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Changing the Structure of Minimum Wages: Firm Adjustment and Wage Spillovers

Giulia Giupponi
Stephen Machin

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

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Abstract

This paper analyses the economic impact of a significant change to the structure of a minimum wage setting policy. The context is the United Kingdom where government mandated an unexpected change in the structure of minimum wages and their setting in 2016 by introducing a new minimum wage – the National Living Wage (NLW) – for workers aged 25 and over. The new NLW rate was significantly higher than the minimum wage for those under age 25. The analysis studies the consequences of this change in a sector containing many low wage workers, the care homes industry. The new minimum wage structure and associated higher minimum wage for those aged 25 and above significantly affected wages, but at the same time with little evidence of adverse employment effects, nor firm closure. Rather the margin of adjustment used to offset the sizable wage cost shock was a significant deterioration of the quality of care services. There is also strong evidence of wage spillovers as younger workers wages rose in tandem with the higher adult minimum wage, but with no impact on their employment. Based on further empirical tests, employer preference for fairness seems to offer the most plausible explanation for these results.

Key words: minimum wage structure, employment, wage spillovers
JEL: J23; J31

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Giulia Giupponi, Department of Economics and Centre for Economic Performance, London School of Economics. Stephen Machin, Department of Economics and Centre for Economic Performance, London School of Economics.

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1. Introduction

The by now centennial history of minimum wages and their widespread application across developed and developing countries has triggered a great deal of academic research on the topic. Recent years have seen a burst of renewed interest in this topic in both academic and policy settings around the world. In this paper, we study what happened to a range of economic outcomes when there was a substantive recent change in the structure of a minimum wage setting policy. This occurred in the UK when a government that had traditionally been hostile to minimum wages introduced an unexpected and sizable increase for older workers by introducing a new minimum wage rate – the National Living Wage (NLW). This new minimum wage rate for workers aged 25 and over moved the number of minimum wages in operation in the UK labour market up from four to five and, in doing so, structurally altered the minimum wage policy in operation in the labour market.

We are interested in analysing the consequences of this change in the UK minimum wage structure on three big areas of research that have been traditionally explored in the minimum wage literature. Firstly, wage and employment effects are studied in the context of workers and firms in the UK care homes sector, which has been argued to be a good testing ground for evaluating minimum wage effects on employment in earlier research (Machin, Manning and Rahman, 2003; Machin and Wilson, 2004). Secondly, we exploit the change in minimum wage structure to study whether the UK National Living Wage induced wage or employment spillovers onto workers under 25 as the minimum wage setting process was altered. Thirdly, we explore the possibility that care homes responded to the wage cost shock by altering other margins, such as prices, productivity and the quality of care services provided. In addition, we consider whether the policy had implications for aggregate employment and firm dynamics (entry and exit). We do so by

leveraging the unique natural experiment offered by the UK policy setting, coupled with rich matched employer-employee data including detailed information on individual hourly wages for the English care home sector. To the best of our knowledge, this is the first paper in which wage and employment effects, wage spillovers and margins of adjustment other than employment are studied in a unified framework.

To preview the key findings, the changed minimum wage structure and associated higher minimum wage for those aged 25 and above significantly impacted on wages, but there is much less evidence of adverse employment effects, and no significant impact on firm closure nor on entry/exit dynamics more generally. Rather the margin of adjustment that was used was a significant deterioration of the quality of care services.

There is also strong evidence of wage spillovers resulting from the new structure of minimum wages brought about by NLW introduction as younger workers' wages rose in tandem with the higher adult minimum wage, but with there being no spillover impact on their employment. We discuss potential explanations for this pattern of spillovers, including preferences for pay fairness and administrative simplicity. The evidence suggests that employers' - rather than workers' – preferences for fairness play an important role in within-firm wage setting policies in the sector that is studied.

The content of this paper relates to all of the three main streams along which the minimum wage literature has evolved through time. Firstly, the primary focus of this literature has been on the employment and unemployment effects of minimum wages.[1] Secondly and partly in response

[1] Following an early and mostly US-based time-series work that found negative employment effects among teenagers (Brown, Gilroy and Kohen, 1982), starting from the early 1990s quasi-experimental micro-based studies found no evidence of disemployment effects in the US and the UK (Card and Krueger, 1994; Machin, Manning and Rahman, 2003; Stewart, 2004). A recent revival of minimum wage research in the US has adopted spatial identification strategies, also mostly finding it hard to detect evidence of job cuts due to minimum wages (Dube, Lester and Reich, 2010 and 2016; Baskaya and Rubinstein, 2015; Clemens and Wither, 2014). In a rather different context of union

to the fact that, in a number of settings, employment effects have proven elusive to track down, a smaller but growing body of research has examined other margins of adjustment by firms, such as prices, profits and firm value.[2] Thirdly, another strand of the minimum wage literature has studied the impact on wage inequality at the bottom of the distribution and at spillover effects up the wage distribution.[3] Thanks to combination of rich data sources and a novel research setting, we contribute to this literature by providing a comprehensive assessment of the impact of the NLW introduction on employment and other margins of firm adjustment, as well as novel evidence on downward wage spillovers.

The rest of the paper is structured as follows. Section 2 first sets the UK NLW introduction into context with some of the recent sizable minimum wages that have been implemented elsewhere, and then describes the care homes sector studied in the empirical work that follows. Section 3 describes the data, together with some descriptive statistics and a discussion of representativeness. Section 4 presents the main results of the impact of the changed minimum wage structure on wages, employment and total hours. Section 5 illustrates the analysis of wage and employment spillovers, and Section 6 discusses possible explanations for the observed pattern of results. Additional margins of adjustments are considered in Section 7. Section 8 concludes.

bargained minima, Kreiner et al. (2017) study the effect of a change in the youth minimum wage in Denmark and find an employment elasticity to the wage rate of -0.8.

[2] On prices, see Aaronson, (2001), MaCurdy (2015) or Harasztosi and Lindner (2017); on profits, see (Draca, Machin and Van Reenen (2011); and on stock market values, see Bell and Machin (2018). Multiple adjustment channels are studied in Harasztosi and Lindner (20l7) and Hirsch et al. (2015). Sorkin (2015) emphasises the distinction between modes of adjustment in the short and long run.

[3] See DiNardo, Fortin and Lemieux (1996), Lee (1999) and Autor, Manning and Smith (2016).

2. Minimum Wages and the Care Home Sector

2.1 Recent Large Minimum Wage Hikes

In different settings around the world, national minimum wages have seen a burst of renewed interest in recent years as political parties have recognised the popularity of mandated wage floors with the general public.[4] This has probably become more marked in places where real wages have not been rising and where living standards have stagnated, as raising the minimum wage is a genuine policy lever that governments can use to generate wage increases at the bottom end of the wage distribution.

In this paper we consider the economic effects of one such change. The context is the introduction of the National Living Wage in the United Kingdom (which is to be discussed in more detail below). Yet, the UK is not the only country in which minimum wages have recently been high on the policy agenda. Indeed, for example, Germany has introduced a national minimum wage at a high level, and some big increases have been observed in parts of the United States.

In January 2015, Germany introduced a national minimum wage of €8.50 an hour (approximately £6.40 at that time). Before then, wage rates were based on industry-level collective agreements negotiated by trade unions and business representatives, which however led to an uneven application of wage minima across sectors with more and less established trade unions. As of January 2017, the statutory minimum has reached €8.84 (£7.60).

In the Unites States, the Obama administration pushed for a substantial increase in the federal minimum rate from $7.25 an hour to $10.10 an hour, motivated by the desire to boost wage growth at the bottom of the wage distribution and by many US studies of minimum wages (cited

[4] A 2014 Gallup poll reported that 66 percent of respondents in the UK and 76 percent in the US were in favour of minimum wage increases. According to another recent Gallup poll, in 2016, 56 percent of Americans supported raising the national minimum wage from $7.25 to $15.00 per hour by 2020, 36 percent opposed the idea and 7 percent had no opinion on the matter.

above) in which detrimental employment effects have proven elusive. The US federal minimum wage has remained at $7.25 per hour since July 2009, but in 2015 cities such as Seattle and Los Angeles legislated measures to progressively increase the minimum wage to $15.00 per hour in 2017 and 2020 respectively.[5]

2.2 Minimum Wage Setting in the UK and the National Living Wage

The UK introduced a National Minimum Wage (NMW) in April 1999. Prior to that, there used to be industry-level wage floors – the Wage Councils – that were in force between 1909 and 1993, but that covered only approximately 12 percent of the workforce at the time of their repeal. In the 1997 elections, the Labour Government committed to introducing a national minimum wage and established the Low Pay Commission (LPC), an independent advisory body set up by the National Minimum Wage Act in 1998. The LPC is composed of nine members, of which three representatives of business organisations, three of employees and three of social partners (these include the Chair and two academics). The LPC's remit is set by the Government and requires that the LPC provide evidence-based advice to the Government on minimum wage rates and uprates.[6] The body submits its recommendations to the Government, which can accept or reject them. If accepted, the recommended uprating subsequently becomes effective.

In April 1999, a minimum hourly wage of £3.60 for workers aged 22 and over, and a lower rate of £3.00 for workers aged between 18 and 21 were established. Additional rates have been introduced for workers aged 16-17 in 2004 and for apprentices in 2010. Additionally, in 2010 the adult wage group was expanded to workers aged 21. As of October 2015, the NMW rates were as follows: an adult minimum rate of £6.70 for workers aged 21 and over, a youth development rate

[5] For recent research studying the big Seattle increase see Jardim et al. (2017) and on California see Reich et al. (2017).
[6] The LPC assesses research and considers evidence from a wide set of sources, including academic research, site visits around the country, and oral evidence taken from a broad range of stakeholders.

of £5.30 for those aged 18-20, a youth minimum of £3.87 for 16-17 year olds and an apprentice rate of £3.30.[7]

After winning the May 2015 election, the new Conservative Party government called an emergency budget on July 8th 2015, in which the Chancellor George Osborne unexpectedly announced the introduction of the National Living Wage (NLW). This changed the structure of minimum wages by introducing a new minimum wage rate of £7.20 an hour for workers aged 25 or above, while leaving the minimum wage rates for younger workers unchanged. Now there are five minimum wages, the NLW for workers aged 25 and over, the NMW for 21-24 year olds, the youth development rate for 18-20 year olds, the young worker rate for 16 and 17 year old and the apprentice minimum wage. Additionally, the NLW was set to achieve a 2020 target of £9.00.[8] The main justification for the NLW introduction was to offset the sizable cuts in tax credits that were simultaneously announced as part of the emergency budget but *de facto* did not take place. Table A1 in Appendix A2 shows the evolution of minimum wage rates since the NMW introduction in 1999.

The NLW introduction was an unexpected and radical political intervention for various reasons. Firstly, it arises from a party that traditionally opposed minimum wages, especially at the time of the NMW introduction in April 1999. Admittedly, the stagnant profile of real wages in the UK since the beginning of the crisis and the growing popularity of minimum wages amongst the general public made political parties of different views recognise that minimum wages can help raise wages and improve living standards, and generated a bipartisan call for a minimum wage

[7] The LPC's recommendations have been almost always accepted by the UK government. The apprentice rate has, however, twice been changed by the Government beyond the LPC recommendations: firstly in 2011, when the rate was increased by £0.05 even though the LPC recommended a freeze; secondly in 2015, when the business secretary uprated the apprentice minimum by an additional £0.50, substantially pushing it up from £2.73 in 2014 to £3.30 in 2015.

[8] The suggested target for 2020 is more precisely 60% of median earnings, which – at the time of the announcement – was forecasted to be £9.00 by the UK Office for Budget Responsibility.

increase. Secondly, the NLW introduction generated a wage change much larger than recent uprates, namely an increase of 10.8 percent at the time of announcement in July 2015 and of 7.5 percent when made effective on April 1st 2016. As a result of the change, the number of workers covered by minimum wages (formally those paid at or below the relevant minimum and up to £0.05 above) has grown from 1.6 million to 2.5 million in April 2016, and is expected to reach 3.8 million by 2020. Finally, the intervention significantly modifies the role of the LPC in providing future recommendations, given that it sets a target for 2020 and alters the structure of minimum wage rates by establishing an additional age band.

Most importantly for our analysis, the unexpected and sizable wage shock generated by the NLW introduction provides a unique "experiment" to study the wage and employment consequences of a change in the minimum wage structure.

2.3 The Care Home Sector

We look at the impact of the NLW introduction on workers and firms operating in the residential care home industry. As has been detailed in the earlier research on the sector in the period surrounding the NMW introduction (Machin, Manning and Rahman, 2003; Machin and Wilson, 2004), the choice of looking at care homes as a good testing ground for studying the economic effects of minimum wage floors is motivated by several reasons. Firstly, the sector is highly vulnerable to changes in minimum wages, since it employs a large number of low-paid workers. Of these, many are aged 25 and over, making the setting especially suited to analysing the NLW introduction. Secondly, the sector provides an example of what could be closely considered a competitive labour market. It consists of a large number of relatively small firms providing a rather homogeneous service. It is very labour intensive and not unionised. Consequently, a minimum wage change is likely to have a substantial impact on total costs,

potentially affecting the economic outcomes of workers and firms that are more affected. Thirdly, the sector is also interesting as residents fees are regulated and paid for by local authorities. The inability to pass on higher costs in the form of higher prices increases the likelihood of finding large employment effects from wage shocks.

Besides its pay and market structure, the residential care home sector is also interesting from a socio-demographic perspective. The aging of the population is generating a growing need of care services for the elderly. Yet, soaking staff costs coupled with tight local authority budgets appear to be putting the care home industry at strain and might have important consequences for access to social care.[9]

3. Data and Descriptive Statistics

3.1 Data Sources

The main data source that is used in the analysis is the National Minimum Dataset for Social Care (NMDS-SC). This is an online system administered by Skills for Care and funded by the Department of Health that collects information on the adult social care workforce in England. Social care providers can use NMDS-SC to store and organise efficiently information about their workers, such as payroll data, training and development, job roles, qualifications and basic demographics. By having an account and updating it regularly, providers can easily view and analyse their data, apply for training and development funds, compare their staffing and compensation profile with that of other providers locally, regionally or nationally, access

[9] For the years 2016/17, the Government allowed local authorities who provide social care to adults to increase the council tax by up to 2 percent to fund adult social care only. Known as the "adult social care precept", this increase is in addition to the usual funding of adult social care through council tax. Of the 152 authorities with adult social care responsibilities (unitary authority districts, metropolitan boroughs, London boroughs and county councils), 144 used some or all of the precept. The almost unanimous adoption of the adult social care precepts leaves does not allow us to analyse whether the precept had any role in helping care providers cope with the NLW introduction.

publications about the social care sector, access e-learning resources for free and directly share their data and returns with governmental authorities such as the Care Quality Commission and the NHS. Access to NMDS-SC is free of charge. However, access to services such as the Workforce Development Fund is conditional on the account being updated yearly.

