . These are reasonably sizable in the context of the minimum wage literature, though are not so big given the very large impact of minimum wage introduction on the wages and wage distribution of care home workers.

The other, related, way to look at the employment response to wage changes is to directly compute the elasticity of employment with respect to the wage, using the initial wage gap variable as an instrument for the change in average wages. Structural estimates of employment change equations are reported in columns (7) and (8). They reveal a well

determined negative wage effect that is moderate in size<sup>19</sup>, ranging from about -.35 to -.55, depending on the specification.

One issue of possible importance is the speed at which employers may adjust in response to minimum wages. It is hard to do anything very convincing here given we only follow homes nine months before and after minimum wage introduction. But, from what we can look at, it seems that wage adjustment was very rapid and the wages clearly adjusted at the time of introduction and barely at all before (i.e. there seems no evidence of ‘anticipation’ effects on wages). Employment adjustment may be slower, but one should note that this is a very high employee turnover sector (presumably in part due to the very low wages). Furthermore a study of what happened to wages and employment in care homes before and after the more recent uprating of the minimum wage (up to £4.10 for adults and £3.50 for 18-21 year olds in October 2001) finds employment effects of much the same magnitude, and no stronger, than those reported here (Allison, 2002).

While the estimated employment effects are clearly not as strong as the wage effects considered in the previous section of the paper, they do suggest that employers cut employment and hours in response to the minimum wage.<sup>20</sup> One might wonder how this is possible in this sector as these firms are regulated and there are minimum standards of care for the residents that are mandated. However, inspection of these homes is far from perfect and the sector is notorious for examples of homeowners providing inadequate standards of care (for example, they have been the subject of several TV documentaries). It seems

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<sup>19</sup> See Hamermesh (1993) for a very detailed consideration of the large body of work that estimates labour demand elasticities.

<sup>20</sup> The analysis is based upon the balanced panel of homes. Given our data we can also look at closures, although only in the window very recently after minimum wage introduction (since our second wave is based on a sample of homes in May 1999). Running probit models of closure on the two minimum wage variables, and either including or excluding the control variables, resulted in positive, but very small estimated marginal effects (all of which were statistically insignificant). Whilst it is clear that effects may differ if one looks at a longer period, this short run analysis finds no evidence that rising wage costs ensuing from minimum wage introduction resulted in home closure. The same conclusions were reached for a county-level analysis of entry

plausible that managers face a trade-off between the fraction of the time they are in breach of care guidelines (which is determined by employment) and the probability of being fined when inspected in that situation. In addition, owner-managers often work considerable hours in the homes themselves and may have the ability to substitute their labour for that of paid help.

#### *Other Outcomes and the Minimum Wage*

This section briefly investigates the impact of the minimum wage on other outcomes. It is possible that they may have ‘passed on’ increased wage costs from the minimum wage introduction through higher prices though the extent to which this is possible may be limited by the price regulation in place. Second, there may have had to be re-organizations that could raise productivity (e.g. quality of care improvements, or increases in care worker productivity, or simply making people work harder for their higher wages).

We consider these possibilities in Table 7. The upper panel reports price change equations and the lower two panels consider two productivity measures, using the same kind of models as for wages and employment. The first productivity measure used is changes in residents per worker hour, the second comes from managers’ responses to a question about whether they think worker effort went up, stayed the same, or fell in the period around minimum wage introduction.

Perhaps not surprisingly given the nature of price regulation in the care homes sector we find no evidence that prices rose by more in the initial low wage firms. All the estimated coefficients in the upper panel are small and none of the coefficients approach anything near statistical significance (all have t-ratios  $< 1$ ). As such there seems to be no evidence that minimum wage increases might have been passed on through higher prices in this sector.

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and closure using Labour Force Survey data. All of these results are presented in the earlier Discussion Paper version of this paper (Machin, Manning and Rahman, 2002).



There is also not much evidence in line with the re-organization/productivity improvement idea considered in the lower panels of Table 9. While the estimated coefficients on the minimum wage variables in both the change in residents per worker hour and subjective effort change equations are all estimated to be positive, none are significantly different from zero when the control variables are included.

