Minimum Wages and the Wage Policy of Firms*

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Abstract

The question of how firms set wages for their employees has been of longstanding interest in economics. In this paper, we investigate what models of wage determination are at play in a low-wage labor market. We exploit a sizable and salient age-specific minimum wage change in the United Kingdom – the National Living Wage (NLW) introduction. Starting April 2016, the NLW raised the minimum wage rate applying to workers aged 25 and over, leaving unchanged the minimum wage rates for younger workers. Using matched employer-employee data on the English residential care home sector, we document positive wage spillovers on workers aged under 25. Younger workers' wages are shown to have risen in tandem with those of older workers, with no detrimental effects on youth employment at both the market level and the firm level. We probe the inter- vs intra-firm nature of wage spillovers, and show that they arise within rather than between firms. Based on empirical tests and qualitative evidence from an ad-hoc survey of care homes in the sample, pay-equity concerns offer the most plausible explanation for the emergence of wage spillovers. The wage spillover effects that we document are shown to emerge in other low-paying sectors of the UK labor market.

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1. Introduction

It is now a widely accepted view in economics that firms play an important role in wage setting. This view is supported by several empirical studies of wage determination that document a significant firm-specific wage component (Card, Heining and Kline, 2013; Card et al., 2018; Song et al., 2018). By contrast, we know relatively little about how firms set wages for their employees and what issues are involved in the determination of a firm's wage policy. The wage policies of firms may be designed to achieve one or more objectives, such as attracting and retaining a given quantity or quality of talent, meeting employees or societal expectations around fair compensation, or containing administrative and bargaining costs. The process of wage determination by firms is likely heterogeneous across segments of the labor market.

In this paper, we focus on the low-wage section of the labor market, and investigate (i) what models of wage determination are at play and (ii) how they interact with the policy environment. Our policy focus is placed on minimum wages, which are a prominent example of wage policy that can interact with wage setting by firms at the low-end of the pay spectrum. We exploit a sizable and salient age-specific minimum wage change in the United Kingdom – the National living Wage (NLW) introduction – which raised the minimum wage rate applying to workers aged 25 and over from £6.70 to £7.20 an hour (a 7.5 percent increase) from April 1, 2016, while leaving unchanged the minimum wage rates for younger workers. The unexpected nature and the size of this age-specific minimum wage change provide a unique 'natural experiment' to study the general-equilibrium wage (and employment) response to a quasi-exogenous wage change targeting a subset of the low-wage workforce.

At the market level, we document large, positive wage spillovers of the NLW on workers aged under 25. Younger workers' wages are shown to have risen in tandem with those of older workers, with no detrimental effects on youth employment. At the firm level, we provide evidence that wage spillovers arise within rather than between firms, and that they are stronger in firms with a larger fraction of older workers whose wages are directly affected by the NLW introduction. Both the market-level and firm-level results provide a clear indication of uniform wage setting across workers in the low-wage labor market. But why do firms set wages uniformly across employees? We discuss potential drivers of wage spillovers and assess their relative importance. Based on empirical tests and qualitative evidence from an ad-hoc survey of pay practices, we conclude that fairness norms offer the most plausible explanation for the emergence of wage spillovers.

In the first part of the paper we analyze the market-level wage and employment effects of the NLW introduction. The analysis is based on matched employer-employee data on the English adult social care sector from the Adult Social Care Workforce Data Set (ASC-WDS). ASC-WDS is a monthly panel of matched employer-employee data, including detailed information on workers' demographics, job role and hourly pay rate, among other, and covering the period from September 2014 to March 2019. Adult social care covers the provision of personal and physical support to adults – mostly the elderly – affected by physical or learning disabilities, or physical or mental illnesses. Social care is a setting especially suited to studying the interaction between company wage policies and minimum wage policy for two reasons. Firstly, social care is traditionally a low-unionized and low-wage sector, with a large fraction of workers paid at the minimum wage and with high vulnerability to minimum wage increases (Machin, Manning and Rahman, 2003; Machin and Manning, 2004). Secondly, detailed matched employer-employee data with precise information on hourly wages is available for this sector, making it a rather unique setting for studying both market- and firm-level wage effects. To the best of our knowledge, comparable data on other sectors of the economy are not available in the UK.

At the market level, we document strong positive wage spillovers on workers aged under 25 following the NLW introduction. We show that average gross hourly wages of workers in the social care sector are perfectly smooth at the age-25 cutoff both one month before and one, two and three years after the NLW introduction. At the same time, no discontinuity emerges in the number of workers employed in the sector around the same policy threshold. These results stand in stark contrast to the prediction of a standard competitive spot market model, which – under the assumption of perfect substitutability at the age-25 threshold – would predict a discontinuity in either wages or employment. Using finely-binned gross hourly wage distributions, we can reject that the market-level wage spillovers are due to compositional changes, contractual rigidities, ageing-out effects or frictions in the adjustment of wages to the new 'NLW norm'. We probe the external validity of this part of the analysis using a large-scale survey of wages and hours covering the entire private sector in the UK labor market. We show that our market-level results hold across the entire UK labor market and, specifically, across low-paying industries and occupations.

The second part of the paper analyzes firm-level effects. While the market-level analysis documents the existence of positive wage spillovers, this part of the paper investigates whether wage spillovers arise within or between firms. Wage spillovers are a between-firm phenomenon if they arise as a consequence of younger workers sorting into higher-paying firms; they are a within-firm phenomenon if they reflect company wage policies aimed at retaining talent, preserving equality, controlling administrative costs, and the like. To assess the inter- or intra-firm nature of wage spillovers, we implement a difference-in-differences design with continuous treatment and compare the size of wage spillovers across firms that were differentially exposed to the NLW introduction, due to variation in the proportion of workers aged 25 and over paid below the NLW in the pre-reform period. Wage spillovers, we show, are larger precisely in those firms in which larger fractions of older workers had their wages increased as a consequence of the minimum wage reform. Also in this case, no disemployment effects can be tracked down, neither at the extensive nor at the intensive margin. Similarly, we do not find significantly lower turnover rates among young workers in firms with more generous wage spillover policies.