The dataset is a panel of matched employer-employee data. For each provider, we have information on the industry and main service provided, service capacity and uptake level, number of staff employed, geographic location and system update dates. For workers, we have information on demographics (gender, age, nationality), job role, contracted and additional weekly hours of work, hourly pay rate, date in which the hourly pay is uprated and qualification. We have access to the snapshot of the NMDS-SC online system at monthly frequency from September 2015 to March 2017, each snapshot including all providers in the system at that date and the latest date in which they updated their account.

A second source of information is the Care Quality Commission (CQC) registry. The registry contains a complete record of all active English care providers regulated by CQC at monthly frequency. It provides information on the activity status of businesses and so can be utilised to identify when homes shut down and when new homes enter the sector. Moreover, the registry includes firm-level ratings of the quality of care from the inspection reports conducted by the CQC. The ratings – which will be described in more detail in Section 7.3 – are an invaluable source of information to assess the effects of the minimum wage increase on the quality of services provided.

3.2 Sample Design

Around 22,000 providers are registered with NMDS-SC as of March 2016. Of these, approximately 10,000 are residential care homes with or without nursing. We match the sample of

residential care homes with the CQC registry of active locations from September 2015 to March 2017, from which we can obtain information on whether a firm is active or closed in a given month. Our sample comprises care homes that meet the following three requirements: (i) being open in March 2016, (ii) having a record on NMDS-SC for all the months in which the firm is open according to the CQC registry and (iii) having updated their NMDS-SC account at least once after March 2016. This selection leaves us with a balanced panel of 4,134 firms that are active in March 2016 and remain open until March 2017.

3.3 Descriptive Statistics

Table 1 reports descriptive statistics for the balanced sample of firms from one month before the NLW introduction that took place in April 2016 to three, six and twelve months after. The relatively low hourly pay and large fraction of workers aged 25 and over in the pre-NLW data confirm the high vulnerability of the care home sector to the NLW introduction, which therefore appears particularly pertinent to study the impact of the NLW as it potentially affected a large proportion of workers. A second feature of the data is that average wages rise in the months after the NLW introduction, by 2, 3 and 4 percent after one, two and four quarters respectively. This is true both in the full sample of workers and for those aged under 25 and 25 and over. The progressive rise in average wages over time is due to the fact that firms update their records on NMDS-SC over time – an aspect we will discuss more in depth in the next section.

The statistics reported in Table 1 also show that the care home sector is characterised by small-to-medium size establishments working close to full capacity (the occupancy rate measured as the ratio of residents to beds is above 90 percent). Mean and median employment are approximately 39 and 32 respectively. The workforce is predominantly female (84 percent), on average older than 40 and working approximately 30 hours per week. The main occupation in this

sector is care assistant, which accounts for 56 percent of the workforce. Only 4 percent of the workers hold a nursing qualification. All these characteristics remain fairly constant before and after April 2017, suggesting that the NLW did not induce a compositional change in the productive structure of care homes.

3.4 Representativeness

It is important to assess the representativeness of our sample as compared to the full population of care homes and their workforce. Estimates from Skills for Care indicate that the NMDS-SC data cover more than 50 percent of the workforce in CQC regulated homes, suggesting that the system might provide a good representation of the sector in England. We also compare the characteristics of our sample with statistics on firms and workers in the care home sector that we derive from the ONS Business Registry and the Labour Force Survey. According to the 2016 ONS Business Registry, firms in the residential care industry for the elderly and disabled have an average firm size that matches the one in our sample (approximately 37 on ONS). Similarly, looking at baseline characteristics for carers in the LFS for the first quarter of 2016, we find that they line up quite satisfactorily with those in our sample of workers, as in the LFS the proportion of female carers is 0.85, average age 42, average hourly wage £7.77 and average weekly hours worked 34. Overall, these statistics are reassuring of our ability to draw any general conclusions from the analysis of the data we undertake.

4. Wages and Employment Impacts of National Living Wage Introduction

4.1 Wages Impact

As previously noted, the residential care home sector appears to be potentially vulnerable to the NLW introduction given its wage structure and workforce's age composition. In this section we confirm that the NLW had real "bite" in the care home sector and generated the expected effects

on hourly wages and their distribution. This is clearly a necessary condition before analysing the employment and other economic consequences of minimum wages.

Table 2 reports results on the first part of the investigation of the impact of the NLW introduction on wages. It shows several measures of the bite of the NLW. Specifically, these are the proportion of workers paid less than the NLW (or less than the age-specific NMW if younger than 25), the percentage paid exactly at the minimum and the wage gap. The latter is a measure of how much wages would have to increase in a given firm in order to meet the new legal requirements and is computed as follows:

$$GAP_j = \frac{\sum_j h_{ij} \max\{W_{ij}^{min} - W_{ij}, 0\}}{\sum_j h_{ij} W_{ij}} \quad (1)$$

where h_{ij} is weekly hours worked by worker i in firm j, W_{ij} is the hourly wage of worker i in firm j and W_{ij}^{min} is the new age-specific minimum wage (i.e. £3.87 for workers aged 16-17, £5.30 for workers aged 18-20, £6.70 for workers aged 21-24 and £7.20 for older workers). As before, pre- and post-NLW statistics are reported for care homes in the balanced panel.

The residential care sector has clear potential to be heavily affected by the NLW. Around 55 percent of workers aged 25 and over, who would be legally affected by the NLW, were paid below the NLW before it was introduced and only 3 percent were paid exactly at £7.20. Given the small proportion of young workers, similar figures are found for the whole sample of workers (51 and 3 percent respectively). The NLW wage gap averaged 4 percent before the NLW introduction, confirming the high vulnerability of the sector to the minimum wage increase.

Results in Table 2 also demonstrate that the NLW strongly affected care home wages. The post-NLW data show a larger drop in underpayment over time (of 16, 18 and 29 percentage points after three, six and twelve months respectively), a halving of the wage gap and a noticeable spike of up to 20 percent at the new minimum. A substantial distributional impact of the NLW on wages

can also be seen by looking at Figure 1, which plots the hourly wage distribution for care assistants one month before and three, six and twelve months after the NLW introduction. The charts provide compelling evidence of the sizable compression effect the NLW had at the bottom of the hourly wage distribution and the emergence of a sharp spike at the new minimum after its introduction. Among care assistants, the spike reached 20 percent in June 2016, 26 percent in September 2016 and 30 percent by March 2017.

One issue is that not all care homes update their records at the same time, nor with the same frequency. In order to avoid sample selection driven by unobservable worker and firm characteristics that may be correlated with the timing and frequency of updating, we do not condition our sample on a specific update date and only require that a firm update its records once in the twelve months after April 1st 2016.[10] As a result, some of the post-NLW data are not updated. For this reason, the spike at £7.20 as well as the statistics presented in Table 2 change progressively over time. Nonetheless, the spike in June 2016 is already remarkably sizable.

To confirm the role of updates in shaping the progressive change of the wage distribution, Figure 2 replicates Figure 1 for a subsample of workers whose wages were updated within given time windows. Specifically, the top left panel includes workers with wage updates between October 2015 and March 2016, the top right panel between April and June 2016, the bottom left panel between April and September 2016, and the bottom right panel between April 2016 and March 2017. The histograms show a spectacular spike at £6.70 in the pre-NLW period, and an even larger, sharper spike of around 40 percent at the new minimum in the post-NLW period.

[10] Approximately 90 percent of NMDS-SC users update within a year.

Having established a strong impact of the minimum wage on wages in the care home industry, we now show that homes with the highest potential to be affected were indeed the most affected. To this end, we estimate hourly wage change equations of the following form:

$$\Delta lnW_{j,t} = \alpha_1 + \beta_1 MIN_{j,t-1} + X'_{j,t-1}\gamma_1 + \varepsilon_{j,t} \quad (2)$$

where $\Delta lnW_{j,t}$ is the change in the natural logarithm of the average wage in firm j between March 2016 and three, six or twelve months after; $MIN_{j,t-1}$ is a measure of the NLW bite at the care home level, that is either the initial proportion of workers paid below the NLW or the NLW wage gap; X is a vector of pre-NLW firm-level characteristics including the proportion of female workers, average age, the proportion working as care assistants, the proportion with nursing qualification, the occupancy rate and a set of indicators for the nine English regions.

The parameter of interest is β_1, which measures the relationship between wage growth and the minimum wage. The parameter is identified from between-home variation in pre-NLW wage levels and it therefore identifies the causal effect of the minimum wage on wage growth only if – absent the minimum wage change – there was no relationship between the initial level of wages and wage growth. We provide supporting evidence for this identifying assumption by looking at the relationship between wage growth and initial wages around a time in which no minimum wage change took place. To this end, we select a balanced sample of firms active between March 2015 and March 2016 from NMDS-SC adopting the exact same criteria we use for our main sample. We consider whether there is any relationship between wage growth and the logarithm of initial wages between March 2015 and three and six months after, a period over which the NMW remained unaltered.[11] Results are reported in panel A of Table A1 in Appendix A2. The

[11] As of March 2015, the NMW rates were as follows: an adult minimum rate for workers aged 21 and over of £6.50, a youth development rate of £5.13 for those aged 18-20, a youth minimum of £3.79 for 16-17 year olds and an

coefficients in columns (1) and (4) indicate a significant and negative relationship between wage growth and initial wage levels in 2015. However, as compared to the period surrounding the NLW introduction (reported in columns (2) and (5)), the magnitude of these effects is much smaller in absolute value. As a result, the difference between the two coefficients remains strongly negative and significant (see columns (3) and (6)), indicating that there was a clear shift in the relationship between wage growth and initial wages between the two periods.

Table 3 reports the estimated wage equations for the balanced panel of firms. Panel A refers to $\Delta lnW_{j,t}$ between March 2016 and June 2016, panel B between March 2016 and September 2016, and panel C between March 2016 and March 2017. For each of the three panels, the specifications in columns (1) and (2) report the estimated coefficient β_1 for a model in which $MIN_{j,t-1}$ is the pre-NLW proportion of workers paid below the NLW (or their age-specific NMW if less than 25 years old), while columns (3) and (4) for a model using the wage gap as main regressor. The regression models in columns (2) and (4) include the above-listed firm-level controls.

In all cases there is significant evidence of larger increases in wages in homes with more low-wage workers in the pre-NLW period, as measured by the low-wage proportion or the wage gap. According to the regression estimates in panel C, a one standard deviation increase in the proportion of low-paid workers (corresponding to a 33 percentage point change) implies a 1.6 percentage-point faster wage growth on a baseline of 4 percent. A similar effect of 1.6 percentage point faster wage growth is found as a result of a one standard deviation increase in the wage gap (corresponding to a 4 percentage point change). Both effects are sizable and establish a strong and

apprentice rate of £2.73. Since the NMW was then uprated in October 2015, in Table A1 we only consider changes between March and June, and March and September 2015.

significant relationship between minimum wages and wage growth. We find comparable results when looking at weekly earnings growth as shown in Table A2 in Appendix A2.[12]

4.2 Employment Impact

Having established that the NLW had important wage and wage structure effects, we next consider a "second stage" of whether or not the wage cost shock induced by the NLW had consequences on employment and total hours. We start by estimating reduced-form employment and total hours change equations similar to the wage equations illustrated in the previous subsection. Specifically, we regress the change in the logarithm of the number of employees and of total weekly hours ($\Delta lnY_{j,t}$) on measures of the NLW bite, as follows:

$$\Delta lnY_{j,t} = \alpha_2 + \beta_2 MIN_{j,t-1} + X'_{j,t-1}\gamma_2 + \nu_{j,t} \quad (3)$$

where MIN and X are defined as before.

Similarly to the wage equation, the identifying assumption for β_2 is that – absent the minimum wage increase – there would be no relationship between initial wages and employment (or total hours) growth. We investigate whether the relationship between employment growth and initial wages changed in the period surrounding the NLW introduction as compared to a year before – a period with no minimum wage changes. Panels B and C of Table A1 in Appendix A2 report the results of this exercise for employment and total hours growth respectively.

The first thing to notice is that the correlations between employment (total hours) growth and initial wages are much weaker than those found for wage growth. Interestingly, the estimated coefficients for the "no policy" period are all very small in size and statistically insignificant, which we take as evidence that the model's identifying assumption seems to be supported by the data.

[12] The coefficients reported in Columns (1) to (4) in the three panels of Table A2 in Appendix A2 closely match those obtained for hourly wages, suggesting that the wage elasticity of weekly earnings is approximately one. This is indeed what we find in columns (5) and (6) where we estimate the structural form as described in section 4.2.

When looking at the period surrounding the NLW introduction, we find only a slightly stronger degree of correlation between employment (total hours) growth and initial wages, suggesting that employment and total hours tended to grow less fast in homes more vulnerable to minimum wage increases. However, according to columns (3) and (6), these correlations are in all cases not significantly different from the correlations around the period with no policy change, suggesting that there has been only a mild shift in the relationship across the two periods.

Columns (1) to (4) of Tables 4 and 5 report the regression estimates of the key parameter of interest β_2 for employment and total hours respectively. The estimates reported in column (2) of Tables 4 and 5 indicate that a one standard deviation increase in the proportion of low-paid workers reduces employment growth by 0.6 percentage points from a baseline of 1.4 percent, and reduces total hours growth by 0.3 percentage points from a baseline of 2.1 percent. As for the wage gap, columns (4) of Tables 4 and 5 show that a one standard deviation increase in the wage gap reduces employment and total hours growth by 0.4 and 0.7 percentage points respectively. However, none of the estimates is significantly different from zero despite being rather precisely estimated.[13]

We further investigate the employment and hours consequences of the NLW introduction by estimating a structural model of labour demand of the following form:

$$\Delta lnY_{j,t} = \alpha_3 + \beta_3 \Delta lnW_{j,t} + X'_{j,t-1}\gamma_3 + \eta_{j,t} \quad (4)$$

where all variables are as previously defined. The parameter β_3 measures the wage elasticity of labour demand and is estimated by instrumenting the change in the logarithm of the average wage $\Delta lnW_{j,t}$ using $MIN_{j,t-1}$ as instrumental variable. The wage equations illustrated in the previous

[13] Results reported in Tables 4 and 5 refer to the period between March 2016 and March 2017. Tables A3 and A4 in Appendix A2 report the coefficient estimates for the periods between March and June 2016, and March and September 2016.

section can be therefore considered as the first stage of this instrumental variable model and show that the instrument is relevant. To be valid, an instrument should also satisfy the exclusion restriction and be as good as randomly assigned, i.e. our measures of the NLW bite should only affect the outcome through their impact on wage growth and be uncorrelated with any other proximate determinant of employment or total hours growth. Although neither of these two assumptions can be formally tested, the evidence in Table A1 (panels B and C) seems to support the assumption of random assignment.