## VI. Conclusions

In this paper we have presented empirical work on the wage and employment consequences of the recent introduction of the UK national minimum wage for a specific sector of the UK labour market. As we argued in the introduction to the paper we think examination of the economic effects of this minimum wage introduction provides a good testing ground for looking at minimum wage effects and provides an ideal opportunity for presenting some fresh evidence on the debate about what minimum wages do. We implement our empirical study by focusing on workers in the care homes industry, a low wage sector that was highly vulnerable to minimum wage introduction. In the absence of suitable data from existing sources we chose to examine the minimum wage impact by carrying out our own survey before and after the minimum wage was introduced.

From our analysis of these data we find there to have been a very important wage compression effect on the bottom half of the wage distribution in this low wage sector. Before its introduction around 1 in 3 care home workers were paid less than the minimum wage. In April 1999 we see a spike in the wage distribution of around 30 percent at exactly the minimum wage (and little evidence of non-compliance). This resulted in wage growth being considerably higher in the period surrounding minimum wage workers in homes who had more low-paid workers before the minimum came in. This seems to establish that the

minimum wage had considerable 'bite' on wages and this substantially altered the structure of wages of this sector.

Turning to the employment consequences, we are able to find some evidence of employment and hours reductions occurring in homes after minimum wage introduction. This seems to be in line with the aggregate behaviour of the labour market for care assistants, where the fast employment increases of the pre-minimum wage period slowed down in 1999 and 2000.

Of course, one should be very careful to note that the sector we have examined is particularly vulnerable to the minimum wage as it has very many low-paid workers. It is also rather special in that its product market structure means homes are constrained in their ability to pass higher wage costs on into higher prices. Given this, and the fact that studies of the impact of minimum wage introduction on the overall UK labour market uncover little evidence of job loss (Stewart, 2001), one should remain cautious in drawing conclusions from this study about the impact of the introduction of the National Minimum Wage on the UK as a whole.

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**Table 1:**  
**Survey Descriptive Statistics**

	All Firms		Balanced Panel		Balanced Panel (Excluding firms with a lot of missing worker information)	
	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum	Pre-Minimum	Post-Minimum
Number of Homes	1866	2142	641	641	615	615
Number of Workers	17.2 (12.2)	17.2 (13.0)	16.4 (9.7)	16.7 (11.9)	16.5 (9.7)	16.8 (11.9)
Hourly Wage (None imputed)	4.03 (0.85)	4.27 (0.80)	4.00 (0.80)	4.24 (0.72)	3.98 (0.74)	4.23 (0.71)
Hourly Wage (With imputed)	4.01 (0.82)	4.26 (0.75)	3.98 (0.75)	4.23 (0.71)	3.98 (0.74)	4.22 (0.70)
Weekly Hours (None imputed)	25.6 (6.5)	25.2 (6.1)	24.9 (6.3)	25.0 (5.8)	24.7 (5.9)	24.8 (5.7)
Weekly Hours (With imputed)	25.8 (6.5)	25.4 (6.0)	25.2 (6.2)	25.2 (5.8)	24.9 (5.9)	25.0 (5.6)
Weekly Earnings (None imputed)	103.85 (38.92)	108.31 (37.65)	100.41 (37.84)	106.47 (34.33)	99.00 (33.79)	105.59 (33.97)
Weekly Earnings (With imputed)	104.14 (37.11)	108.76 (35.96)	100.61 (34.55)	107.11 (33.86)	99.70 (33.61)	106.23 (33.65)
Proportion of workers with missing information	0.10	0.11	0.06	0.05	0.04	0.04
Proportion Female	0.92	0.92	0.92	0.93	0.93	0.93
Average Age	40.1 (6.6)	40.7 (6.9)	40.3 (6.3)	40.5 (6.5)	40.3 (6.2)	40.5 (6.5)
Proportion Care Assistants	0.63	0.61	0.63	0.64	0.63	0.64
Proportion With Nursing Qualification	0.10	0.11	0.11	0.11	0.11	0.11
Number of Beds	20.7 (36.6)	19.7 (16.3)	18.5 (18.5)	19.0 (19.8)	18.6 (18.8)	19.1 (20.2)
Number of Residents	18.5 (35.7)	17.8 (15.0)	16.5 (17.7)	17.0 (18.8)	16.6 (18.0)	17.1 (19.1)
Occupancy Rate	0.87	0.89	0.88	0.89	0.88	0.89
Average Weekly Price per Bed (£)	252.4 (86.1)	258.2 (92.3)	250.1 (78.3)	257.4 (79.3)	249.6 (78.3)	256.9 (78.9)
Proportion DSS/Local Authority	0.55	0.58	0.52	0.57	0.52	0.57

Notes:

Standard deviations in parentheses. Pre-Minimum observations refer to responses received before April 1999 and Post-Minimum to responses received after March 1999. Care Assistants include senior, day and junior carers but exclude night carers and sleep-ins. The final two columns exclude homes where less than half of the workers have missing hours or wage information.