In the third part of the paper, we examine potential determinants of the observed wage effects. Building on Behrend (1960)'s paradigm, our conceptual framework distinguishes two macro drivers of wage spillovers: inter- and intra-firm factors. Inter-firm factors reflect the dynamics of competition between firms to attract and retain workers. If wage spillovers are driven by these inter-firm dynamics, we should observe larger wage spillovers among workers with better outside options. Intra-firm factors reflect, instead, a cost to the firm of keeping a diversified wage structure. Wage dispersion can be costly to the firm for various reasons. We identify three such reasons: (i) the time and resource cost of having to bargain individualized wages, (ii) the administrative cost of keeping track of a diversified wage structure, and (iii) pay equity concerns. While it is difficult to single out a specific factor, if anything because firms may try to achieve multiple objectives with their wage setting policies, we attempt to gauge the relative importance of the various determinants. By means of a set of empirical tests, we rule out the hypothesis that wage spillovers are driven by competition among firms and show that the size of a firm's spillovers is not correlated with a broad array of proxies for its workers' outside option. Similarly, we do not find evidence in favor of administrative and bargaining costs playing a significant role in generating uniform pay structures. We provide instead three pieces of indirect evidence on the relevance of fairness norms. First, we show that wage spillovers are larger in firms with a larger share of older workers whose wages increased because of the NLW, even conditional on an equal share of young workers being 'eligible' for a wage spillover (i.e. paid below the NLW in March 2016). Second, and consistent with models of fairness positing that equity concerns apply to a worker's reference group (Cabrales, Calvó-Armengol and Pavoni, 2008), we show that wage spillovers arise only within job roles within the firm. Thirdly, in line with the notion that inequality aversion in the firm leads to flatter occupation-firm-specific wage-tenure profiles (Cabrales, Calvó-Armengol and Pavoni, 2008), we use the pre-NLW firm-specific wage-tenure gradient as a proxy for fairness norms at the firm level, and show that firms with flatter wage-tenure profiles (stronger fairness norms) implement larger wage spillovers.

Finally, we complement the qualitative evidence from ASC-WDS with qualitative evidence from the Adult Social Care Survey of Pay Practices (ASC-SPP), an ad-hoc survey of social care providers drawn from the ASC-WDS archives, which we designed to investigate pay practices in the sector. Consistent with the empirical analysis, survey responses indicate that uniform pay/wage spillovers are overwhelmingly motivated by fairness principles.

In sum, this paper shows that, in a low-wage labor market, firms apply uniform pay across workers of different ages employed in similar job roles, in spite of the possibility to legally apply a lower rate to younger workers. The emergence of positive downward wage spillovers from minimum wage legislation is a within-firm phenomenon, driven by inequality aversion and fairness norms inside the firm. These results are relevant for models of the low-wage labor market, since they provide direct evidence that wages are not set individually, but rather at the reference-group level and based on a principle of fairness. The evidence is also informative of how public policies interact with wage setting within the firm. As such, it can be relevant for the design of a host of wage policies with the potential of affecting the within-firm wage structure (e.g. payroll taxes or minimum wages). In this respect, it is worth noting that, even though the policy change that we are exploiting is quite singular in nature, the existence of an age-specific minimum wage structure is rather common in countries with minimum wage regulations in place. Hence, the labor market policy considerations drawn from the analysis in this paper are likely widely applicable to similar institutional contexts.

Related literature. This paper is mainly related to a line of research examining company wage policies. There has been a long-standing interest in labor economics and industrial relations on how firms set wages, what objectives they attempt to achieve and what constraints they face in this process (Behrend, 1960). Building on a vast experimental literature on social preferences (Fehr and Schmidt, 1999; Sobel, 2005), an important branch of this literature has focused on the role played by fairness norms in wage setting, from both a theoretical and an empirical perspective. Theoretical contributions have inspected the implications of equity concerns for within-firm and market-level wage dynamics and skills segregation (see Cabrales, Calvó-Armengol and Pavoni (2008) and references cited therein). On the empirical side, there is a growing body of evidence documenting the labor supply effects of pay inequality and the constraints imposed by equity principles on wage setting (Card et al., 2012; Breza, Kaur and Shamdasani, 2017; Dube, Giuliano and Leonard, 2019). We complement this strand of work by providing quasi-experimental evidence on firm wage policies and by testing empirically the role played by inter- and intra-firm determinants of wage setting practices.

Second, by documenting the non-competitive nature of wage setting in a low-wage labor market, this paper contributes to the still relatively scarce empirical evidence on monopsony power and wage setting in low-wage labor markets (Giuliano, 2013; Dube, Giuliano and Leonard, 2019). Implicitly, our paper also offers a test for the assumption of absence of discrimination across employees, which is central to efficiency considerations in monopsonistic models of the labor market. In other words, the fact that we find that firms do not differentiate wages across workers of different ages underscores a key assumption of monopsony models. Absent this assumption, workers' idiosyncratic preferences toward amenities will create variation in wages via compensating differentials (Rosen, 1986). To the contrary, if firms are not able to set wages individually, monopsonistic models à la Manning (2003) and Card et al. (2018) predict suboptimally low employment in equilibrium.

Third, by virtue of the fact that it analyzes the effects of an age-specific policy, this paper is related to prior work analyzing the wage and employment effects of age-specific minimum wage policies (Böckerman and Uusitalo, 2009; Kabátek, 2020; Kreiner, Reck and Skov, 2020) and payroll tax cuts (Saez, Matsaganis and Tsakloglou, 2012; Saez, Schoefer and Seim, 2019). Our analysis adds to the existing evidence by identifying both market- and firm-level effects from a policy change that is salient, sizable and costly to the firm.

Finally, to the best of our knowledge, we are the first to cleanly document the existence of downward wage spillovers and to characterize their intra-firm nature. In this respect, we contribute to a well-established literature on the wage distributional effects of minimum wage policies and collectively bargained wage floors (DiNardo, Fortin and Lemieux, 1996; Lee, 1999; Autor, Manning and Smith, 2016; Leonardi, Pellizzari and Tabasso, 2019).

The paper proceeds as follows. Section 2 outlines the institutional details of the UK minimum wage legislation and illustrates the features of the adult social care sector in England. Section 3 describes the data. Market-level results are discussed in Section 4, while the firm-level analysis is laid out in Section 5. Section 6 investigates potential determinants of wage spillovers and is complemented by a discussion of notions of fairness in Section 7. Section 8 concludes.

2. Institutional and economic context

2.1 Minimum wages in the UK

The UK has had a system of age-specific, national minimum wage rates since April 1999.[1] The National Minimum Wage (NMW) was legislated in the National Minimum Wage Act 1998 and came into force on April 1, 1999. Back then, 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.