Estimates of the structural elasticities are reported in columns (5) and (6) of Tables 4 and 5, using the initial proportion of low paid and the wage gap as instruments for the wage change respectively.[14] The estimated wage elasticity of employment ranges between -0.23 and -0.41 (Table 4), while that of hours is between -0.21 and -0.44 (Table 5). Evaluated at an average wage growth of approximately 4 percent, these elasticities indicate that headcount employment would drop by 0.9-1.6 percent and total hours by 0.8-1.8 percent. The estimated employment and total hour elasticities are modest, bit relatively large compared to many of the estimates in the recent minimum wage literature. However, none of the structural elasticities nor the reduced-form estimates is significantly different from zero, leading to the conclusion that there is no clear evidence of detrimental employment, nor hours effects, of the NLW introduction.[15, 16]

[14] In Tables 4 and 5, both the dependent variable and the main regressor are computed as the change between March 2016 and March 2017. Tables A3 and A4 in Appendix A2 report estimates for the period between March and June 2016 in panel A, and between March 2016 and September 2016 in panel B.

[15] In order to check that our results are not driven by the lack of updating by firms, we estimate the wage, employment and total hour equations on the subsample of firms that updated the wages of at least 50 percent of their workers in the period between October 2015 and March 2016, and in the period after March 2016. All results hold in this subsample and are available upon request.

[16] The absence of employment effects could in fact mask changes in the composition of the workforce, for a given level of employment. We find no evidence of differential levels of inflows, outflows and total flows as a consequence of the NLW introduction, which leads us to exclude the presence of such compositional changes.

5. Wage and Employment Spillovers

5.1 Wage Spillovers Down the Wage Distribution

The NLW increased the minimum wage for workers aged 25 and over to £7.20 per hour, but left the minimum wage rate for workers aged 21-24 at the October 2015 level of £6.70 per hour. It is an interesting question, then, whether care homes left wages for workers under 25 unchanged at the old NMW, or whether they decided to also raise them, perhaps for reasons of administrative simplicity or inequality aversion within the firm.

In this subsection, we provide compelling graphical evidence that it is indeed the case that the NLW generated positive spillover effects on the wages of younger cohorts. Figure 3 shows the evolution of the hourly wage distribution for care assistants aged under 25 from one month before to twelve months after the NLW introduction. Figure 4 reproduces the same graphs on the subsample of workers whose hourly wages were updated between October 2015 and March 2016 (top left panel), between April 2016 and June 2016 (top right panel), between April 2016 and September 2016 (bottom left panel), and between April 2016 and March 2017 (bottom right panel). Strikingly, we observe a spectacular spike located at the new adult minimum after April 2016, and a strong wage compression in the bottom half of the distribution. Both the location and size of the spike, and the amount of bottom wage compression are analogous to what we found for the entire sample of care assistants over all age groups. According to Figure 4, while 34 percent of care assistants aged under 25 were paid at the NMW in March 2016; up to 35 percent of younger workers are at the new NLW after its introduction.

We complement the graphical analysis illustrated above by performing some regression analysis of spillover effects on wages. Firstly, we run a simple reduced-form model of the growth

rate of hourly wages for workers under 25 as a function of measures of the NLW bite for older workers. The reduced-form model reads as follows:

$$\Delta lnW_{j,t}^{Y} = \alpha_5 + \beta_5 MIN_{j,t-1}^{O} + X'_{j,t-1}\gamma_5 + \theta_{j,t} \quad (5)$$

where $\Delta lnW_{j,t}^{Y}$ is the change in the natural logarithm of the average wage of workers under 25 in firm *j* between March 2016 and three, six or twelve months after; $MIN_{j,t-1}^{O}$ indicates alternatively the initial proportion of workers aged 25 and over that are paid below the NLW, or the NLW wage gap for older workers; X is the vector of pre-NLW firm-level characteristics that we described in our previous analyses. The reduced-form estimates are reported in columns (1) to (4) of Table 6.

We also perform a structural estimation of the cross wage elasticity between wages of younger workers and adult workers. In the structural estimation, we regress the change in log average wages for younger workers $\Delta lnW_{j,t}^{Y}$ on the change in log average wages for older workers $\Delta lnW_{j,t}^{O}$, and we instrument the latter using $MIN_{j,t-1}^{O}$ as instrumental variable. The structural model reads as follows:

$$\Delta lnW_{j,t}^{Y} = \alpha_6 + \beta_6 \Delta lnW_{j,t}^{O} + X'_{j,t-1}\gamma_6 + \iota_{j,t} \quad (6)$$

Estimates of the structural cross elasticity parameter β_6 are reported in columns (5) and (6) of Table 6, where we respectively use the proportion of low paid workers among those aged 25 and over, and the wage gap for older workers as instruments. The first stage regression coefficients are reported in Table A5 in Appendix A2.

All the estimates in Table 6 indicate significantly positive spillovers on the hourly wages of younger workers and cross elasticities of approximately 0.7. According to columns (2) and (4) of panel C, a one standard deviation increase in the proportion of older workers paid below the NLW or in the adult wage gap (corresponding respectively to 34 and 4 percentage points in the estimation sample) are associated with a 1.3 and 1.2 percentage point faster wage growth for

younger workers, on a baseline youth wage growth of 4.1 percent. Cross-elasticity estimates indicate that a one percent increase in average adult wages induces a 0.7 percent increase in average youth wages.[17,18]

5.2 Employment and Total Hours Spillovers

Having documented significant and positive spillovers on wages that resulted from the changed minimum wage structure, we also test for the presence of spillover effects on employment and total hours for workers under 25. Indeed, firms might be induced to raise wages of younger workers for reasons of fairness or simplicity, but at the same time may reduce youth employment along the intensive or extensive margin if youth productivity is lower than the uprated wage. We adopt a methodology similar to the one used to investigate wage spillovers, regressing the change in the share of total employment aged under 25 and the change in the share of total hours worked by workers under 25 on (i) measures of the NLW bite amongst workers aged 25 and over ($MIN^{O}_{j,t-1}$) and (ii) $\Delta lnW^{O}_{j,t}$ instrumented using $MIN^{O}_{j,t-1}$. Reduced-form estimates of employment and total hours spillovers are reported in columns (1) to (4) of Tables 7 and 8, while structural cross wage elasticities of demand are reported in columns (5) and (6).[19] Overall we find no statistically significant evidence of negative spillovers at the extensive and the intensive margins of employment, suggesting that the residential care home sector has so far coped with the NLW

[17] We also investigated whether the size of wage spillovers changes with the bite of the NLW on older workers. There was no evidence of statistically significant differential effects between firms with a proportion of low-paid older workers above and below the mean in the sample (and similarly for firms with an NLW gap for older workers above and below the mean in the sample).

[18] We also consider spillover effects on weekly earnings. As reported in Table A6 in Appendix A2, the coefficients are not as precisely estimated as those of the wage spillover equations, except for those in panel C that are highly statistically significant. Nonetheless, in none of the estimates in columns (5) and (6) we can reject a coefficient magnitude comparable to the corresponding effect in Table 6.

[19] Tables 7 and 8 report estimates for the period between March 2016 and March 2017. Estimates for the periods between March and June 2016, and March and September 2016 can be found in Tables A7 and A8 in Appendix A2.

introduction since it managed to raise wages of legally unaffected workers without reducing employment.[20]

6. Reasons for Wage Spillovers

6.1 Wage Spillovers in the Domiciliary Care Sector

In this and the next subsection, we investigate potential explanations of why the wage spillovers that we uncovered in the previous analysis may have come about. A first obvious candidate for explaining why we observe positive spillovers on younger workers is that either workers or firms are concerned with the fairness of the within-home wage structure and prefer that workers doing the same job receive the same wage, even though some of them may be more productive. There is considerable evidence for such preferences for fairness in the minimum wage literature. Survey data on fast food restaurants in Texas and administrative data on the retail sector in Finland indicate that employers have been reluctant to apply youth sub-minima (Katz and Krueger, 1991; 1992; Böckerman and Uusitalo, 2009), and laboratory experiments have shown that minimum wage increases generate entitlement effects and change workers' perceptions of what a fair wage is (Falk et al., 2006).

It seems plausible that if workers' preferences for "equal pay for equal job" were entirely responsible for the emergence of wage spillover effects, the latter should be stronger for employees working in team or with direct sight of their colleagues while working. In order to test whether spillover effects are driven by workers' as opposed to employers' equity concerns, we replicate

[20] The lack of spillovers on employment could in fact mask a change in the composition of the younger workforce, for a given proportion of employees aged under 25. An analysis of inflows, outflows and total flows of younger workers indicated that – if anything – firms that had the larger wage spillovers experienced lower levels of churning amongst the younger segments of their workforce, thus excluding significant compositional changes in response to the wage cost shock.

our analysis of spillover effects in the domiciliary care sector for which we have data on NMDS-SC.

Domiciliary care is a social care service provided to people who live in their own houses and require assistance with personal care routines, household tasks such as cleaning and cooking, or any other activities they may need to live independently. Domiciliary care assistants typically work individually, drive their own car to visit customers' homes, and are often contracted on flexible working hours or zero-hour contracts since domiciliary care work tends to be organised into short and fragmented home visits. Given the nature and organisation of work, workers employed by domiciliary care agencies tend to have limited face-to-face interactions with co-workers on the job and are unlikely to be fully aware of their working conditions. If downward wage spillovers were entirely due to workers' fairness preferences, we would expect them to be milder in the domiciliary care sector than the care homes one, *ceteris paribus*.

The summary statistics reported in Table 9 illustrate the main differences between firms and workers in the care home and domiciliary care sectors.[21] While the gender and age composition is essentially identical across the two sectors, and wage differentials are relatively limited, working arrangements diverge strikingly. The incidence of zero-hour contracts is nine times as large in the domiciliary care sector when considering workers of all ages and five times as large for workers aged under 25. Similarly the proportion of workers on alternative work arrangements, i.e. employed with temporary, bank or agency contracts, is almost twice as large in the domiciliary care sector (14 against 8 percent). These substantial differences corroborate the notion that domiciliary care work schedules are inherently fragmented as the nature of the job would suggest.

[21] The sample of care homes is the one used in the previous analysis, while the sample of domiciliary care agencies is selected following the same criteria used to select the sample of care homes and illustrated in section 3.2.

We replicate the analysis of wage spillover effects on the sample of domiciliary carers. Figure 5 shows the evolution of the hourly wage distribution for domiciliary carers aged under 25 from one month before to twelve months after the NLW introduction. It is based on the subsamples of workers whose hourly wages were updated between October 2015 and March 2016 (top left panel), between April 2016 and June 2016 (top right panel), between April 2016 and September 2016 (bottom left panel), and between April 2016 and March 2017 (bottom right panel).[22] The similarity with the patters observed for care assistants in the care home sector is striking. A large spike at the new minimum and a strong wage compression in the bottom half of the wage distribution clearly emerge after April 2016. The size of the spike is in line with the one found for care assistants aged under 25, with approximately 31 percent of young domiciliary carers being paid exactly £7.20. We also estimate the empirical models (5) and (6) on the domiciliary care sample. Results are reported in Table 10. None of the structural cross elasticities reported in columns (5) and (6) of panels A, B and C is statistically different from one, indicating that wages for younger workers increased one for one with wages of adult workers.[23,24]

Therefore, in spite of the remarkably different working arrangements documented above, domiciliary care workers experience wage spillovers very similar in magnitude to those we identified in the care home industry. We interpret this evidence as supportive of the fact that team

[22] Figure A2 in Appendix A2 reproduces the same graph on the full sample of domiciliary carers aged under 25.
[23] Table A9 in Appendix A2 reports the coefficient estimates of the wage equations in the sample of domiciliary care agencies. Results in columns (1) and (2) of panels A, B and C are very much in line with those reported in Table 3 for the sample of care homes. Results in columns (3) and (4) are instead smaller in magnitude and less precisely estimated. Given the high incidence of zero-hour contracts in the domiciliary care sector, the NLW gap appears less appropriate as a measure of the NLW bite in this context as opposed to the care home one (Datta et al., forthcoming).
[24] The first-stage coefficients for the wage spillover equations in the domiciliary care sector are reported in Table A10 in Appendix A2.

dynamics and worker-specific preferences for fairness are not key drivers of downward minimum wage spillovers.[25]

6.2 Evidence on the "fairness" hypothesis

The evidence presented in the previous subsection seems to exclude a strong role for workers' preferences alone in within-firm wage setting. Two additional theories could explain the emergence of downward wage spillovers. The first is fairness concerns and inequality aversion by employers. The second is administrative simplicity, whereby employers try to minimise the costs of managing a diverse wage structure and of individual-level bargaining. While we cannot formally test which of these two alternative theories has the largest bearing, in this section we discuss evidence we gathered from a survey of care homes that seems to support the "fairness hypothesis".

For an earlier project funded by the Low Pay Commission, we ran a survey of English care homes. We obtained information on all care homes in England from the CQC directory and sent questionnaires to all homes in January and February 2016 for the pre-NLW part of the survey, and in late June, August and November 2016 for the post-NLW part of the survey. We obtained a total of 1390 responses in the pre-NLW survey and of 827 responses in the post-NLW survey that were provided by the owner manager of the care homes.[26] In both the pre- and post-NLW surveys, we asked respondents about their views on the level of the NLW. Before the NLW introduction, 42.7 percent of respondents believed that the level of the NLW was about right, while 15.0 percent thought it too low and 37.6 percent too high. Interestingly, after the implementation of the new wage floor, respondents appear to be much more favourable to the minimum wage floor, with 52.5

[25] For the sake of completeness, we also investigate employment and total hours spillovers in the domiciliary care sector in Tables A11 and A12 in Appendix A2. None of the estimated coefficients is statistically significantly different from zero.

[26] More information on the survey of care homes is available upon request.

percent considering it about right, 19.7 percent too low and only 23.7 percent too high.[27] In the post-NLW survey we asked respondents to leave a verbal comment about what they believed would be the impact of the NLW on their business. While it is not uncommon for respondents to state that it is fair for a worker to earn a "living wage", none of the replies refers to administrative simplicity and bargaining costs.