**Table 2: The “Bite” of the Minimum Wage Introduction**

	All Firms		Balanced Panel		Balanced Panel (Excluding firms with a lot of missing worker information)	
	Pre- Minimum	Post- Minimum	Pre- Minimum	Post- Minimum	Pre- Minimum	Post- Minimum
% Paid Less Than Minimum Wage	32.3	1.0	31.2	0.8	31.6	0.7
% Paid Less Than Adult Minimum Wage	38.2	4.2	37.7	4.3	38.2	4.3
Wage Gap	0.039	0.002	0.041	0.003	0.039	0.002
Adult Wage Gap	0.047	0.006	0.049	0.007	0.047	0.007
% Paid Exactly Minimum Wage	8.7	27.7	9.3	28.4	9.5	28.7
% Paid Exactly Adult Minimum Wage	8.6	30.0	9.0	30.6	9.3	31.0
Number of Homes	1866	2142	641	641	615	615

Notes:

Pre-Minimum observations refer to responses received before April 1999 and Post-Minimum to responses received after March 1999. The final two columns exclude homes where less than half of the workers have missing hours or wage information.

**Table 3: Changes in Log Wages And Initial Period Wage Measures in the Period Surrounding Minimum Wage Introduction**

<b>Change in Log Average Hourly Wage</b>							
	Time Period	Initial Low Pay Proportion	Initial Wage Gap	Initial Log Wage	Controls	R <sup>2</sup>	Number of Homes
(1)	1998/99	.145 (.012)			No	.19	641
(2)	1998/99	.149 (.021)			Yes	.30	598
(3)	1998/99		.800 (.070)		No	.36	641
(4)	1998/99		.815 (.086)		Yes	.45	598
<b>Change in Log Average Weekly Wage</b>							
	Time Period	Initial Low Pay Proportion	Initial Wage Gap	Initial Log Wage	Controls	R <sup>2</sup>	Number of Homes
(1)	1998/99	.136 (.025)			No	.04	641
(2)	1998/99	.141 (.035)			Yes	.19	598
(3)	1998/99		.664 (.118)		No	.06	641
(4)	1998/99		.693 (.159)		Yes	.21	598

Notes: Sample is balanced panel of homes. Standard errors in parentheses. Control variable are the initial proportion female, proportion with nursing qualification, proportion of care assistants and average age (all workers), occupancy rate, proportion of local authority/dss residents, county and response month dummies.

**Table 4: Changes in Log Wages And Initial Period Wage Measures in the Period Surrounding Minimum Wage Introduction Compared to an Earlier Period (When no Minimum Wage was in Place)**

<b>Change in Log Average Hourly Wage</b>				
		1998/99: Period Surrounding Minimum Wage Introduction	1992/93: Earlier Time Period Where no Minimum Wage was in Place	Difference (Standard Error)
(1)	Initial period log wage	-.360 (.040)	-.174 (.057)	-.186 (.070)
(2)	Initial period low pay proportion (counterfactual in 1992/93)	.147 (.013)	.019 (.013)	.126 (.026)
(3)	Initial period wage gap (counterfactual in 1992/93)	.800 (.070)	.225 (.102)	.575 (.124)

Notes: Based on 641 homes in 1998/99 and 231 homes in 1992/93. Standard errors are in parentheses.