The National Minimum Wage Act 1998 also appointed the Low Pay Commission (LPC), an independent advisory body charged with advising the Government on minimum wage policy. The LPC is composed of nine members, of which three representatives of business organizations, three representatives of workers and three labor market experts (these include the Chair and two academics). The LPC's remit, as set by the Government, is to provide evidence-based advice on minimum wage rates.[2] The body submits its recommendations to the Government, which can accept or reject them.[3] If accepted, the recommended rates subsequently become effective.

On July 8, 2015, the Chancellor of the newly elected conservative government announced the introduction of the National Living Wage (NLW) – a new minimum wage rate for workers aged 25 or above. The NLW raised the minimum wage applying to workers aged 25 and over starting April 1, 2016, while leaving unchanged the minimum wage rates for younger workers. Following the NLW introduction, 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-olds and the apprentice rate for apprentices. Appendix Figure A1 shows the evolution of minimum wage rates since April 1999.

[1] Prior to that, there used to be industry-level wage floors – the Wage Councils – that were in force between 1909 and 1993. At the time of their repeal, Wage Councils covered only approximately 12 percent of the workforce.
[2] 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.
[3] The LPC's recommendations have been almost always accepted by the UK government. The apprentice rate has 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 (on top of a recommended £0.07 increase), pushing it up from £2.73 in 2014 to £3.30 in 2015.

Figure 1 hones in on the policy variation that we exploit for identification. The figure shows the evolution of the minimum wage rate(s) applying to 'adult' workers aged 21 and over between September 2014 and March 2019. Adult workers were subject to the same NMW until the end of March 2016. Starting from April 2016, a different minimum wage rate applies to workers aged 21-24 (NMW), and aged 25 and over (NLW). Back then, the NMW was set to £6.70 an hour and the NLW to £7.20.

The NLW introduction was a radical political intervention in various ways. Firstly, it generated a minimum wage increase much larger than previous uprates, of 10.8 percent at the time of announcement and of 7.5 percent at the time of implementation (see Figure 1). As a result, minimum wage coverage (formally those paid at or below the relevant minimum and up to £0.05 above) grew from 1.6 million to 2.5 million in April 2016. The NLW introduction also set a target for the NLW to achieve 60 percent of median wages by 2020. Secondly, the intervention departed significantly from the legislative procedure that had been applied since 1999, in which the LPC had a prominent role in the definition of the minimum wage rates. By setting a target for 2020, it implicitly modified the role of the LPC in providing guidance. Finally, the NLW introduction was highly salient.[4] These features of the policy change – and the lack of publicity or prior policy discussions – highlight the drastic and unexpected nature of the reform.[5]

Most importantly for our analysis, the unexpected, sizable and age-specific minimum wage change generated by the NLW introduction provides a unique 'natural experiment' to study the general-equilibrium wage (and employment) response to a quasi-exogenous wage change targeting a subset of the workforce. As will be discussed in detail in Sections 4 and 5, the policy variation is suitable to the study of wage adjustments at both the market and the firm level. It is also worth noting that, even though the specific policy change that we are exploiting is quite singular in nature, the existence of age-specific minimum wage structures is rather common in countries with minimum wage regulations in place. As such, the labor market policy considerations drawn from the analysis in this paper is likely widely applicable to similar institutional contexts.

It is important to stress that in the UK it is not unlawful to age-discriminate based on minimum wage rates. The Equality Act 2010 states that it is not unlawful age discrimination to pay workers of different ages at different rates, if the pay structure is based on the age bands set out in the national minimum wage legislation. As such, an employer can pay a younger worker at a lower rate than an older worker, so long as the minimum wage rate for the younger worker is lower than that for the older worker, and the younger worker is paid less than the highest rate of the minimum wage.

[4]In the ASC-SPP survey of social care providers – which is described in Section 3 and Appendix C – 9 out of 10 respondents state that they were aware of the features of the NLW at the time in which it was introduced (see Appendix Table C2).

[5]The main justification for the introduction of the NLW was to offset the sizable cuts in tax credits (that typically apply to individuals aged 25 and above), which were simultaneously announced as part of the emergency budget, but de facto never implemented.

2.2 Adult social care in the UK

Adult social care is the support provided to adults – mostly the elderly – affected by physical or learning disabilities, or physical or mental illnesses. The support provided could be for personal care activities such as eating, cleaning and getting dressed, or for domestic routines such as going to the shops. Adult social care can be provided in care homes (*residential care*) or in the patient's home (*domiciliary care* or *home care*).

In this paper we mostly focus on workers and firms operating in the residential care industry, or care home industry. Residential care refers to the provision of accommodation and personal care to adults in a communal residential center, which may or may not provide nursing facilities. Members of staff in residential care homes are predominantly care assistants, who provide 24-hour supervision, meals and help with personal care needs. The residential care sector is characterized by a large number of small-medium enterprises offering a highly labor-intensive and rather homogeneous service, and it employs a large number of low-paid workers. Traditionally, the sector has been very low-unionized, with a union coverage rate of less than 20 percent among all care assistants and of less than 5 percent among care assistants aged under 25 in 2017 according to Labor Force Survey data. In the UK, adult social care fees are regulated and, for the most part, paid for by local authorities. Indeed, even though approximately 75 percent of residential care places are owned and managed by private-sector, for-profit firms, up to 60 percent of places are funded by local authorities at regulated prices. Taken together, these characteristics make the residential care sector especially vulnerable to the wage-cost shock induced by minimum wage changes, as has been documented in earlier research on the sector (Machin, Manning and Rahman, 2003; Machin and Manning, 2004).

While residential care will be the main focus of the analysis, we will also look – albeit to a smaller extent – to domiciliary care. The type of service offered in domiciliary care is similar to that in residential care, as it still revolves around the provision of personal care to adults with physical, learning or mental disabilities. The main difference between the two sectors is that domiciliary care services are provided in a customer's own home, whilst residential care involves the customer staying permanently in a communal establishment set up solely to provide care. Domiciliary care assistants tend to work individually and travel to multiple homes to visit patients during the day. Conversely, residential care assistants work largely in teams and operate in the residential care home.

Apart from being a sector especially suited to studying minimum wage policy, adult social care is also an interesting context to study wage-setting practices, since detailed employer-employee matched data with precise information on hourly wages is available for this sector. A comprehensive description of the data sources that we adopt is provided in Section 3. To the best of our knowledge, comparable data on other sectors of the economy are not available in the UK.