We perform a back-of-the-envelope calculation and estimate what the average counterfactual savings from paying all care assistants their age-specific minima would be. It turns out that, if all care assistants were paid their minimum wage, the total wage bill would decrease by 2.6-2.9 percent.[28] The same figure would drop to 1.2-1.3 percent if only care assistant under 25 were paid their age-specific minima. For a labour share of total costs of approximately 60 percent and assuming no scope for efficiency wages, we conclude that after the NLW introduction employers have been willing to take a profit hit of up to 1.7 percent – above and beyond the 2.4 percent needed to meet the NLW requirements – when raising wages above the legal minimum.[29]

7. Other Margins of Adjustment

Given the lack of evidence of employment effects in spite of significant wage increases for both legally affected and unaffected workers, this section explores whether the minimum wage increase had an impact on outcomes other than employment and total hours. It is possible that firms respond to the wage cost shock by adjusting other margins, such as prices, profits, productivity and the quality of care services. We consider these outcomes in the following subsections.

[27] See Table A13 in Appendix A2 for results on the balanced panel.
[28] The age specific minima are the NLW of £7.20 for those aged 25 and over, the NMW for those under 25, a youth development rate of £5.30 for those aged 18-20, a youth minimum of £3.87 for 16-17 year olds and an apprentice rate of £3.30.
[29] We obtain an estimate of the labour share of total costs from our post-NLW survey, where we ask the question "Approximately what percentage of your total costs are labour costs?".

7.1 Price setting and resident intake

In theory, the lack of evidence of employment responses could be explained by the ability to pass minimum wage increases onto consumers in the form of higher prices. In practice, though, this is unlikely to happen since residential care fees are, in the majority of cases, regulated by local authorities. Even though private for-profit companies dominate the care home industry, a large fraction of their residents are funded by local authorities.[30] According to LaingBuisson, 60 percent of residential care home places were funded by local authorities in 2014, making local authorities the largest purchaser of adult social care services. Limited by tight budgets, local authorities have kept fee levels low, leading to an average 5 percent reduction in real fee rates over the period 2010 to 2016 (LaingBuisson, 2015). Analyses based on our survey of care homes – where we collected data on minimum and maximum weekly prices – do not provide significant evidence of larger price increases in firms where the NLW introduction bit harder, as the presence of price regulations would suggest.[31]

Firms' limited ability to change prices may lead them to alter the care mix that they provide by decreasing the proportion of residents paid for by the local authority or by increasing the share of relatively more expensive services, for a given level of prices. While we do not have information on the mix of residents in the NMDS-SC data, we collected information on the proportion of residents funded by the local authority and the proportion requiring specialist care in our survey of care homes. Estimates based on the survey data do not point to significant changes in the

[30] According to a recent report by the House of Commons, in 2014 private sector residential care places reached 74 percent of all places, followed by voluntary sector (18 percent) and local authority places (8 percent). The role of the private sector was even more prominent in care homes with nursing, where it had 86 percent of all places, while the voluntary sector 8 percent and the public sector the remaining 6 percent. The data refer to the UK (House of Common, 2017). In our sample, 82 percent of homes are private sector for-profit companies, 14 percent are voluntary and 0.6 percent local authority (the remaining 3.4 percent being classified as "Other").
[31] Results available upon request.

proportion of local authority funded residents, but are suggestive, albeit at the margins of statistical significance, of an increase in the proportion of residents requiring specialist care.[32]

7.2 Productivity

A margin that firms may try to improve in response to the increase in costs is productivity. In order to explore this hypothesis, we construct a measure of productivity as the logarithm of residents per worker hour. We regress the change in productivity against measures of the NLW bite and the change in the logarithm of average wages appropriately instrumented. According to the estimates reported in Table 11, there is no evidence of larger productivity improvements by those firms that were more heavily affected by the NLW introduction.[33]

7.3 Quality of care services

Another possibility is that firms respond to the cost shock by reducing the quality of care services provided. We have information on the quality of care from the inspection reports conducted by the CQC. The CQC is the independent regulator of health and adult social care in England. It is responsible for setting standards of care and for monitoring, inspecting and rating adult social care providers, to make sure that they meet fundamental standards of quality and safety. At the heart of CQC's regulatory activity, the rating process is based on periodic inspections of care providers followed by the publication of reports showing the evaluation of the quality of care. The ratings are articulated into five key lines of enquiry and an overall judgement. The five lines of enquiry ask if the service is safe, effective, caring, responsive to people's needs and well-

[32] Results available upon request.
[33] Results in Table 11 refer to the period between March 2016 and March 2017. Analogous results for the periods between March and June, and March and September 2016 are reported in Table A14 in Appendix A2.

led, while the overall judgement is an aggregation of these five dimensions.[34] The rating can be "outstanding", "good", "requires improvement" or "inadequate".[35]

We have access to the most recent firm-level CQC ratings as of March 2016 and March 2017, and can link them to observations in the NMDS-SC database. Of the 2480 homes that we could match, 931 had been inspected and rated before and after the NLW introduction. Figure A3 in Appendix A2 displays the distribution of ratings by key line of enquiry as of March 2016 for the full sample (Panel A) and for the subsample of firms with rating both before and after March 2016 (Panel B). In a similar fashion, Panels A and B of Figure A4 in Appendix A2 show the distribution of the change in ratings between March 2016 and March 2017 for the two samples. Ratings tend to be concentrated in the mid-range categories, with approximately 65 percent of homes providing a good overall service and 35 percent requiring improvement as of March 2016 (Panel A of Figure A3). The subgroup of firm that were inspected both before and after March 2016 tend to have poorer performances across all lines of enquiry (Panel B of Figure A3), suggesting that performance and the frequency of inspections might be negatively correlated. Ratings vary upward or downward between March 2016 and March 2017 for approximately 50 percent of the sample inspected in both periods (Panel B of Figure A4).

We investigate whether the NLW introduction caused a change in the quality of care services by running regression models similar to equations (3) and (4), where – for each line of

[34] The key lines of enquiry are specified as follows. *Safe*: residents are protected from abuse and avoidable harm. *Effective*: care, treatment and support achieves good outcomes, helps residents maintain quality of life and is based on the best available evidence. *Caring*: staff involve and treat residents with compassion, kindness, dignity and respect. *Responsive*: services are organised so that they meet the resident's needs. *Well-led*: the leadership, management and governance of the organisation make sure it is providing high-quality care that is based around the resident's individual needs, it encourages learning and innovation, and it promotes an open and fair culture. Further details can be found at http://www.cqc.org.uk/what-we-do/how-we-do-our-job/five-key-questions-we-ask.

[35] *Outstanding*: the service is performing exceptionally well. *Good*: the service is performing well and meeting CQC's expectations. *Requires improvement*: the service is not performing as well as it should and has been told that it must improve. *Inadequate*: the service is performing badly and CQC has taken action against the person or organisation that runs it. Further details can be found at www.cqc.org.uk/what-we-do/how-we-do-our-job/ratings.

enquiry – we regress the change in rating between March 2016 and March 2017 against measures of the NLW bite ($MIN_{j,t-1}$) and against the change in the logarithm of the average wage ($\Delta lnW_{j,t}$) instrumented with $MIN_{j,t-1}$. As pointed out before, care homes with lower initial ratings are more likely to be inspected in the post-NLW period, i.e. are more likely to experience a change in ratings. If initial ratings are correlated with the initial level of wages and, in turn, with the bite of the NLW, our estimates of the causal effect of the NLW on the quality of care would be biased. To account for the potential confounding effect of initial ratings, we include them among the controls.

Results are reported in Table 12, where Panel A refers to the overall rating and subsequent panels refer each to one of the five key lines of enquiry. Both reduced-form and structural-form coefficients are negatively and statistically significantly different from zero across all specifications and quality dimensions, indicating that the quality of care is a margin of response to increased wage costs. According to the structural estimates in columns (5) and (6) of Panel A, a 4 percent increase in average hourly wages leads to a drop of approximately 0.1 in the overall rating on a baseline change of 0.11.

7.4 Firm closure

The analysis of employment and total hour effects is based on the balanced sample of firms that remain active throughout the period of our analysis. We are also interested in assessing whether the wage shock induced by the NLW introduction impacted the probability of survival of firms in the residential care home sector. To this end, we consider the panel of firms that were active in March 2016 (but may close in subsequent months) and that we could match with the CQC registry to obtain information on the activity status of each care home at monthly frequency. The resulting panel is composed of 4,306 care homes, of which 0.1 percent closed by June 2016, 0.6 percent by September 2016 and 1.9 percent by March 2017.

In order to empirically assess whether the NLW had a role in the pattern of closures, we run reduced form linear probability models of the probability of being closed three, six or twelve months after the NLW introduction on our measures of the wage bite $MIN_{j,t-1}$. Regression estimates are reported in Table 13, for closures as of March 2017, and in Table A15 in Appendix A2 for closures as of June 2016 and September 2016. All coefficient estimates are statistically insignificant and their magnitudes modest, suggesting that care homes where the minimum wage change hit the most were not more likely to go out of business.

Not having access to information on profits or balance sheet data, we are unable to assess whether the wage shock induced by the NLW introduction caused a significant reduction of firm profits. Even though we cannot exclude the existence of a profit hit, the above results make it clear that any profit hit that could have occurred has so far not been large enough to drive firms out of business.

7.5 Aggregate employment and firm dynamics

Finally, we consider whether the NLW introduction impacted aggregate employment and firm dynamics (entry and exit). To this end, instead of restricting the sample to firms that were active throughout the period of analysis, we consider all firms ever active in the months surrounding the NLW introduction. Our findings suggest that aggregate employment did not suffer as a consequence of the NLW introduction, since jobs that were paid below the NLW before April 2016 are fully replaced by jobs paid at or above the NLW after its introduction. Likewise, firm dynamics – entries and exits – were not significantly affected by the NLW in the twelve months after it came into force. The analysis of aggregate employment effects and firm dynamics is discussed in detail in Appendix A1.

8. Conclusion

This paper contributes to the recent revival of research and policy interest in minimum wages by studying the impact of a significant change in the structure of minimum wages that occurred in the UK in 2016. Leveraging unique exogenous variation brought about by the NLW introduction and novel matched employer-employee data with good-quality information on individual wages, we provide a comprehensive analysis of the effects of minimum wages on employment, the wage distribution and firm adjustment levers, thus contributing to the three key research areas in the minimum wage literature in a unified framework.

The altered structure was brought about by the government introducing a new minimum wage – the National Living Wage – for older workers. This resulted in there being a fifth minimum wage rate in operation, as compared to the four that operated prior to the change, with quite sizable differences in the minima paid to different age workers who previously were paid the same.

This change in the minimum wage structure is utilised to study the wage and employment effects of minimum wages in the care homes sector of the UK economy, a sector whose organisational structure makes it potentially particularly vulnerable to changes in wage costs induced by minimum wages. The changed minimum wage structure is also used as a means to identifying wage and employment spillovers because of the age related change in the operation of minimum wages. Margins of adjustment other than employment are also explored.

The analysis finds that, on the labour demand side of things, care homes mostly seemed to manage to cope with the additional wage costs that resulted from the NLW as there is at best modest evidence of employment changes in response to the sizable wage cost shock that ensued, and no evidence of home exit resulting from this. Conversely, and rather worryingly from the perspective of care home residents, the quality of care services appears to have significantly

suffered as a consequence of the wage shock. This reduction in care quality seems to be the main margin of adjustment we are able to identify amongst a range of possible firm responses.

The structure of wages by age also substantively changed, as there are significant wage spillovers for younger workers from the NLW introduction. Thus the main wage impact of the changed minimum wage structure was on both the wages of directly affected older workers and indirectly affected younger workers, but with less evidence of employment adjustment in response to these. Employers' preferences for fairness emerges as the most plausible explanation for the observed wage spillovers.