**Table 5: Changes in Log Employment and Hours  
And Initial Period Wage Measures in the Period Surrounding Minimum Wage  
Introduction Compared to an Earlier Period (When no Minimum Wage was in Place)**

<b>Change in Log Number Employed</b>				
		1998/99: Period Surrounding Minimum Wage Introduction	1992/93: Earlier Time Period Where no Minimum Wage was in Place	Difference (Standard Error)
(1)	Initial period log wage	.108 (.082)	-.190 (.147)	.299 (.168)
(2)	Initial period low pay proportion (counterfactual in 1992/93)	-.059 (.042)	-.022 (.044)	-.037 (.061)
(3)	Initial period wage gap (counterfactual in 1992/93)	-.173 (.108)	.053 (.137)	-.226 (.174)
<b>Change in Log Total Hours</b>				
		1998/99: Period Surrounding Minimum Wage Introduction	1992/93: Earlier Time Period Where no Minimum Wage was in Place	Gap (Standard Error)
(1)	Initial period log wage	.153 (.093)	-.220 (.165)	.375 (.189)
(2)	Initial period low pay proportion (counterfactual in 1992/93)	-.069 (.046)	.028 (.053)	-.097 (.069)
(3)	Initial period wage gap (counterfactual in 1992/93)	-.313 (.135)	.365 (.180)	-.678 (.224)

Notes: Based on 641 homes in 1998/99 and 231 homes in 1992/93. Standard errors are in parentheses.

**Table 6: Changes in Log Employment and Hours  
And Initial Period Minimum Wage Measures in the  
Period Surrounding Minimum Wage Introduction**

	Change in Log Number Employed							
	Reduced Form Models						Structural Models	
	(1)	(2)	(3) Clean panel	(4)	(5)	(6) Clean panel	(7) IV estimates	(8) Clean panel, IV estimates
Initial Proportion Paid Less Than Minimum Wage	-.059 (.042)	-.136 (.056)	-.165 (.057)					
Initial Wage Gap				-.173 (.108)	-.281 (.141)	-.552 (.259)		
Change in Log Hourly Wage							-.345 (.159)	-.561 (.317)
Demographic Variables		Yes	Yes		Yes	Yes	Yes	Yes
Firm Characteristics Variables		Yes	Yes		Yes	Yes	Yes	Yes
Response Month Dummies		Yes	Yes		Yes	Yes	Yes	Yes
Average Elasticity: (4.00-3.60)	-.14	-.31	-.38	-.08	-.14	-.27		
Observations	641	598	575	641	598	575	598	575
R-squared	.003	.155	.152	.001	.149	.143		
	Change in Log Total Hours							
	Reduced Form Models						Structural Models	
	(1)	(2)	(3) Clean panel	(4)	(5)	(6) Clean panel	(7) IV estimates	(8) Clean panel, IV estimates
Initial Proportion Paid Less Than Minimum Wage	-.069 (.046)	-.144 (.066)	-.170 (.066)					
Initial Wage Gap				-.310 (.135)	-.402 (.145)	-.509 (.311)		
Change in Log Hourly Wage							-.494 (.289)	-.518 (.353)
Demographic Variables		Yes	Yes		Yes	Yes	Yes	Yes
Firm Characteristics Variables		Yes	Yes		Yes	Yes	Yes	Yes
Response Month Dummies		Yes	Yes		Yes	Yes	Yes	Yes
Average Elasticity (4.00-3.60)	-.16	-.33	-.39	-.15	-.20	-.25		
Observations	641	598	575	641	598	575	598	575
R-squared	.003	.135	.148	.004	.132	.139		

Notes: Sample is balanced panel of homes. Standard errors in parentheses. Control variable are the initial proportion female, proportion with nursing qualification, proportion of care assistants and average age (all workers), occupancy rate, proportion of local authority/dss residents, county and response month dummies.