One obvious drawback of focusing on a single sector of the economy is that the results obtained therein may not extend to other sectors. To overcome this limitation, we replicate the core of our market-level analysis using a large-scale survey of employees for the entire UK labor market. The data used and empirical results are illustrated in Appendix B. However, it is worth emphasizing that the main objective of this paper is to investigate models of wage determination in the labor market. We document the existence and nature of one such model in a low-wage segment of the labor market. Whilst we show in Appendix B that the model we identify appears to extend to other low-paying industries, it can nonetheless coexist with other wage-setting strategies.

3. Data

3.1 Adult Social Care Workforce Data Set (ASC-WDS)

The main data source that is used in the analysis is the Adult Social Care Workforce Data Set (ASC-WDS). This is an online data collection service that covers the adult social care workforce in England. The service is administered by Skills for Care – an independent charity with expertise in adult social care workforce development and a delivery partner for the Department for Health and Social Care. For social care providers, ASC-WDS is in essence a human resource management platform, which allows them to store and organize information on their workforce, including payroll data. Through their ASC-WDS account, providers can also view and analyze data on their own workforce, apply for training and development funds, benchmark themselves against other providers locally, regionally or nationally based on key workforce metrics, and directly share their data and returns with governmental authorities such as the Care Quality Commission and the National Health Service. Access to ASC-WDS is free of charge. The data collected within the service is relied upon by the Government, the Department for Health and Social Care, local authorities and the Care Quality Commission to monitor and make planning and funding decisions for the sector.[6]

From the standpoint of a researcher, ASC-WDS is a panel of matched employer-employee data at monthly frequency. For each provider, we have information on the main service provided, service capacity and utilization, number of staff employed, geographic location and dates in which the system is updated by the provider. For each provider, we observe if it is a single firm or if it belongs to a larger parent organization, of which we know the identifier. For workers, we have information on demographics (gender, age, nationality), job role, contracted and additional weekly hours of work, hourly pay rate, qualifications and the dates in which the worker's records are updated. We have access to the monthly data files from September 2014 to March

[6]The Care Quality Commission 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.

2019, each file including all providers in the system at that date.[7] Skills for Care estimates that at the end of March 2016 – our baseline month – ASC-WDS had 56 percent coverage of English regulated social care establishments and approximately 50 percent coverage of workers employed by registered providers (Davison and Polzin, 2016).

We now define the samples used in the market-level analysis and the firm-level analysis. For the market-level analysis, we consider all workers employed in residential care homes active in any given month between September 2014 and March 2019. As of March 2016, the sample comprises a workforce of close to 332,700 individuals, employed by a total of 9,100 providers belonging to 4,500 single or parent organizations.[8] For the firm-level analysis, we employ a balanced panel of 4,631 providers that have been active throughout the period from March 2016 to March 2017. We restrict the sample to firms having updated their records at least once after March 2016 – a requirement which is not especially restrictive considering that more than 90 percent of employers update their data within a year. Finally, due to the nature of the research question, we consider firms that employed workers under 25 both in March 2016 and March 2017.[9]

Table 1 reports the mean and standard deviation of a set of individual and firm characteristics for workers in the market-level sample in columns (1) and (2), and for workers and firms in the firm-level sample in columns (3) to (6). All figures are as of March 2016. The statistics confirm the depiction of the residential care sector that was provided in Section 2.2, namely that the industry is characterized by low pay (£7.91 per hour on average) and is highly exposed to minimum wage changes – in March 2016 51 percent of workers aged 25 and over were paid below the NLW.[10] The average employee is a woman (84 percent of the workforce being female), aged

[7] In order to accurately establish the activity status of each provider and, if present, their parent organization, we link the ASC-WDS data to the Care Quality Commission registry. The latter offers a complete record of all active English care providers regulated by the Care Quality Commission. The archive is available at monthly frequency and updated each month. It can be used to precisely identify the activity status of providers at each point in time.

[8] Throughout the manuscript we use the terms 'provider' and 'firm' interchangeably to indicate a single-establishment firm or an establishment within an organization.

[9] Conditioning the sample of firms to be active between March 2016 and March 2017, and to employ young workers in both periods, may generate endogenous sample selection. We test whether this is the case in Appendix Tables A1 and A2. In Appendix Table A1, we consider all firms active (and employing workers under 15) in March 2016 and estimate linear probability models of the organization being active in March 2017, March 2018 and March 2019, as a function of the bite of the NLW among workers aged 25 and over in March 2016, and conditional on a set of firm-level characteristics at baseline and local authority district fixed effects. This specification corresponds to the reduced-form specification that we use in the firm-level analysis and that is described in more detail in Section 5.1. The estimates in Appendix Table A1 suggest that there is no systematic relationship between the NLW bite – our 'treatment' variable – and firm survival over the three years after the NLW introduction. The coefficient in column (1) indicates a modestly significant, negative effect of the NLW bite in 2016 on the probability of survival in March 2017; the effect is small (2 percent of the baseline) and fades away in subsequent years. The results reported in Appendix Table A2 test instead for sample selection with respect to conditionality on youth employment in March 2016 and March 2017. All estimates are based on linear probability models similar to the one described above. Based on the sample of firms active in March 2016, the coefficient in column (1) is an estimate of the effect of the NLW bite on the probability of employing workers under 25 in March 2016. The estimates in columns (2) to (4) are instead based on firms active and employing young workers in March 2016, and represent the association between the NLW bite in March 2016 and the probability of employing young workers in subsequent years (conditional on being active). Taken together, the estimates suggest that conditioning on youth employment is not introducing sample selection endogenous to treatment intensity.

[10] In 2016, the tenth percentile of UK hourly wages was approximately £7.30 and the average hourly wage £15.70.

42 and with approximately 5 years of tenure in the firm. Workers aged under 25 make up 12 percent of the workforce. The main occupation in residential care is 'care assistant' (equivalently 'carer'), in which 55 percent of the workforce is, followed by 'ancillary staff' (15 percent), 'senior carer' (9 percent), 'nurse' (6 percent) and 'administrative staff' (2 percent). Carers and senior carers attend to the personal needs of residents, with senior carers potentially overseeing teams of carers. Ancillary staff perform support activities not involving direct personal care, such as cleaning and cooking. Nurses provide skilled care and have nursing qualifications, while the vast majority of (senior) carers do not. Hourly wages are lowest for ancillary staff (£7.13 on average) and care assistants (£7.20), slightly higher for senior carers (£8.05) and administrative staff (£8.62), and in line with national median wages for nurses (£12.82). Almost 9 out of 10 workers are hired on a permanent contract and 8 percent as 'bank' staff, i.e. on a casual contract. Whether permanent or not, 8 percent of workers are on a zero hours contract, a contractual arrangement in which workers are not guaranteed any hours of work in a particular period. Zero hours contracts are especially popular in social care, domiciliary care in particular. Finally 3 firms out of four are private, for-profit entities (even if all the services provided are purchased by one or more local authorities), 16 percent are non-profit, and 7 percent are fully funded and managed by local authorities.