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Figure 1

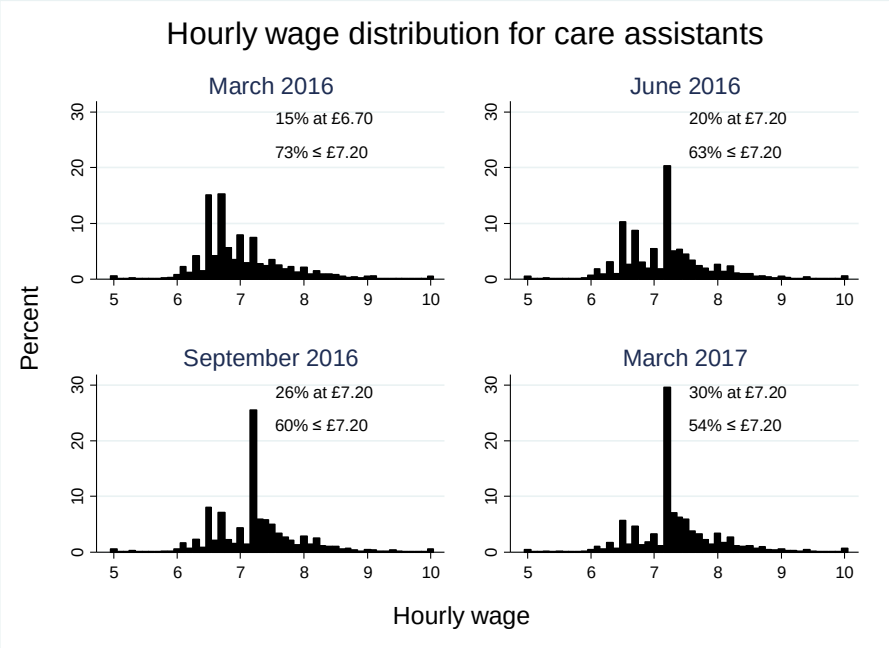


Figure 2

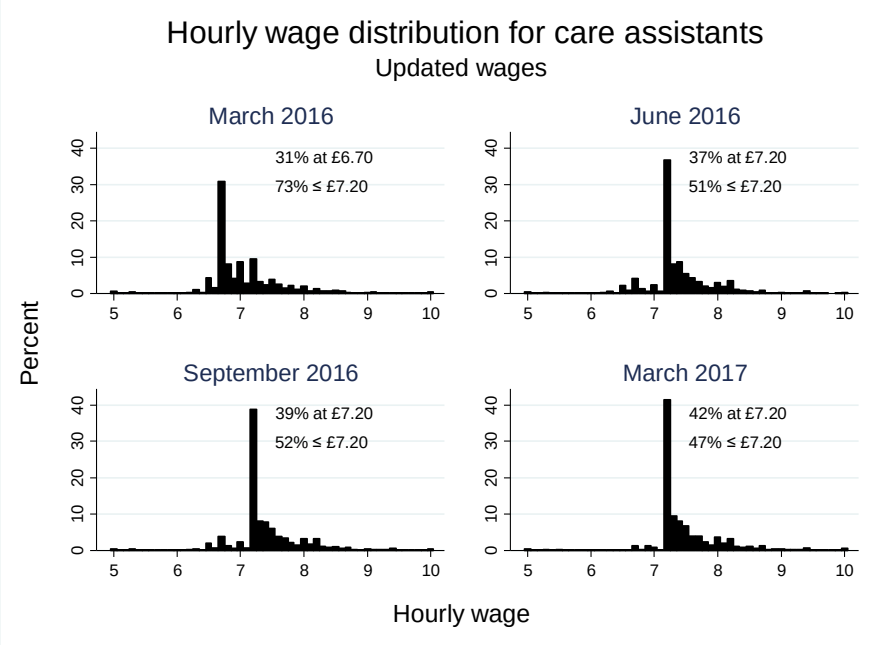


Figure 3

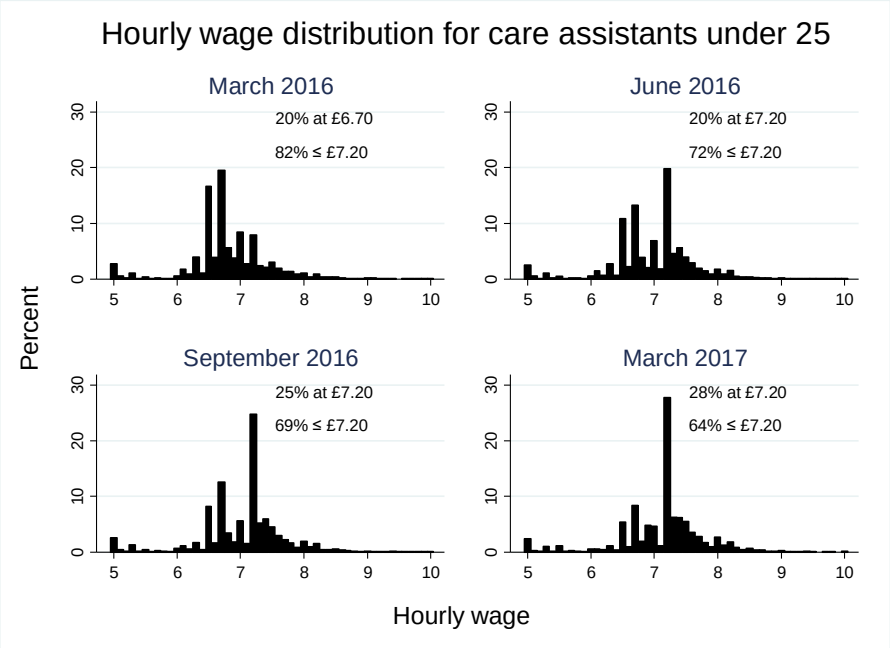


Figure 4

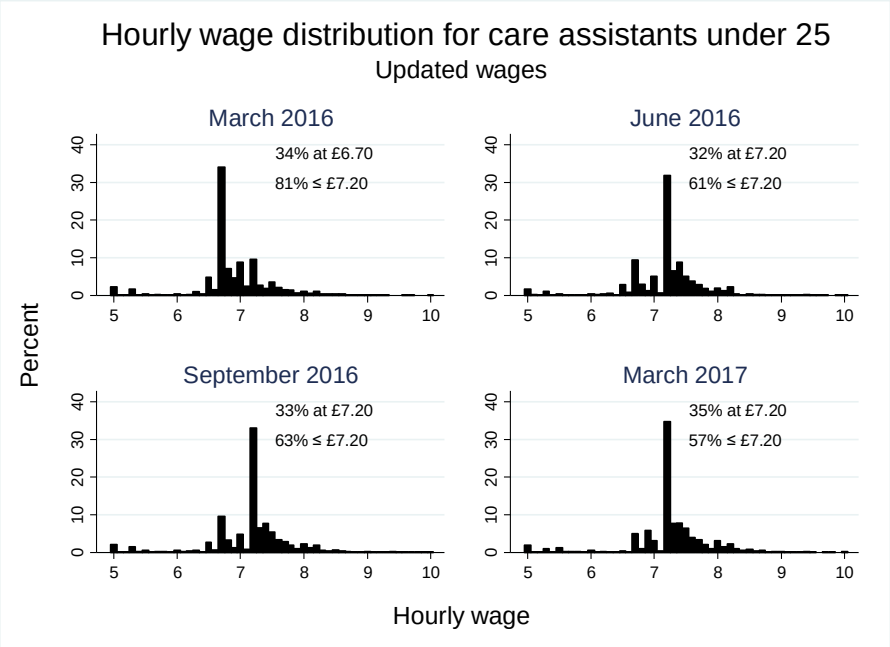


Figure 5

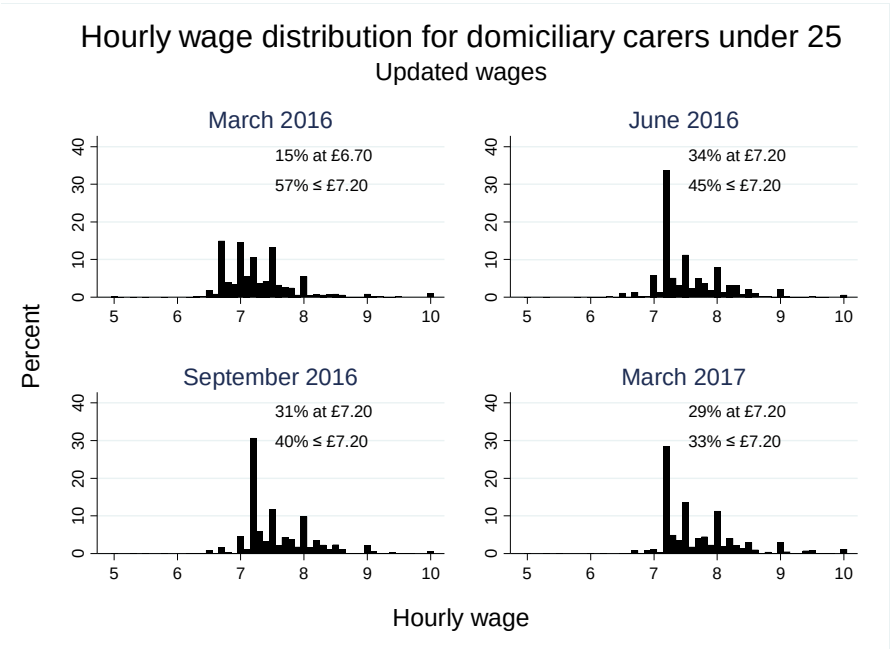

Hourly wage distribution for domiciliary carers under 25
Updated wages
March 2016
15% at £6.70
57% ≤ £7.20
June 2016
34% at £7.20
45% ≤ £7.20
September 2016
31% at £7.20
40% ≤ £7.20
March 2017
29% at £7.20
33% ≤ £7.20
Percent
0
10
20
30
40
5
6
7
8
9
10
Hourly wage

Table 1 – Descriptive Statistics

	Mar 2016		Jun 2016		Sep 2016		Mar 2017	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Number of employees	38.93	30.94	39.21	31.27	39.35	31.77	39.58	31.29
Median	32.00		32.00		33.00		33.00	
Proportion under 25	0.12	0.09	0.12	0.09	0.12	0.09	0.11	0.09
Wage	7.55	1.08	7.70	1.09	7.76	1.08	7.85	1.08
Wage (25 and over)	7.64	1.11	7.80	1.11	7.86	1.11	7.95	1.10
Wage (under 25)	6.82	0.78	6.97	0.81	7.03	0.80	7.11	0.80
Weekly hours	28.78	5.10	28.77	5.10	28.80	5.10	28.79	5.13
Weekly earnings	215.00	54.47	219.15	55.35	221.30	55.45	223.92	56.12
Proportion female	0.84	0.13	0.84	0.13	0.84	0.13	0.84	0.13
Age	42.69	4.60	42.74	4.58	42.82	4.61	43.04	4.63
Proportion care assistant	0.56	0.16	0.56	0.16	0.56	0.16	0.56	0.16
Proportion with nursing qualification	0.04	0.07	0.04	0.07	0.04	0.07	0.04	0.07
Occupancy rate	0.92	0.15	0.92	0.14	0.92	0.14	0.92	0.14
Number of homes	4,134		4,134		4,134		4,134	

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017.

Table 2 – The Bite of the National Living Wage

	Mar 2016		Jun 2016		Sep 2016		Mar 2017	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Proportion paid less than minimum wage	0.51	0.32	0.35	0.35	0.29	0.33	0.22	0.30
Proportion paid less than minimum wage (25 and over)	0.55	0.34	0.37	0.37	0.30	0.35	0.23	0.31
NLW gap	0.04	0.04	0.03	0.04	0.02	0.04	0.02	0.03
NLW gap (25 and over)	0.04	0.04	0.03	0.04	0.02	0.03	0.02	0.03
Proportion paid exactly £7.20	0.03	0.10	0.13	0.23	0.17	0.25	0.20	0.26
Proportion paid exactly £7.20 (25 and over)	0.03	0.10	0.13	0.23	0.17	0.26	0.20	0.27

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017.

Table 3 – Wage Equations

Dep. Var.: Change in log average hourly wage

Panel A – March 2016 to June 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.023***	0.021***		
	(0.002)	(0.002)		
Initial NLW gap			0.136***	0.110***
			(0.018)	(0.019)
Observations	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.037***	0.036***		
	(0.002)	(0.002)		
Initial NLW gap			0.264***	0.244***
			(0.023)	(0.026)
Observations	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.049***	0.049***		
	(0.002)	(0.002)		
Initial NLW gap			0.400***	0.390***
			(0.027)	(0.029)
Observations	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 4 – Employment Equations

Dep. Var.: Change in log number of employees

March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.012	-0.020*				
	(0.011)	(0.011)				
Initial NLW gap			-0.033	-0.088		
			(0.103)	(0.111)		
Change in log average wage					-0.410*	-0.225
					(0.230)	(0.289)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 5 – Hours Equations

Dep. Var.: Change in log total weekly hours

March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.011	-0.010				
	(0.013)	(0.014)				
Initial NLW gap			-0.158	-0.173		
			(0.146)	(0.154)		
Change in log average wage					-0.212	-0.444
					(0.280)	(0.404)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 6 – Wage Spillover Equations

Dep. Var.: Change in log average hourly wage for employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.017***	0.017***				
	(0.003)	(0.003)				
Initial NLW gap (25+)			0.109***	0.110***		
			(0.031)	(0.033)		
Change in log average wage (25+)					0.643***	0.592***
					(0.103)	(0.152)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.029***	0.031***				
	(0.004)	(0.004)				
Initial NLW gap (25+)			0.220***	0.234***		
			(0.040)	(0.043)		
Change in log average wage (25+)					0.747***	0.724***
					(0.089)	(0.118)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.033***	0.038***				
	(0.005)	(0.005)				
Initial NLW gap (25+)			0.268***	0.308***		
			(0.060)	(0.063)		
Change in log average wage (25+)					0.722***	0.654***
					(0.100)	(0.125)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 7 – Employment Spillover Equations

Dep. Var.: Change in share of employees aged under 25

March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.004	-0.001				
	(0.004)	(0.004)				
Initial NLW gap (25+)			-0.002	0.007		
			(0.034)	(0.038)		
Change in log average wage (25+)					-0.026	0.014
					(0.075)	(0.080)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 8 – Total Hours Spillover Equations

Dep. Var.: Change in share of total weekly hours worked by employees aged under 25

March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.002	0.001				
	(0.004)	(0.004)				
Initial NLW gap (25+)			0.009	0.020		
			(0.036)	(0.040)		
Change in log average wage (25+)					0.022	0.042
					(0.078)	(0.084)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 9 –Differences between the Care Home and the Domiciliary Care Sector

March 2016

	Care Homes		Domiciliary Care		Difference	
	Mean	S.D.	Mean	S.D.		
Firm-level outcomes						
Number of employees	38.93	30.94	62.90	70.52	-23.97	***
Proportion under 25	0.12	0.09	0.12	0.09	0.01	*
Number of firms	4,134		1,248			
Worker-level outcomes						
Wage	7.65	2.07	7.52	1.25	0.13	***
Wage (under 25)	6.85	1.10	7.25	0.79	-0.41	***
Proportion on zero-hour contracts	0.07	0.25	0.64	0.48	-0.57	***
Proportion on zero-hour contracts (under 25)	0.12	0.33	0.67	0.47	-0.54	***
Proportion on permanent contracts	0.90	0.29	0.83	0.38	0.08	***
Proportion on temporary contracts	0.01	0.12	0.05	0.23	-0.04	***
Proportion bank workers	0.07	0.26	0.04	0.20	0.03	***
Proportion agency workers	0.00	0.04	0.05	0.23	-0.05	***
Weekly hours	28.43	11.80	12.27	15.89	16.16	***
Weekly earnings	215.45	118.30	74.44	118.79	141.01	***
Proportion female	0.84	0.37	0.87	0.34	-0.02	***
Age	42.31	13.92	41.65	13.39	0.65	***
Proportion care assistant	0.55	0.50	0.81	0.39	-0.26	***
Proportion with nursing qualification	0.05	0.23	0.00	0.05	0.05	***
Number of workers	181,888		131,680			

Notes: The sample is made of all workers and firms in the balanced panel of care homes and domiciliary care agencies active between March 2016 and March 2017. The last column reports the difference in means between the care home and domiciliary care sectors and the associated significance level. P-value: *** p<0.01, ** p<0.05, * p<0.1.