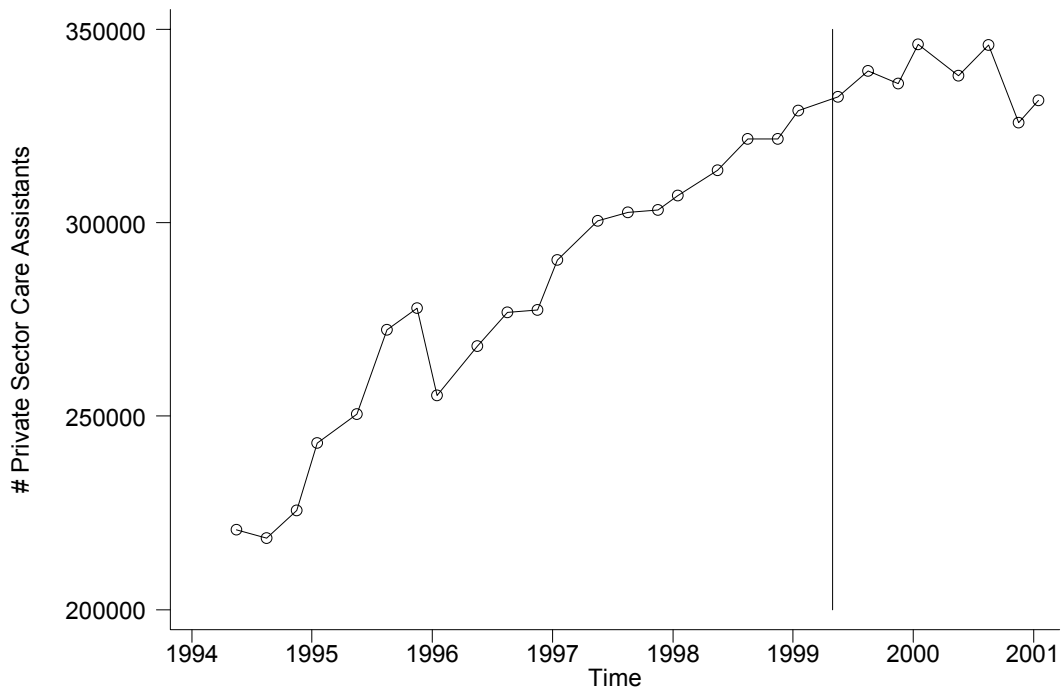
**Table 7: Prices, Productivity and the Minimum Wage**

	<b>Change in Log Average Price</b>			
	(1)	(2)	(3)	(4)
Initial Proportion Paid Less Than Minimum Wage	-0.001 (0.024)	-0.013 (0.027)		
Initial Wage Gap			0.116 (0.145)	0.048 (0.155)
Demographic Variables		Yes		Yes
Home Characteristics Variables		Yes		Yes
Response Month Dummies		Yes		Yes
R-Squared	0.00	0.11	0.00	0.11
Number of Homes	572	501	572	501
	<b>Change in Log Residents Per Worker Hour</b>			
	(5)	(6)	(7)	(8)
Initial Proportion Paid Less Than Minimum Wage	0.103 (0.044)	0.068 (0.047)		
Initial Wage Gap			0.334 (0.275)	0.111 (0.273)
Demographic Variables		Yes		Yes
Home Characteristics Variables		Yes		Yes
Response Month Dummies		Yes		Yes
R-Squared	0.01	0.21	0.00	0.20
Number of Homes	586	514	586	514
	<b>Subjective Responses on Change in Worker Effort</b>			
	(9)	(10)	(11)	(12)
Initial Proportion Paid Less Than Minimum Wage	0.063 (0.183)	0.100 (0.201)		
Initial Wage Gap			0.530 (1.085)	0.922 (1.166)
Demographic Variables		Yes		Yes
Home Characteristics Variables		Yes		Yes
Response Month Dummies		Yes		Yes
Log-Likelihood	-245.24	-210.91	-245.18	-210.72
Number of Homes	561	486	561	486

Notes:

As for Table 6. Effort variable coded as an ordered response based on answers to the question “Has the minimum wage had an impact on work effort in your business? No/Yes – Decrease/Yes-Increase”. It is ordered from 0 (decrease), 1 (no change), to 2 (increase). Ordered probit coefficients (and associated standard errors) reported for this variable.