3.2 Adult Social Care Survey of Pay Practices (ASC-SPP)

We complement the quantitative evidence based on the ASC-WDS data with qualitative information from the Adult Social Care Survey of Pay Practices (ASC-SPP). The ASC-SPP is an ad-hoc survey of social care providers drawn from the ASC-WDS archives, designed to investigate pay setting, vacancy posting and hiring practices of adult social care providers. The survey design, sampling frame and implementation are described in detail in Appendix C.1, and the survey questionnaire is reported in Appendix C.4. The survey results – reported in Appendix C.3 – will be illustrated in Section 6.

3.3 Annual Survey of Hours and Earnings (ASHE)

The Annual Survey of Hours and Earnings (ASHE) is a large-scale survey of earnings and hours of employed individuals in the UK. The survey collects information on the wages and paid hours of work of nearly one percent of the working population, drawing the sample of individuals from National Insurance records and requesting their employers to fill the survey forms. The survey covers employment in all industries and occupations in the UK and can therefore be used to investigate UK-wide market-level responses to the NLW. Conversely, ASHE cannot be used to study firm-level responses to the NLW, since the sampling frame does not guarantee that all workers in a given establishment or firm are observed in the data. Using ASHE, we probe the external validity of the market-level results obtained for the adult social care sector. A detailed description of the ASHE data and of the market-level effects estimated therein is provided in Appendix B.

4. Market-level effects

4.1 Wage and employment responses

In this section, we analyze the effects of the NLW introduction on age-specific hourly wages and employment. We use the sample of all *care assistants* employed in residential care homes in any given month. To evaluate the wage effects of the NLW introduction, we test whether average gross hourly wages by age become discontinuous at the age-25 eligibility cutoff after the policy change. Note that, prior to the NLW introduction, all workers aged 21 and over were legally subject to the same NMW. Under the plausible assumption that workers aged just below and just above 25 are close-to-perfect substitutes in terms of their labor productivity, hourly wages are expected to be smooth around the age-25 cutoff in the pre-reform period. We formally test for the presence of a discontinuity at the eligibility threshold using a regression discontinuity (RD) design. We use the following empirical specification:

$$w_{it} = \alpha_0 + \alpha_1 \cdot \mathbb{I}[age_{it} \geq 25] + f(age_{it} - 25) + g(age_{it} - 25) + \varepsilon_{it} \tag{1}$$

where w_{it} denotes the gross hourly wage for worker i in month-year t, age_{it} is i's age measured at the quarterly level at time t, and ε_{it} is the error term. In this model, the parameter of interest is α_1, which captures the discontinuity in wages at age 25. Following Calonico et al. (2018), we treat our running variable as discrete and estimate the model non-parametrically by fitting a local polynomial to a 'collapsed' version of the data, in which we aggregate the individual observations by the discrete values of the running variable and compute the average outcome for all observations with the same value of the running variable. Panel A of Appendix Figure A2 reports the RD estimate and associated 95 percent confidence interval of a set of McCrary tests for a discontinuity in the density function at the age-25 cutoff for the end-month of each quarter in the sample period. The test fails to reject the null hypothesis of no discontinuity in the density of the running variable at the relevant threshold throughout the period analyzed, supporting the identification assumption of the RD design.[11]

[11] We also conduct a set of falsification tests for the assumption of local randomization in the minimum window around the cutoff $[24.75, 25]$. Firstly, we run a sequence of density tests in the end-month of each calendar quarter in the sample (from September 2014 to March 2019). The statistical tests assess whether the density of observations in the window is consistent with what would be observed if observations where assigned randomly to either side of the threshold. The tests support the assumption of local randomization in 74 percent of cases. Secondly, we run a set of balancing tests on predetermined covariates. We estimate the RD effect of age on the probability of being employed as carer and – conditional on being a carer – of being female. The balancing tests strongly support the assumption that individuals workers aged slightly below and slightly above 25 share the same predetermined characteristics throughout the period analyzed. Results available upon request.

Panel A of Figure 2 visualizes the effect of the NLW introduction on average wages of care assistants by age. The graph plots the average gross hourly wage in each age bin (with age measured in quarters) in March 2016 and in March 2017, and reports the RD estimate and associated standard error for both periods in the top right corner. The figure shows that – prior to the reform – wages were a moderately increasing, smooth function of age and averaged £7.00 around the 25 age threshold. Twelve months after the NLW introduction, the age-profile of wages is a shifted version of the pre-reform one, with a small and moderately significant discontinuity of £0.05 at the cutoff. Panel B of Figure 2 shows that the evolution of hourly wages by age continues as a vertical shift two and three years after the reform, with no statistically significant discontinuity at the NLW-eligibility threshold. Panel B of Appendix Figure A2 reports the sequence of RD estimates for the entire period of analysis, confirming the substantial smoothness of the wage profile both before and after the reform. These results indicate that younger workers' wages rose in tandem with those of older workers' ones, with no detectable differences around the policy cutoff. In other words, the NLW introduction generated positive wage spillovers on young workers who were not legally bound by the minimum wage increase.