Table 10 – Wage Spillover Equations in the Domiciliary Care Sector

Dep. Var.: Change in log average hourly wage for employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.026***	0.025***				
	(0.005)	(0.006)				
Initial NLW gap (25+)			0.183***	0.155**		
			(0.069)	(0.072)		
Change in log average wage (25+)					0.953***	1.037***
					(0.199)	(0.293)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.036***	0.035***				
	(0.006)	(0.007)				
Initial NLW gap (25+)			0.263***	0.226**		
			(0.086)	(0.088)		
Change in log average wage (25+)					1.001***	1.001***
					(0.173)	(0.227)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.046***	0.047***				
	(0.008)	(0.009)				
Initial NLW gap (25+)			0.443***	0.417***		
			(0.150)	(0.158)		
Change in log average wage (25+)					0.981***	0.892***
					(0.175)	(0.178)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of domiciliary care agencies active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 11 – Productivity

Dep. Var.: Change in log residents per worker hour

March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.012	0.001				
	(0.015)	(0.015)				
Initial NLW gap			0.079	0.015		
			(0.159)	(0.169)		
Change in log average wage					0.015	0.037
					(0.311)	(0.423)
Observations	4,083	4,083	4,083	4,083	4,083	4,083
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 12 – Quality of care

Dep. Var.: Change in rating between March 2016 and March 2017 (latest rating)

Panel A – Overall quality

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.142***	-0.125***				
	(0.022)	(0.023)				
Initial NLW gap			-1.146***	-1.008***		
			(0.203)	(0.211)		
Change in log average wage					-2.441***	-2.513***
					(0.485)	(0.563)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – Safe

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.095***	-0.082***				
	(0.023)	(0.025)				
Initial NLW gap			-0.815***	-0.735***		
			(0.221)	(0.231)		
Change in log average wage					-1.611***	-1.839***
					(0.497)	(0.594)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – Effective

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.091***	-0.077***				
	(0.021)	(0.022)				
Initial NLW gap			-0.628***	-0.524**		
			(0.200)	(0.207)		
Change in log average wage					-1.491***	-1.294**
					(0.433)	(0.517)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Panel D – Caring

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.078***	-0.077***				
	(0.015)	(0.016)				
Initial NLW gap			-0.520***	-0.506***		
			(0.150)	(0.156)		
Change in log average wage					-1.512***	-1.266***
					(0.335)	(0.404)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Panel E – Responsive

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.091***	-0.075***				
	(0.020)	(0.021)				
Initial NLW gap			-0.795***	-0.697***		
			(0.194)	(0.200)		
Change in log average wage					-1.460***	-1.727***
					(0.423)	(0.517)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Panel F – Well-led

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.124***	-0.110***				
	(0.024)	(0.026)				
Initial NLW gap			-0.997***	-0.883***		
			(0.226)	(0.236)		
Change in log average wage					-2.150***	-2.202***
					(0.521)	(0.604)
Observations	2,480	2,480	2,480	2,480	2,480	2,480
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the latest rating in the relevant line of enquiry as of March 2016, the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table 13 – Closures

Dep. Var.: Indicator for Firm Closure

March 2016 to March 2017

	(1)	(2)	(3)	(4)
Initial low-paid proportion	-0.001	0.003		
	(0.007)	(0.007)		
Initial NLW gap			0.038	0.066
			(0.059)	(0.062)
Observations	4,306	4,306	4,306	4,306
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of homes active in March 2016, unconditional on their survival until March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Appendix A1 – Aggregate employment and firm dynamics

A1.1 Aggregate Employment Effects

We explore the aggregate employment effects of the NLW introduction using a bunching approach as in Cengiz et al. (2018). The bunching approach allows us to infer the effect on employment throughout the wage distribution by comparing the number of missing jobs below the minimum to the number of excess jobs above the minimum before and after the policy change. The main intuition behind this approach is that when a higher minimum wage is introduced, workers who used to be paid at a wage below the new minimum can no longer be paid at their old rate. As a consequence, provided that there is almost full compliance with the law, the mass of jobs at the bottom of the wage distribution should disappear. Some of these jobs will obtain the wage uprate and therefore appear at or right above the new minimum, some might be destroyed, and some other new jobs might be created through a labour supply effect. Therefore, the size of the excess mass above the new minimum provides an account of preserved and newly created jobs, and the sum of the excess and the missing mass measures the total employment change, whether positive or negative. It is reasonable to believe that the bulk of the dynamics will occur in a neighbourhood of the new minimum, as changes in the upper tail of the wage distribution are unlikely to be driven by minimum wage changes.

To implement this strategy, we consider the entire workforce of care homes ever active between October 2015 and March 2017, therefore allowing for entries and exits. This allows us to investigate the aggregate employment effects of the NLW introduction. We collapse the individual data and calculate monthly employment counts at the local authority district level by £0.50 hourly wage bins from six months prior to a year after the NLW introduction, and from two pounds below to five pounds above the NLW rate of £7.20.[36] We then estimate how changes in the excess and missing mass by wage bin evolve relative to March 2016 adopting the following fixed effect framework:

[36] While we do not have any ex-ante information on what is the range over which the minimum wage change can have distributional consequences, we draw on the information in Figure 1 and restrict our analysis to wages between £5.20 and £11.20.

$$N_{l,w,m} = \gamma_0 + \sum_{k=-4}^{8} \sum_{\tau \neq -1, \tau=-6}^{12} \gamma_{k,\tau} \mathbb{I}_w^k \times \mathbb{I}_m^\tau + \phi_{l,w,m} \quad (7)$$

where $N_{l,w,m}$ is employment headcount in local authority l, wage bin w and month m, $\mathbb{I}_w^k$ is an indicator taking value one if wage bin w is k-bin distant from the £7.20 bin, $\mathbb{I}_m^\tau$ is an indicator taking value one if month m is τ-period distant from April 2016 and $\phi_{l,w,m}$ a disturbance term. The key parameters of interest are $\gamma_{k,\tau}$ for $k = \{-4, \dots, 8\}$ and $\tau = \{-6, -5, \dots, -2, 0, \dots, 11, 12\}$, as they trace the evolution of the missing and excess mass relative to the time of the policy change. In this model, given that the timing of the NLW introduction is common to all local authorities, identification comes from variation in the number of workers for which the minimum wage change is binding across local authorities.

In Figure A5 in Appendix A2 the vertical bars correspond to the estimated γ_τ^k for $k = \{-4, \dots, 8\}$ and for selected values of τ, namely $\tau = 3$ in the top left panel, $\tau = 6$ in the top right panel, $\tau = 9$ in the bottom left panel and $\tau = 12$ in the bottom right panel. For each bar, a capped line indicates the 95 percent confidence interval of the $\hat{\gamma}_\tau^k$. The connected dots indicate instead the cumulative sum of the bin-specific effects. Across all the panels, the missing mass is concentrated in the two wage bins right below the new minimum and the excess mass in the first bin above it, while employment changes in the other bins are very small and statistically indistinguishable from zero. The pattern of the cumulated effects suggests that jobs previously paid below the NLW are fully replaced by jobs in the three bins right above the new minimum, and that there are no spillover effects in the upper part of the wage distribution.

While the previous chart displays the change in mass by wage bin for selected post-treatment periods relative to March 2016, Figure A6 in Appendix A2 documents the evolution of the total number of jobs below the minimum $\alpha_\tau = \sum_{k=-4}^{-1} \gamma_\tau^k$ (missing mass), the total number of jobs above the minimum $\beta_\tau = \sum_{k=0}^{8} \gamma_\tau^k$ (excess mass), and their sum $\Delta_\tau = \alpha_\tau + \beta_\tau$ (net excess mass) for $\tau = \{-6, -5, \dots, -2, 0, \dots, 11, 12\}$. The numbers reported at the bottom of the figure are the point estimates $\widehat{\Delta}_\tau$. The graph shows a sharp reduction in the number of jobs below the NLW between the six months prior and the twelve months after its implementation. The below mass decreases by a statistically significant

amount exactly in April 2016 – showing that the minimum wage increase had real bite – and remains persistently negative throughout the following twelve months. The evolution of the excess mass almost perfectly mirrors this pattern, displaying a significant and positive jump from $\tau = 0$ onwards. This is confirmed by the behaviour of the "net excess mass" that is very small in magnitude and never statistically different from zero. Interestingly enough, there is no pre-trend in $\hat{\alpha}_\tau$ nor $\hat{\beta}_\tau$. According to these result, there is little if no indication of negative aggregate employment effects due to the NLW introduction.

Following our previous investigation of potential spillover effects, we extend the bunching framework to account for different patterns between workers aged under 25, and workers aged 25 and over. In practice, we augment the bunching model interacting the main regressor with an age-group dummy.[37] Results are reported in Figures A7 and A8 in Appendix A2 for adult workers, and in Figures A9 and A10 for younger workers. The age-specific patterns are very similar to the aggregate ones. The evolution of the net excess mass in Figure A10 seems to suggest a mild but nonetheless small and statistically insignificant negative employment effect for younger workers. All in all, we take this bunching exercise as evidence that the NLW introduction did not have any significant aggregate employment effects.

A1.2 Aggregate firm dynamics

We are also interested in whether the NLW introduction had an impact on firm entry. We therefore consider all firms ever active in the period between March 2016 and March 2017, allowing for both entries into and exits out of the sample. Estimating reduced-form linear probability models for the probability of entry as we did above for the probability of exit is infeasible, since we do not have a measure of the minimum wage bite for entrants. We therefore collapse the data at the local authority district level[38] and run reduced-form regressions of the following form:

$$E_{l,t} = \alpha_4 + \beta_4 MIN_{l,t-1} + Z'_{l,t-1}\gamma_4 + \omega_{l,t} \qquad (8)$$

[37] This model requires collapsing the data by age category, wage bin, month and local authority.
[38] Local authority district areas as defined by ONS split England into 326 areas of local governance.

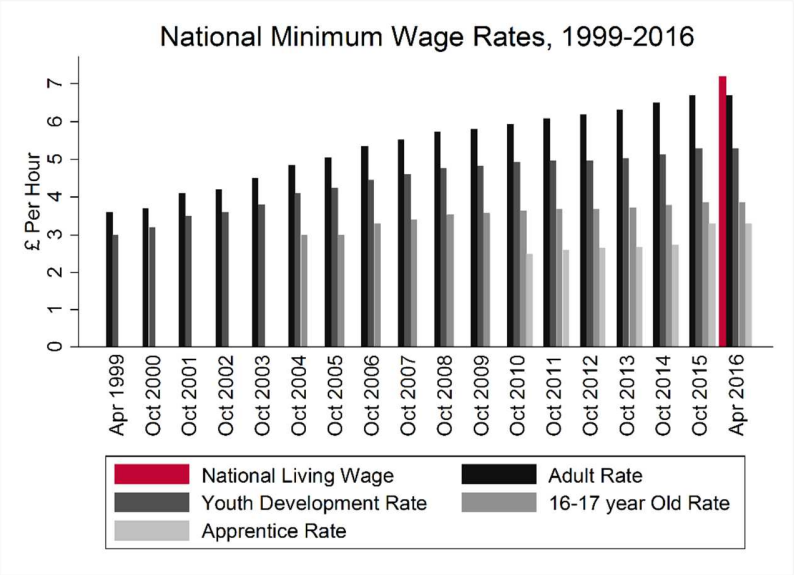
where $E_{l,t}$ is the proportion of entrants in local authority l between March 2016 and time t – where t can be June 2016, September 2016 or March 2017 – , $MIN_{l,t-1}$is either the proportion of low-paid workers or the wage gap at local authority level in March 2016, and Z is a vector of local-authority controls including the proportion of female workers, average age, the proportion working as care assistants, the proportion with nursing qualification, the occupancy rate and a set of regional dummies. For entries between March 2016 and March 2017, reduced form estimates are reported in columns (1) to (4) of Panel C of Table A16 in Appendix A2. Columns (5) and (6) instead show structural form estimates in which $MIN_{l,t-1}$ is used as an instrument for the change in the logarithm of the average wage in the local authority $\Delta lnW_{l,t}$.[39] The statistical insignificance of the estimated coefficients and their limited size indicate that the NLW introduction did not have an impact on firm entry at the local authority level.

For completeness, we also report reduced-form and structural-form estimates for firm exits at the local authority level in Table A17 in Appendix A2. Consistently with the firm-level results, we do not find evidence of a detrimental effect of the NLW introduction on care home survival.

[39] Estimates for entries between March and June 2016 are reported in Panel A of Table A16 in Appendix A2, while those for entries between March and September 2016 in Panel B of the same table.

Appendix A2 – Additional Figures and Tables

Figure A1



Notes: From Low Pay Commission.

Figure A2

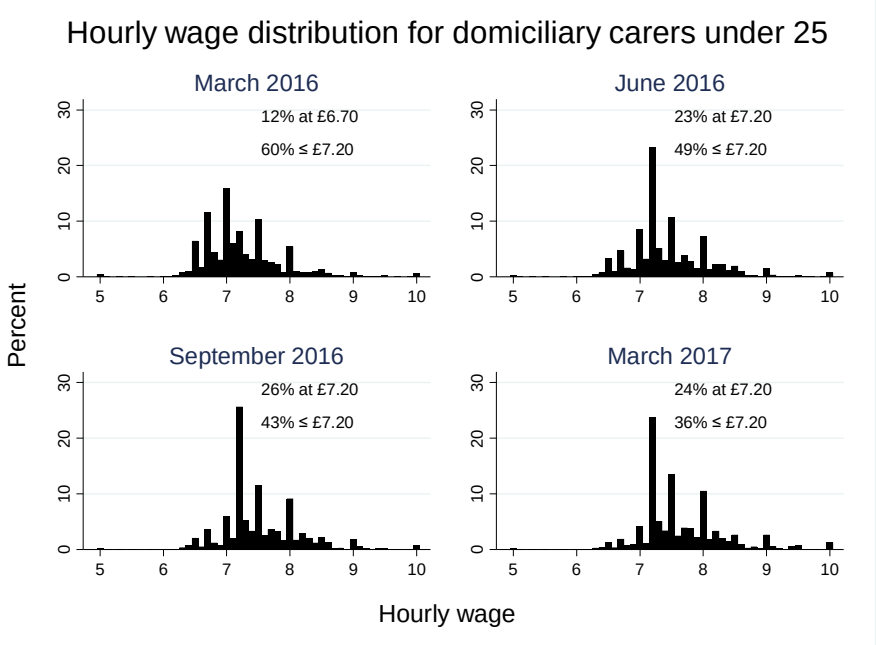
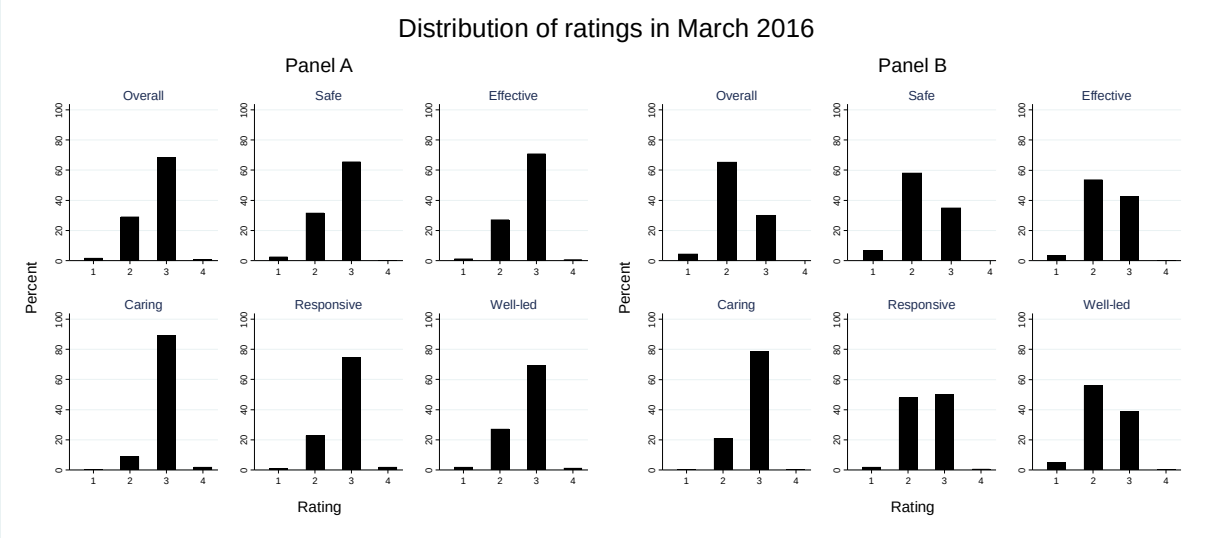
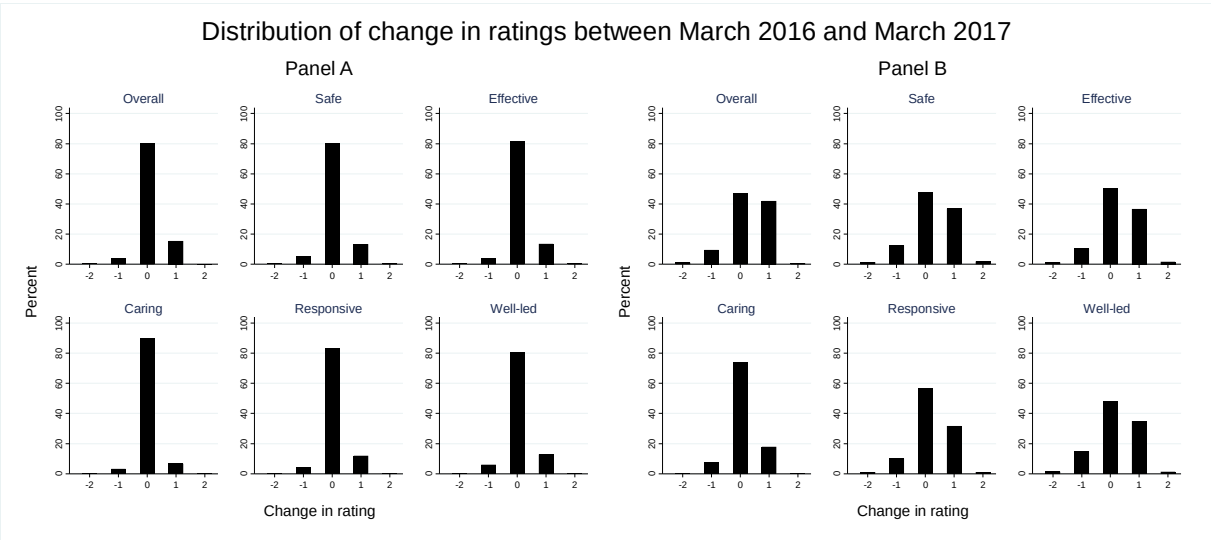