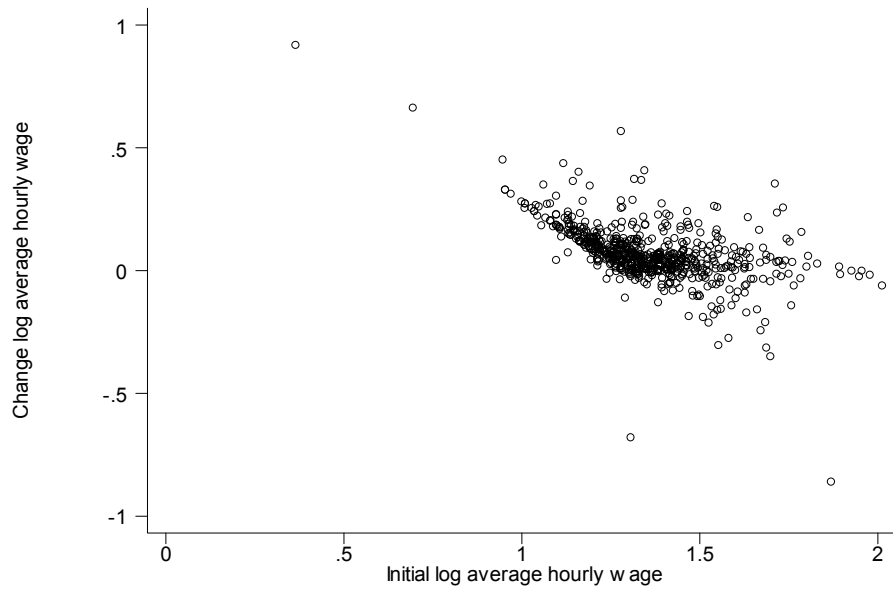
**Figure 1**  
**Numbers of Private Sector Care Assistants, 1994-2001**



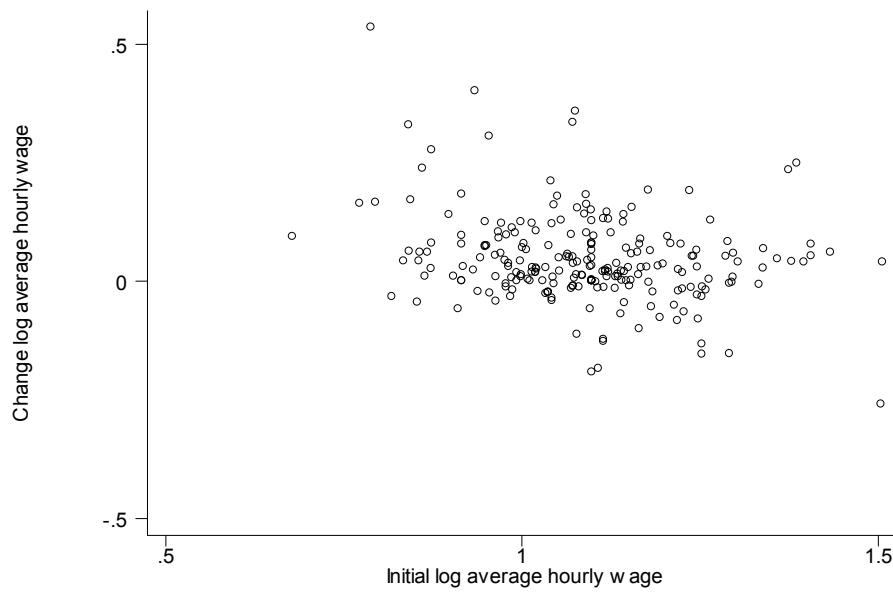
Notes:

Source: Labour Force Survey. Each point corresponds to the mid-month of each LFS quarter. Vertical line corresponds to minimum wage introduction in April 1999.

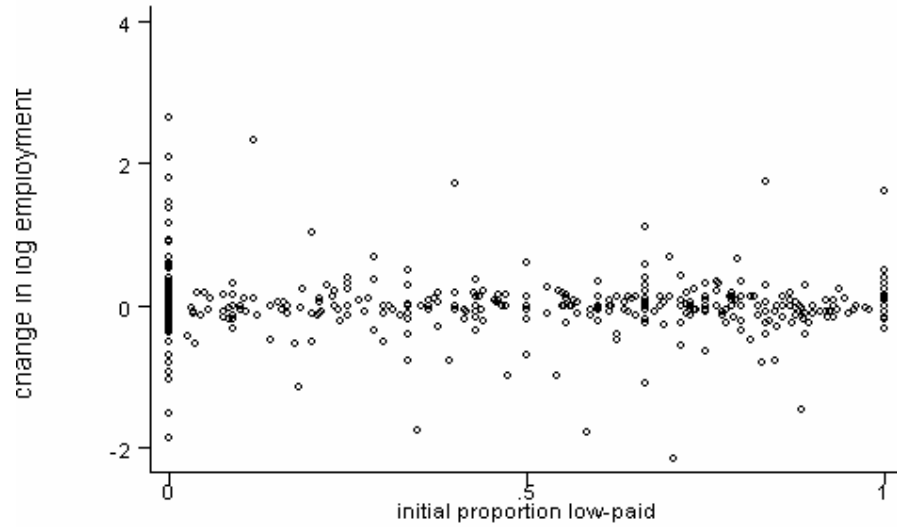
**Figure 2a**  
**The Relationship Between Wage Growth and Initial Wages: 1998/99**