To quantify the size of market-level wage spillovers, Appendix Table A3 displays estimates of the coefficient α_1 in model 1 for different wage outcomes. We estimate the model pooling data for March 2017, March 2018 and March 2019, and including time fixed effects in the estimation. Column (1) reports the estimated α_1 using hourly wages of care assistants as outcome variable. In column (2), the outcome variable is a measure of the counterfactual hourly wage that care assistants would have received absent wage spillovers. For workers aged 25 and over, the counterfactual wage is equivalent to their actual wage $w_{i,t}$, where t indexes calendar years. For younger workers, it is defined as $\max(w_{i,t-1}; NMW_t^{21-24})$ if $w_{i,t-1} < NLW_t$, and $w_{i,t}$ otherwise.[12] The results in column (2) indicate that, absent wage spillovers, a discontinuity of £0.20 would have emerged at the age-25 cutoff on average in the post-NLW years. The magnitude of wage spillovers can be measured as $\frac{\hat{\alpha}_1^{counterf} - \hat{\alpha}_1^{actual}}{\hat{\alpha}_1^{counterf}}$, which is reported in the bottom row of the table. We estimate a wage spillover of 90 percent among care assistants.[13]

Panel C of Figure 2 shows that the positive wage spillovers were not accompanied by negative employment spillover effects on young workers. The figure reports the employment count for carers by age bin before and after the reform, showing no discontinuity at age 25 nor substantial changes in the profile of employment by age bin. Panel D of Figure 2 rules out the possibility that employment changes occurred in the months between the announcement and the introduction of the NLW. Employment in those months is characterized by the same profile as one month prior to the reform announcement and no discontinuity can be detected at age 25 in the months between announcement and implementation. No discontinuity in employment can be detected up to three years after the policy reform, as Panel C of Appendix Figure A2

[12] The counterfactual wage for new hires aged under 25 is assumed to be equivalent to NMW_t^{21-24}.

[13] Columns (3)-(4) report analogous estimates for all workers in residential care, where spillovers are equivalent to 92 percent.

shows. Similarly, no discontinuity can be found in average weekly hours worked and worker turnover, as indicated in Panels D and E of Appendix Figure A2.[14]

Our findings are in stark contrast with the predictions of a standard competitive spot market model. In a setting in which all workers are ex-ante subject to the same minimum and are assumed to be perfect substitutes, the competitive framework predicts that – once a policy like the NLW is introduced – a cost-minimizing firm would passively adjust wages and pay workers their age-specific minimum. In the short run, this would generate a discontinuity in wages at the age-25 cutoff. Since young workers are now 'cheaper' to employ, firms would hire more of them, which in equilibrium would drive up their wages. In the longer run, the wage gap would close, but a discontinuity in employment would emerge. The wage and employment effects that we document are inconsistent with these predictions. Rather, they are consistent with a model of wage determination different from the standard competitive one and a degree of wage-setting power by firms.

4.2 Anatomy of wage spillovers

While so far we have focused on average wage effects, we now turn to analyzing how the hourly wage distribution changed in response to the NLW introduction. Empirically, we construct a set of finely-binned hourly wage distributions, with bins of £0.10 width, and trace out their evolution from before to after the NLW introduction for different subgroups of workers. With this strategy, we can neatly identify where spillover effects are localized along the distribution and establish more convincingly the direct causal relationship between the minimum wage policy and the observed wage effects. We can also test the role played by a set of potential determinants in generating the observed wage responses.

Panel A of Figure 3 reports the hourly wage distribution of care assistants aged 25 and over in March 2016 (gray bars) and March 2017 (unfilled bars). The red dashed vertical line indicates the level of the NLW in March 2017. Among eligible workers, the introduction of the NLW generated strong compression at the bottom of the wage distribution and a spectacular spike at the new minimum. The same phenomenon can be observed when focusing on workers aged under 25, as shown in Panel B of Figure 3. The distribution of younger workers' wages exhibits the same spike at the NLW, corroborating the idea that wage spillovers are arising as a consequence of the NLW change and indicating that a large fraction of young workers had their wages raised exactly at the new minimum.

Aging-out effects. Of the various factors that could generate the observed wage effects, a simple one is 'aging-out' effects. If a large fraction of workers aged under 25 are in fact close to turning 25, firms may bundle their wages with those of older workers and increase them at the same time for the sake of simplicity. One simple way to test this hypothesis is to look at the evolution of the wage distribution of workers aged well below 25 in March 2017. Panels

[14]Turnover is measured as the sum of the hiring and separation rates.

C-F of Figure 3 report the wage histograms for workers aged under 24, 23, 22 and 21 in the pre- and post-reform periods. All figures resemble closely the results in Panel B, ruling out the possibility that 'aging-out' effects are generating the spillovers.

Compositional changes. Another factor that may give rise to the observed wage response is a change in the composition of the youth workforce. If most firms suddenly laid off the least productive young workers and hired highly productive ones, this could generate the type of uniform pricing that we have seen. To test this idea, Panel A of Figure 4 keeps fixed the composition of the sample, by selecting workers who are observed both in March 2016 and in March 2017, and who were aged under 24 in March 2016. A spike at the new minimum arises also in this case, excluding substantial composition-driven biases.

Contractual rigidities. Wage adjustments by firms may be constrained by contract- or norm-based wage rigidities. In particular, employment relationships may be characterized by implicit or explicit long-term agreements on the profile of wage increases over time. In the presence of such contractual or norm-based rigidities, employers may be unable to implement age-specific wage adjustments in response to a policy change like the NLW introduction. To assess the role of implicit and explicit contracts in shaping wage spillovers, we restrict the analysis to subgroups of workers aged under 25, for whom contractual rigidities are plausibly non-existent or very weak. Panel B of Figure 4 refers to workers hired by firms that newly established their activity after the NLW introduction. Panel C refers to workers hired after March 2016 and with no prior experience in adult social care. Panel D also refers to new hires, but considering workers who were previously employed in adult social care. Finally, Panel E restricts the sample to temporary, temp-agency and bank – i.e. casual – workers, who can be considered 'outsiders' of the labor market, typically subject to less rigid and shorter contracts. For all those subgroups of young workers, we can still detect a spectacular spike at the NLW, indicating that contractual rigidities cannot plausibly explain our results.

Adaptation to a new norm. Finally, it may take time for the wage structure to adapt to a new institutional norm. Before the NLW was introduced, the NMW had been the established or 'going' rate applying to all workers aged 21 and over since 2010, and to all workers aged 22 and over since 1999. Departing from a vicennial institutional norm may take more than just 12 months. In Panels A-D of Figure 5, we trace out the dynamics of wage spillovers over time, by reporting the evolution of the hourly wage distribution of young workers from March 2016 to March 2020, thus covering four years of the NLW and associated rates. The large spike at the NLW remains a persistent feature of the wage distribution throughout the period and up to four years after the policy reform. In light of these results, we can conclude that the wage spillovers do not seem to be the outcome of short-run, norm-based adjustment frictions.

Robustness. In order to keep the sample as homogeneous as possible, the analysis in this section restricts the sample to care assistants. Results are robust to including all occupations in the sample (Appendix Figures A3 and A4) and to analyzing a representative sample of private-sector UK workers (see Appendix B).