Figure A3



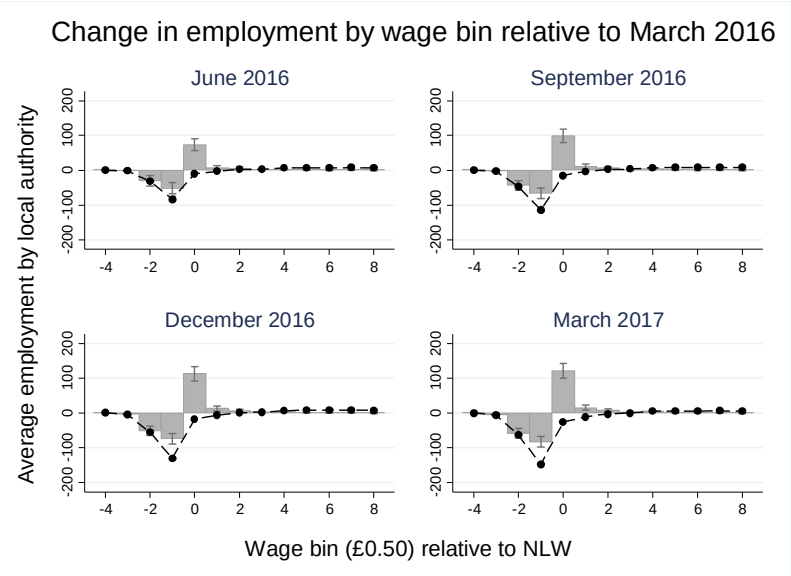
Notes: Panel A is based on the sample of 2480 homes with CQC ratings as of March 2016. Panel B is based on the subgroup of firms that were inspected and rated by CQC both before and after March 2016. Legend: 1 = inadequate, 2 = requires improvement, 3 = good, 4 = outstanding.

Figure A4



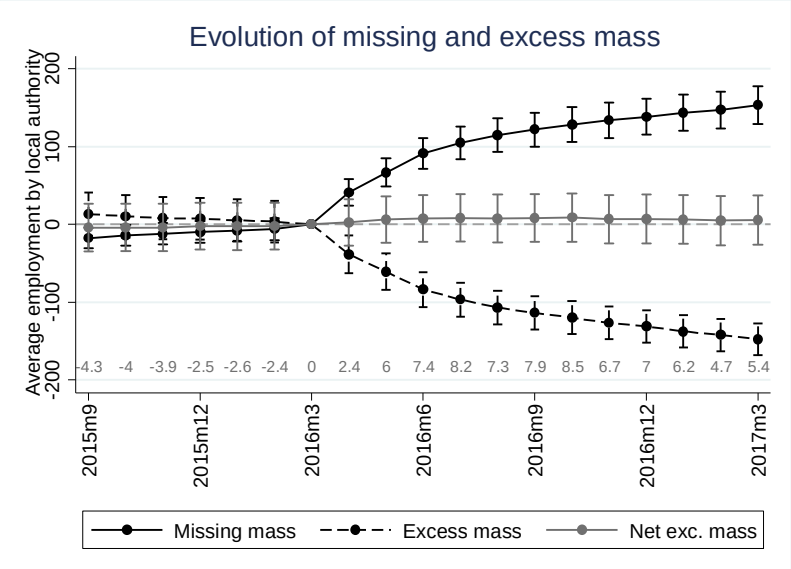
Notes: Panel A is based on the sample of 2480 homes with CQC ratings as of March 2016. Panel B is based on the subgroup of firms that were inspected and rated by CQC both before and after March 2016.

Figure A5



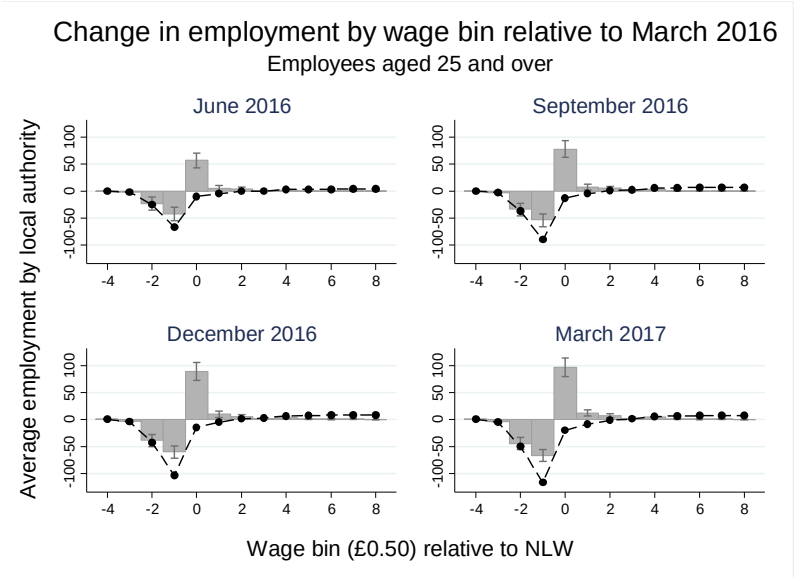
Notes: The vertical bars correspond to the estimated γ_τ^k from equation (7) for wage bins $k = \{-4, \ldots, 8\}$ and for $\tau = 3$ in the top left panel, $\tau = 6$ in the top right panel, $\tau = 9$ in the bottom left panel and $\tau = 12$ in the bottom right panel. Capped lines indicate 95 percent confidence intervals, computed using robust standard errors. The connected dots indicate the cumulative sum of the bin-specific effects.

Figure A6



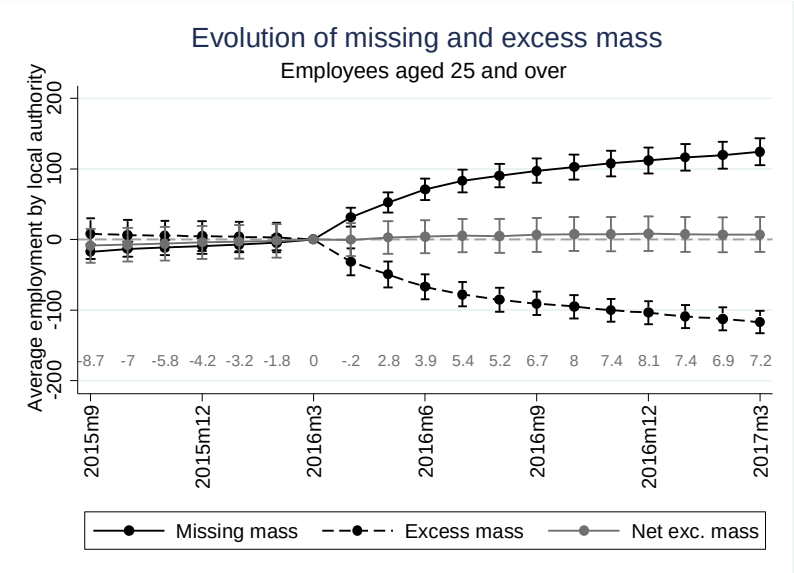
Notes: Missing mass is the total number of jobs below the minimum $\alpha_\tau = \sum_{k=-4}^{-1} \gamma_\tau^k$, excess mass the total number of jobs above the minimum $\beta_\tau = \sum_{k=0}^{8} \gamma_\tau^k$, net excess mass the sum $\Delta_\tau = \alpha_\tau + \beta_\tau$. Coefficient estimates of the net excess mass are reported in grey at the bottom of the figure. Vertical bars indicate 95 percent confidence intervals, computed using robust standard errors.

Figure A7



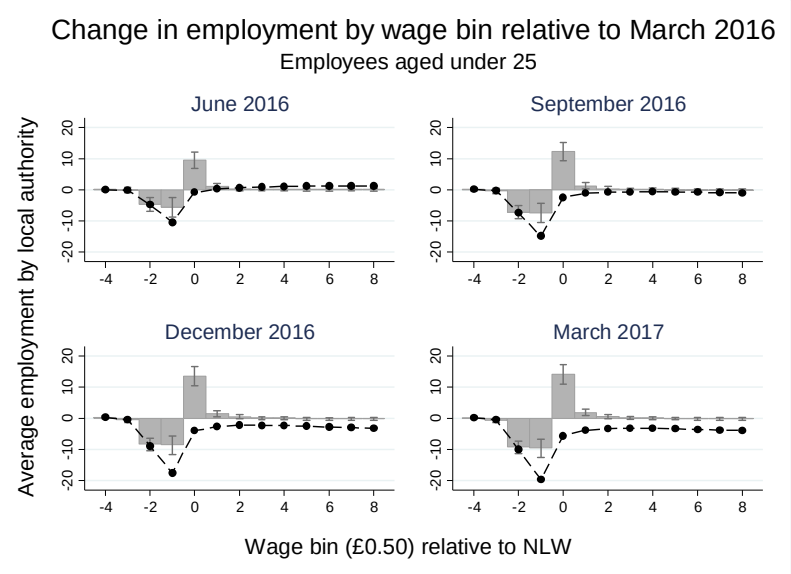
Notes: The vertical bars correspond to the estimated γ_τ^k from equation (7) for wage bins $k = \{-4, \ldots, 8\}$ and for $\tau = 3$ in the top left panel, $\tau = 6$ in the top right panel, $\tau = 9$ in the bottom left panel and $\tau = 12$ in the bottom right panel. Capped lines indicate 95 percent confidence intervals, computed using robust standard errors. The connected dots indicate the cumulative sum of the bin-specific effects.

Figure A8



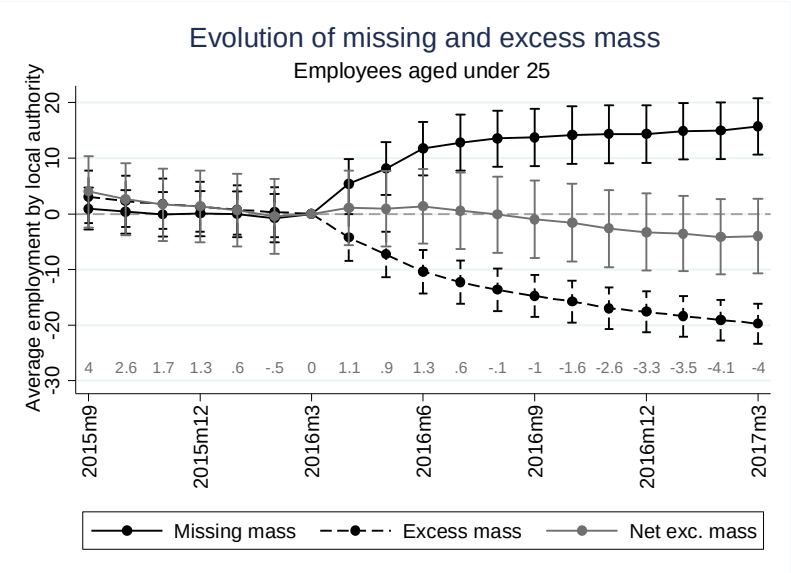
Notes: Missing mass is the total number of jobs below the minimum $\alpha_\tau = \sum_{k=-4}^{-1} \gamma_\tau^k$, excess mass the total number of jobs above the minimum $\beta_\tau = \sum_{k=0}^{8} \gamma_\tau^k$, net excess mass the sum $\Delta_\tau = \alpha_\tau + \beta_\tau$. Coefficient estimates of the net excess mass are reported in grey at the bottom of the figure. Vertical bars indicate 95 percent confidence intervals, computed using robust standard errors.

Figure A9



Notes: The vertical bars correspond to the estimated γ_τ^k from equation (7) for wage bins $k = \{-4, \ldots, 8\}$ and for $\tau = 3$ in the top left panel, $\tau = 6$ in the top right panel, $\tau = 9$ in the bottom left panel and $\tau = 12$ in the bottom right panel. Capped lines indicate 95 percent confidence intervals, computed using robust standard errors. The connected dots indicate the cumulative sum of the bin-specific effects.