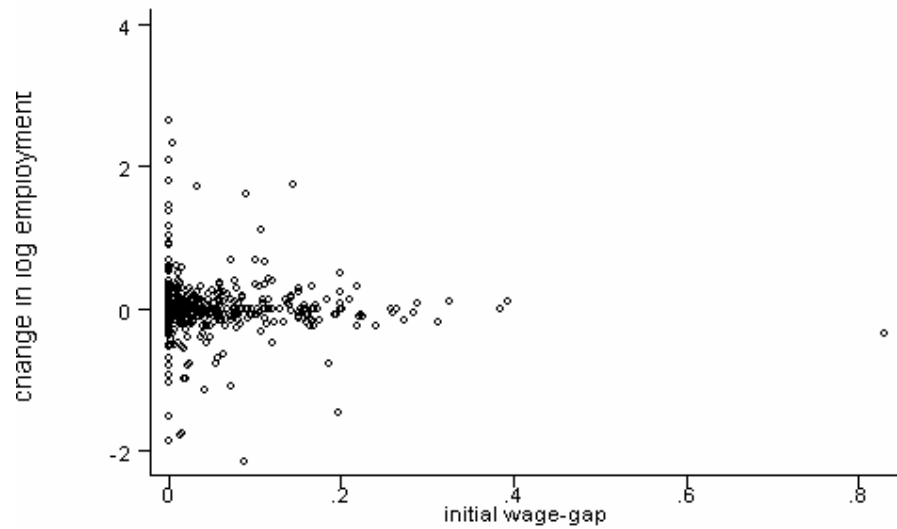
**Figure 2b**  
**The Relationship Between Wage Growth and Initial Wages: 1992/93**



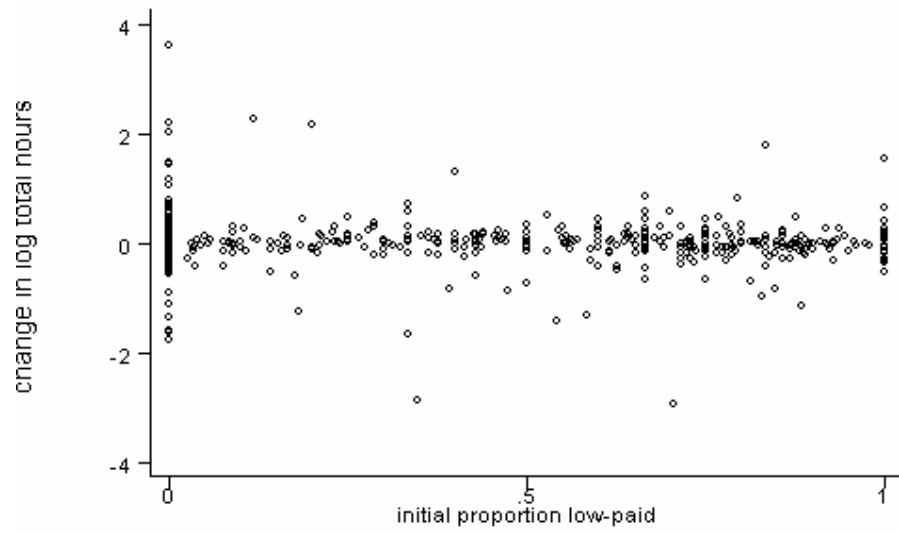
**Figure 3a**  
**The Relationship Between the Change in Log Total Employment and Initial Proportion Low-Paid**