5. Firm-level effects

5.1 Empirical strategy

The market-level results presented in Section 4 document the existence of positive wage spillovers on young workers. To the best of our knowledge, this is the first clear evidence of 'downward' wage spillovers – i.e. spillovers affecting the portion of the wage distribution *below* the minimum – generated by a minimum wage increase. On the contrary, 'upward' wage spillovers at the market level – that is spillovers affecting wages strictly *above* the minimum – have been largely documented in the minimum wage literature (DiNardo, Fortin and Lemieux, 1996; Lee, 1999; Autor, Manning and Smith, 2016). An interesting question that has not been investigated before is whether wage spillovers arise within or between firms. Wage spillovers are a between-firm phenomenon if they arise as a consequence of workers sorting to higher-paying firms – younger workers in case of 'downward' spillovers and workers paid above the minimum in case of 'upward' spillovers. They are, instead, a within-firm phenomenon if they reflect company wage policies aimed – for instance – at preserving equality among workers in the case of 'downward' spillovers or at maintaining wage differentials in the case of 'upward' spillovers.

We investigate this question by analyzing the size of wage spillovers on young workers across firms that were differentially exposed to the NLW introduction. Our empirical strategy is based on a difference-in-differences design with continuous treatment, in which we compare the evolution of younger workers' wages across firms that were differentially affected by the policy change, due to variation in the proportion of workers aged 25 and over paid below the NLW in the pre-reform period. For this part of the analysis, we consider a balanced panel of firms active throughout the period between March 2016 and March 2017, and employing at least one worker aged under 25 in both periods, as described in more detail in Section 3.1. We also report results for the unbalanced panel of firms active in March 2016. Our empirical model can be formalized as follows:

$$\Delta \ln w_{j,t}^{under25} = \beta_{0,t} + \beta_{1,t} MIN_{j,Mar16}^{25+} + X'_{j,Mar16}\beta_{2,t} + \eta_{j,t} \tag{2}$$

where $\Delta \ln w_{j,t}^{under25}$ is average gross hourly wage growth in firm j between month-year $t-3$ and month-year t; $MIN_{j,Mar16}^{25+}$ is the proportion of workers aged 25 and over paid less than the NLW in firm j in March 2016; $X_{j,Mar16}$ includes a set of firm-level controls (the proportion of female workers, average workers' age, and the proportion of carers, senior carers, ancillary staff, nurses and administrative staff) and local authority fixed effects as of March 2016; $\eta_{j,t}$ is the error term.[15] The subscript t indicates the month-year relative to March 2016, which is normalized to take value $t = 0$. The coefficient of interest $\beta_{1,t}$ identifies the effect of the bite of the NLW in $t = 0$ on young workers' wage growth between $t-3$ and t. We estimate the coefficient $\beta_{1,t}$ for $t = \{-15, -12, ..., 0, 3, ..., 36\}$. The coefficients $\beta_{1,t}$ for $t = \{-15, -12, ..., 0\}$ are treatment leads

[15]There is a total of 322 local authority districts in our sample and of 326 local authority districts in England. They split England into 326 areas of local governance.

and provide a way to test for any systematic correlation between young workers' wage growth and the bite of the NLW prior to the NLW introduction. This is analogous to testing for the parallel trends assumption in a traditional difference-in-differences design. To document the evolution of the relationship between the NLW bite and youth wage growth in the post-reform quarters, we measure the outcome variable $\Delta \ln w_{j,t}^{under25}$ as the long difference between $t = 0$ and $t = 3$, $t = 6$, $t = 9$, and so on. This is equivalent to estimating the cumulative effect of the reform over post-reform quarters, i.e. $\sum_{t=3n,n\in\{1,...,12\}} \beta_{1,t}$.

The variable $MIN_{j,Mar16}^{25+}$ is constructed as the proportion of workers aged 25 and over that in March 2016 were paid below the age-specific minimum wage rate that would become effective on April 1, 2016. It can be interpreted as the degree of direct exposure of the firm to the policy reform. Panel A of Appendix Figure A5 depicts the density distribution of the variable $MIN_{j,Mar16}^{25+}$. There is a spike at zero of close to 12 percent. Over the range $(0, 1]$, the distribution is fairly dispersed and moderately left skewed. The average value of $MIN_{j,Mar16}^{25+}$ in the sample is 0.52 (with a standard deviation of 0.32). The share of older workers paid below their next age-specific minimum is highly persistent, as can be seen in Panel B of Appendix Figure A5, which reports the correlation between $MIN_{j,Mar16}^{25+}$ and $MIN_{j,t}^{25+}$ for $t = \{-15, -12, ..., 0, 3, ..., 36\}$.

Our empirical strategy rests on the assumption that, following the NLW introduction, larger fractions of low-paid 25-and-overs are predictive of faster wage growth among older workers at the firm level. To probe this assumption, we estimate model 2 using older workers' wage growth as outcome variable, $\Delta \ln w_{j,t}^{25+}$. Panel A of Figure 6 reports the estimated coefficient $\hat{\beta}_{1,t}$ for $t = \{-15, -12, ..., 0\}$, and the cumulative sum $\sum_{t=3n} \hat{\beta}_{1,t}$ for $n = \{1, ..., 12\}$. The dots indicate the estimated coefficients and the capped vertical bars report 95 percent confidence intervals based on robust standard errors. Results are displayed for the balanced (black circles) and unbalanced (hollow circles) samples. The results show a strong, positive correlation at the firm level between the fraction of older workers paid below the NLW in March 2016 and subsequent wage growth. Moreover, they provide compelling evidence for the causal effect of the NLW introduction on older workers' hourly wage growth: while no systematic correlation between $MIN_{j,Mar16}^{25+}$ and quarterly wage growth can be detected prior to the NLW introduction, a statistically significant correlation emerges following the policy change. Table 2 reports the point estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ and associated standard error, estimated unconditional on $X_{j,Mar16}$ in column (1) and conditional on covariates in column (2). According to the latter, a one-standard-deviation increase in $MIN_{j,Mar16}^{25+}$ (corresponding to a 32 percentage-point change) is associated with 2.3 percentage-point faster growth in older workers' hourly wages on a baseline of 3.5 percent.