Figure A10



Notes: Missing mass is the total number of jobs below the minimum $\alpha_\tau = \sum_{k=-4}^{-1} \gamma_\tau^k$, excess mass the total number of jobs above the minimum $\beta_\tau = \sum_{k=0}^{8} \gamma_\tau^k$, net excess mass the sum $\Delta_\tau = \alpha_\tau + \beta_\tau$. Coefficient estimates of the net excess mass are reported in grey at the bottom of the figure. Vertical bars indicate 95 percent confidence intervals, computed using robust standard errors.

Table A1 – Identification Checks

Panel A – Dep. Var.: Change in log average hourly wage

	March to June			*March to September*		
	2015	2016	Difference	2015	2016	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
Initial log average hourly wage	-0.016***	-0.060***	-0.043***	-0.032***	-0.099***	-0.067***
	(0.003)	(0.006)	(0.007)	(0.005)	(0.009)	(0.010)
Observations	4,126	4,134	8,260	4,126	4,134	8,260

Panel B – Dep. Var.: Change in log number of employees

	March to June			*March to September*		
	2015	2016	Difference	2015	2016	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
Initial log average hourly wage	-0.000	0.030*	0.031	-0.007	-0.002	0.004
	(0.018)	(0.017)	(0.024)	(0.024)	(0.024)	(0.033)
Observations	4,126	4,134	8,260	4,126	4,134	8,260

Panel C – Dep. Var.: Change in log total weekly hours

	March to June			*March to September*		
	2015	2016	Difference	2015	2016	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
Initial log average hourly wage	0.009	0.037	0.028	0.013	-0.007	-0.020
	(0.019)	(0.023)	(0.030)	(0.026)	(0.029)	(0.039)
Observations	4,126	4,134	8,260	4,126	4,134	8,260

Notes: The sample in columns (1) and (4) is a balanced panel of homes active between March 2015 and March 2016. The sample in columns (2) and (5) is a balanced panel of homes active between March 2016 and March 2017. Columns (3) and (5) are based on both samples. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1.

Table A2 – Weekly Earnings Equations

Dep. Var.: Change in log average weekly earnings

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.022***	0.021***				
	(0.004)	(0.005)				
Initial NLW gap			0.141***	0.122***		
			(0.038)	(0.042)		
Change in log average wage					1.015***	1.116***
					(0.219)	(0.309)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.041***	0.040***				
	(0.006)	(0.007)				
Initial NLW gap			0.333***	0.318***		
			(0.054)	(0.060)		
Change in log average wage					1.123***	1.302***
					(0.167)	(0.211)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.063***	0.066***				
	(0.007)	(0.008)				
Initial NLW gap			0.454***	0.455***		
			(0.077)	(0.082)		
Change in log average wage					1.353***	1.166***
					(0.150)	(0.193)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A3 – Employment Equations

Dep. Var.: Change in log number of employees

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.011*	-0.014**				
	(0.006)	(0.007)				
Initial NLW gap			-0.104	-0.127*		
			(0.065)	(0.068)		
Change in log average wage					-0.661**	-1.157*
					(0.325)	(0.676)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.011	-0.016*				
	(0.008)	(0.009)				
Initial NLW gap			-0.048	-0.086		
			(0.087)	(0.094)		
Change in log average wage					-0.460*	-0.354
					(0.246)	(0.395)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A4 – Total Hours Equations

Dep. Var.: Change in log total weekly hours

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.012*	-0.012				
	(0.007)	(0.007)				
Initial NLW gap			-0.122	-0.132		
			(0.078)	(0.085)		
Change in log average wage					-0.589	-1.206
					(0.371)	(0.850)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	-0.010	-0.013				
	(0.009)	(0.010)				
Initial NLW gap			-0.078	-0.114		
			(0.101)	(0.111)		
Change in log average wage					-0.362	-0.468
					(0.289)	(0.469)
Observations	4,134	4,134	4,134	4,134	4,134	4,134
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A5 – Wage Equations for Employees Aged 25 and Over

Dep. Var.: Change in log average hourly wage for workers aged 25 and over

Panel A – March 2016 to June 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.028***	0.027***		
	(0.002)	(0.002)		
Initial NLW gap (25+)			0.204***	0.186***
			(0.024)	(0.026)
Observations	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.043***	0.042***		
	(0.002)	(0.003)		
Initial NLW gap (25+)			0.339***	0.323***
			(0.028)	(0.031)
Observations	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.052***	0.052***		
	(0.003)	(0.003)		
Initial NLW gap (25+)			0.467***	0.471***
			(0.031)	(0.034)
Observations	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A6 – Weekly Earnings Equations for Employees Aged Under 25

Dep. Var.: Change in log average weekly earnings for workers aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.009	0.011				
	(0.012)	(0.013)				
Initial NLW gap (25+)			0.046	0.079		
			(0.123)	(0.130)		
Change in log average wage (25+)					0.423	0.423
					(0.490)	(0.688)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.027*	0.033**				
	(0.015)	(0.017)				
Initial NLW gap (25+)			0.209	0.272*		
			(0.145)	(0.156)		
Change in log average wage (25+)					0.791**	0.840*
					(0.389)	(0.472)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.057***	0.061***				
	(0.019)	(0.020)				
Initial NLW gap (25+)			0.471***	0.509***		
			(0.175)	(0.190)		
Change in log average wage (25+)					1.174***	1.082***
					(0.389)	(0.398)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A7 – Employment Spillover Equations

Dep. Var.: Change in share of employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.002	-0.001				
	(0.002)	(0.002)				
Initial NLW gap (25+)			-0.019	-0.018		
			(0.019)	(0.022)		
Change in log average wage (25+)					-0.052	-0.099
					(0.083)	(0.118)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.001	-0.001				
	(0.003)	(0.003)				
Initial NLW gap (25+)			0.000	-0.013		
			(0.026)	(0.028)		
Change in log average wage (25+)					-0.034	-0.039
					(0.071)	(0.086)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A8 – Total Hours Spillover Equations

Dep. Var.: Change in share of total weekly hours worked by employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.002	-0.001				
	(0.002)	(0.002)				
Initial NLW gap (25+)			-0.023	-0.017		
			(0.021)	(0.023)		
Change in log average wage (25+)					-0.027	-0.094
					(0.088)	(0.128)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.001	-0.000				
	(0.003)	(0.003)				
Initial NLW gap (25+)			-0.004	-0.013		
			(0.027)	(0.029)		
Change in log average wage (25+)					-0.003	-0.039
					(0.074)	(0.090)
Observations	2,866	2,866	2,866	2,866	2,866	2,866
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A9 – Wage Equations in the Domiciliary Care Sector

Dep. Var.: Change in log average hourly wage

Panel A – March 2016 to June 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.026***	0.027***		
	(0.003)	(0.004)		
Initial NLW gap			0.061**	0.060**
			(0.030)	(0.030)
Observations	1,248	1,248	1,248	1,248
Controls	No	Yes	No	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.038***	0.037***		
	(0.004)	(0.004)		
Initial NLW gap			0.095**	0.090**
			(0.041)	(0.039)
Observations	1,248	1,248	1,248	1,248
Controls	No	Yes	No	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.053***	0.050***		
	(0.005)	(0.006)		
Initial NLW gap			0.176**	0.168**
			(0.077)	(0.073)
Observations	1,248	1,248	1,248	1,248
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of domiciliary care agencies active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A10 – Wage Equations for Employees Aged 25 and Over in the Domiciliary Care Sector

Dep. Var.: Change in log average hourly wage for workers aged 25 and over

Panel A – March 2016 to June 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.026***	0.026***		
	(0.004)	(0.004)		
Initial NLW gap (25+)			0.169***	0.149**
			(0.058)	(0.059)
Observations	847	847	847	847
Controls	No	Yes	No	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.036***	0.035***		
	(0.004)	(0.004)		
Initial NLW gap (25+)			0.266***	0.226***
			(0.078)	(0.077)
Observations	847	847	847	847
Controls	No	Yes	No	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.050***	0.048***		
	(0.005)	(0.006)		
Initial NLW gap (25+)			0.518***	0.468***
			(0.145)	(0.154)
Observations	847	847	847	847
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of domiciliary care agencies active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A11 – Employment Spillover Equations in the Domiciliary Care Sector

Dep. Var.: Change in share of employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.002	-0.001				
	(0.003)	(0.003)				
Initial NLW gap (25+)			-0.013	-0.006		
			(0.036)	(0.037)		
Change in log average wage (25+)					-0.041	-0.041
					(0.128)	(0.241)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.003	-0.001				
	(0.004)	(0.005)				
Initial NLW gap (25+)			0.006	0.025		
			(0.054)	(0.055)		
Change in log average wage (25+)					-0.033	0.111
					(0.135)	(0.260)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.006	-0.001				
	(0.005)	(0.006)				
Initial NLW gap (25+)			0.005	0.055		
			(0.059)	(0.058)		
Change in log average wage (25+)					-0.022	0.118
					(0.120)	(0.129)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of domiciliary care agencies active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A12 – Total Hours Spillover Equations in the Domiciliary Care Sector

Dep. Var.: Change in share of total weekly hours worked by employees aged under 25

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.001	0.004				
	(0.006)	(0.006)				
Initial NLW gap (25+)			0.024	0.056		
			(0.077)	(0.076)		
Change in log average wage (25+)					0.174	0.373
					(0.247)	(0.575)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.004	0.001				
	(0.008)	(0.009)				
Initial NLW gap (25+)			0.056	0.118		
			(0.115)	(0.111)		
Change in log average wage (25+)					0.036	0.521
					(0.251)	(0.606)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	-0.012	-0.001				
	(0.009)	(0.011)				
Initial NLW gap (25+)			-0.070	0.046		
			(0.129)	(0.120)		
Change in log average wage (25+)					-0.011	0.099
					(0.221)	(0.274)
Observations	847	847	847	847	847	847
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of domiciliary care agencies active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A13 – Respondent's views about the level of NLW

	All firms		Balanced panel	
	Pre-NLW	Post-NLW	Pre-NLW	Post-NLW
	(1)	(2)	(3)	(4)
Level of NLW is				
About right	42.7%	52.5%	43.7%	57.4%
Too low	15.0%	19.7%	16.2%	19.2%
Too high	37.6%	23.7%	35.6%	20.9%
Don't know	4.7%	4.1%	4.5%	2.5%
Number of respondents	1383	806	248	248

Notes: The data are from a survey of all CQC regulated English care homes that we ran before and after the NLW introduction. We obtained information on all active care homes in England from the CQC registry and sent questionnaires to all homes in January and February 2016 for the pre-NLW part of the survey, and in late June, August and November 2016 for the post-NLW part of the survey. Responses were provided by the owner manager of the care homes. We obtained a total of 1390 responses in the pre-NLW survey and of 827 responses in the post-NLW survey, of which 248 responded to both surveys. In the pre-NLW survey we asked: "Do you think that the proposed level of the NLW is: *(i)* about right, *(ii)* too high, *(iii)* too low, (iv) don't know?". In the post-NLW survey we asked: "Do you think that the current level of the NLW is: *(i)* about right, *(ii)* too high, *(iii)* too low, (iv) don't know?". The table reports respondents' answers to these questions in the pre- and post-NLW waves for the whole sample of respondents (columns 1 and 2) and the balanced panel (columns 3 and 4).

Table A14 – Productivity

Dep. Var.: Change in log residents per worker hour

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.011	0.008				
	(0.008)	(0.009)				
Initial NLW gap			0.043	0.024		
			(0.088)	(0.097)		
Change in log average wage					0.390	0.215
					(0.435)	(0.869)
Observations	4,083	4,083	4,083	4,083	4,083	4,083
Controls	No	Yes	No	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.008	0.007				
	(0.010)	(0.012)				
Initial NLW gap			-0.010	-0.016		
			(0.113)	(0.126)		
Change in log average wage					0.186	-0.064
					(0.325)	(0.507)
Observations	4,083	4,083	4,083	4,083	4,083	4,083
Controls	No	Yes	No	Yes	Yes	Yes

Notes: The sample is a balanced panel of homes active between March 2016 and March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A15 – Closures

Dep. Var.: Indicator for Firm Closure

Panel A – March 2016 to June 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.001	0.002		
	(0.002)	(0.002)		
Initial NLW gap			0.020	0.022
			(0.020)	(0.024)
Observations	4,306	4,306	4,306	4,306
Controls	No	Yes	No	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)
Initial low-paid proportion	0.001	0.003		
	(0.004)	(0.005)		
Initial NLW gap			0.037	0.051
			(0.037)	(0.043)
Observations	4,306	4,306	4,306	4,306
Controls	No	Yes	No	Yes

Notes: The sample is a balanced panel of homes active in March 2016, unconditional on their survival until March 2017. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A16 – Firm entries at local authority level

Dep. Var.: Probability of firm entry

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.004	0.003				
	(0.004)	(0.010)				
Initial NLW gap			0.008	-0.006		
			(0.054)	(0.115)		
Change in log average wage					0.095	-0.033
					(0.374)	(0.616)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.004	0.002				
	(0.004)	(0.010)				
Initial NLW gap			0.008	-0.006		
			(0.054)	(0.115)		
Change in log average wage					0.055	-0.019
					(0.235)	(0.337)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.006	0.003				
	(0.005)	(0.011)				
Initial NLW gap			0.029	-0.009		
			(0.058)	(0.119)		
Change in log average wage					0.065	-0.017
					(0.199)	(0.232)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Notes: The sample is a balanced panel of local authorities. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

Table A17 – Firm exits at local authority level

Dep. Var.: Probability of firm exit

Panel A – March 2016 to June 2016

					IV Proport. below	IV NLW gap
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.004	0.006				
	(0.003)	(0.004)				
Initial NLW gap			0.029	0.055		
			(0.022)	(0.037)		
Change in log average wage					0.225	0.294
					(0.153)	(0.224)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Panel B – March 2016 to September 2016

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.001	-0.004				
	(0.007)	(0.009)				
Initial NLW gap			0.002	-0.008		
			(0.061)	(0.078)		
Change in log average wage					-0.106	-0.023
					(0.220)	(0.229)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Panel C – March 2016 to March 2017

	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion	0.003	0.004				
	(0.014)	(0.018)				
Initial NLW gap			-0.030	-0.036		
			(0.123)	(0.162)		
Change in log average wage					0.073	-0.070
					(0.338)	(0.319)
Observations	321	321	321	321	321	321
Controls	No	No	Yes	Yes	Yes	Yes

Notes: The sample is a balanced panel of local authorities. Robust standard errors are reported in parentheses. P-value: *** p<0.01, ** p<0.05, * p<0.1. Control variables are the initial proportion female, proportion with nursing qualification, proportion of care assistants, average age (all workers), occupancy rate and regional dummies.

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The Centre for Economic Performance Publications Unit
Tel: +44 (0)20 7955 7673 Email info@cep.lse.ac.uk
Website: http://cep.lse.ac.uk Twitter: @CEP_LSE