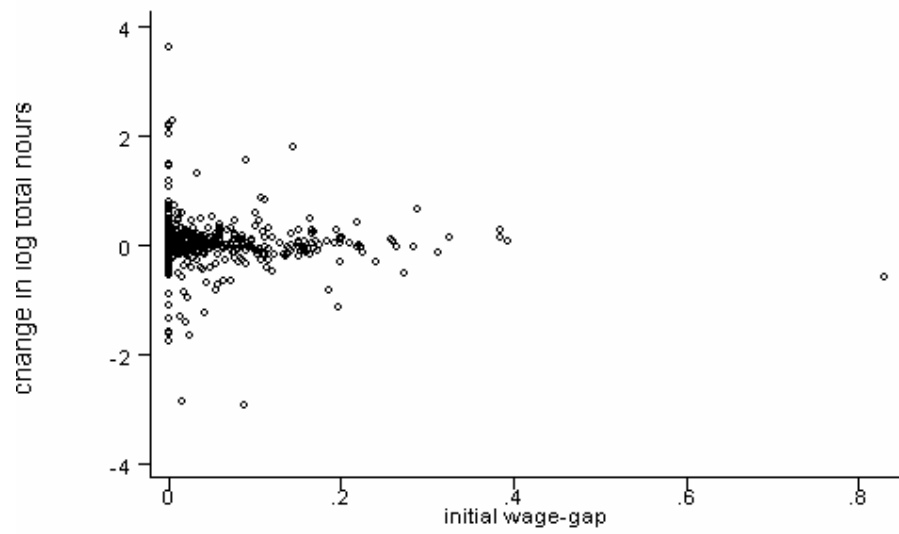
**Figure 3b**  
**The Relationship Between the Change in Log Total Employment and Initial Wage Gap**



**Figure 4a**  
**The Relationship between the Change in Log Total Hours and Initial Proportion Low-Paid**



**Figure 4b**  
**The Relationship between the Change in Log Total Hours and Initial Wage Gap**



## Appendix: Representativeness of the Sample

In this Appendix we compare the distributions of the responses to our survey with those from the UK Labour Force Survey (LFS).

From our survey we report results for care assistants. For the LFS, we report results for private-sector workers in the ‘industry’ ‘social work with accommodation’ (class 85.31), whose occupation is ‘care assistants and attendants’. The LFS sample comes from March 1998 to February 2000 so approximately coincides with the period of our survey.

In the Table below we report selected percentiles of the distribution of the characteristics of care assistants in our sample and in the LFS. We have information on age, hours, job tenure and hourly wages. For age, hours and job tenure there is no problem in comparing the variables in our sample and the LFS and the sample sizes are both large. As can be seen from the Table, the distributions are remarkably similar.

The comparison of the distribution of hourly wages is made more difficult by deficiencies in the LFS data that lead to small sample sizes. First, wage information is only collected in waves 1 and 5 (out of 5) so is automatically missing for 60% of observations. Secondly, the main LFS pay variable (which is derived by dividing weekly wages by weekly hours) is now recognized to have very large amount of measurement error and its use led to a wild over-estimate of the numbers of workers who were affected by the minimum wage (see Dickens and Manning, 2002). In March 1999 it was supplemented by a direct measure of the hourly wage for hourly-paid workers: this measure has less measurement error but is not observed for all workers (for our sample here it is 50%).

As a result of this we only have 167 observations in the LFS on the good measure of the hourly wage. The distribution of this variable is reported in the Table below in the row labelled LFS(1). Its distribution is similar to that in our sample (we restrict ourselves here to the post-NMW period as this is the only period for which we have the LFS (1) measure). One other concern is that those who report an hourly rate in the LFS are not randomly selected. A number of methods for dealing with this have been proposed (see Dickens and Manning, 2002, for a discussion). Here we report the results using an inverse propensity score re-weighting in the row labelled LFS(2). For our sample, probably because they are so homogeneous, the re-weighted distribution is very similar to the unweighted distribution.

All of this evidence suggests that we do not have a problem with the representativeness of our sample. In fact the survey and LFS summary statistics square up exceptionally well.

	Sample	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	Observations
Age	Ours	18	20	27	37	48	56	60	39316
	LFS	18	20	26	36	49	55	59	3218
Weekly Hours	Ours	9	12	18.5	26	35	39	40	39624
	LFS	10	14	20	30	36	40	42	3188
Tenure (months)	Ours	2	4	12	24	60	108	132	39905
	LFS	2	3	9	25	60	108	132	3205



Hourly Wage	Ours	3.6	3.6	3.6	3.80	4.25	5.04	5.57	21313
	LFS(1)	3.3	3.6	3.6	3.77	4.20	4.75	5.00	167
	LFS(2)	3.3	3.6	3.6	3.77	4.15	4.70	5.00	166