Model 2 identifies wage spillovers in reduced form. If we define wage spillovers as the elasticity of young workers' wages to older workers' ones, we can obtain a structural-form estimate of wage spillovers by estimating the following structural-form model:

$$\Delta \ln w_{j,t}^{under25} = \gamma_0 + \gamma_1 \Delta \ln w_{j,t}^{25+} + X'_{j,Mar16}\gamma_2 + \nu_{j,t} \tag{3}$$

The parameter γ_1 measures the elasticity of young workers wages to older workers ones between March 2016 and March 2017. Building on the results presented in the previous paragraph, we can identify γ_1 instrumenting $\Delta \ln w^{25+}_{j,t}$ with $MIN^{25+}_{j,Mar16}$ in a two-stages least square model. A version of model 2 with $\Delta \ln w^{25+}_{j,t}$ can therefore be considered the first stage of the instrumental variable model. The estimates reported in Panel A of Figure 6 and in the first two columns of Table 2 demonstrate the relevance of the instrument (the F-statistics on the excluded instrument being 432.02 in the model with covariates reported in column (2)). Moreover, the absence of pre-trends in Panel A of Figure 6 provides compelling evidence in favor of the exogeneity of the instrument.[16]

5.2 Results

Wage spillovers. Panel B of Figure 6 provides a compelling visualization of the within-firm nature of wage spillover effects. The graph reports the sequence of estimated $\hat{\beta}_{1,t}$ for $t = \{-15, -12, ..., 0\}$, and the cumulative sum $\sum_{t=3n} \hat{\beta}_{1,t}$ for $n = \{1, ..., 12\}$, from model 2. The results show that the variable $MIN^{25+}_{j,Mar16}$ is predictive not only of wage growth among 25-and-overs (as seen in Panel A of Figure 6), but also of wage growth among younger workers at the firm level. These results indicate that it is precisely in those firms that are more severely affected by the NLW introduction – because of their ex-ante exposure to the policy change – that younger workers' wages are seen to grow faster after the reform. Columns (1) and (2) of Table 3 report the reduced-form estimate of $\sum_{t=3n, n\in\{1,...,4\}} \hat{\beta}_{1,t}$, respectively unconditional and conditional on covariates. According to column (2), a one-standard-deviation increase in $MIN^{25+}_{j,Mar16}$ is associated with 1.6 percentage-point faster wage growth among workers aged under 25, on a baseline growth of 3.5 percent. Column (3) reports the IV estimate of parameter γ_1: the elasticity of younger workers' wages to older workers' ones is close to 0.7, indicating that for every 1 percent increase in older workers' wages, younger workers' ones increase by 0.7 percent.[17,18] This is one of the central results of this paper, since it uncovers the within-firm

[16] In columns (3) and (4) of Table 2, we test the relevance of a second instrument, the 'wage-bill gap', which captures the mechanical percent effect of the NLW introduction on the wage bill of the firm. Formally, the gap in firm j at time t is defined as $\frac{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot \max\{NLW_{t+1} - w_{i,j,t}\ , 0\}}{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot w_{i,j,t}}$. The gap measures by how much the wage bill of the firm would have to increase in percent to comply with the NLW regulations, assuming no changes in employment at the extensive or intensive margin, and no wage spillover effects as a result of the NLW introduction. The results in column (4) indicate that a one-standard-deviation increase in the wage-bill gap in March 2016 (corresponding to a 5 percentage-point increase) is associated with a 1.5 percentage-point faster growth in older workers' hourly wages on a baseline of 3.5 percent. The wage-bill gap turns out to be a weaker instrument when compared to the proportion of low-paid workers, as can be seen by the relatively low F-statistic reported in the table. We therefore use the low-paid proportion as main instrument for the analysis and report the IV estimates based on the wage-bill gap in Appendix Table A4. See footnote 17 for more details.

[17] In Appendix Table A4 we report reduced-form and IV estimates of wage spillovers using the wage-bill gap rather than the low-paid proportion as instrumental variable. The wage-bill gap is defined in footnote 16. In column (3) of the table, we estimate an elasticity $\hat{\gamma}_1 = 0.4$. As remarked before, the wage-gap is a weaker instrument as compared to the low-paid proportion, hence these results should be interpreted with caution.

[18] In Appendix Table A5, we report the reduced-form and IV estimates of spillover effects, measuring wage growth in levels rather than percent. The estimate of γ_1 in column (3) indicates that young workers' wages increased on average by £0.64 for every £1 change in older workers' wages, on a baseline growth of £0.24.

nature of wage spillovers – a novel result, to the best of our knowledge – in the literature on the wage-distributional effects of minimum wages.

Employment spillovers. Similar to our market-level results, the firm-level analysis reveals that positive wage spillovers did not arise at the cost of negative employment spillover effects for young workers. Table 4 reports reduced-form estimates of model 2 and IV estimates of model 3 using the change in the share of workers aged under 25 between March 2016 and March 2017 as outcome variable. The estimated effects are small in magnitude and statistically insignificant. Additionally, we do not find evidence of negative employment effects at the intensive margin. As reported in column (3) of Appendix Table A6, we estimate a positive, albeit statistically insignificant, elasticity of weekly hours worked by young workers to older workers wages of approximately 0.36.

Zero hours contracts. A margin along which we find an economically and statistically significant response is the utilization of zero hours contracts among workers aged under 25. Appendix Table A7 reports reduced-form and IV estimates using the change in the share of young workers employed under a zero hours contract as outcome. In addition, in column (4), it reports the IV estimate of the semi-elasticity of the incidence of zero hours contracts among young workers to young workers' wages (in this case, we are instrumenting $\Delta \ln W_{j,t}^{under25}$ with $MIN_{j,Mar16}^{25+}$). The magnitude of the estimated semi-elasticity is such that for every 1 percent increase in older (younger) workers' wages, the share of young workers on zero hours contracts increases by 0.35 (0.53) percentage points on a baseline of 1.3 percentage points. These results reveal that firms in which the NLW bit harder (column (3)) and wage spillovers were larger (column (4)) resorted significantly more to the use of flexible contracts among young workers. As mentioned before, zero hours contracts are a contractual arrangements that gives great intensive-margin flexibility to employers, by not obliging them to offer a minimum number of hours. Increased use of zero hours contracts can be an indirect way to reduce employment at the intensive margin (and de facto also at the extensive margin by offering zero hours forever). Given that we do not find evidence of intensive- nor extensive-margin employment spillovers, we can interpret the increase in zero hours contracts as a form of self-insurance against future shocks, that – in the face of a larger and downward-rigid wage bill – may require employment reductions.[19]

Turnover. Finally, we look at whether firms that operate larger wage spillovers experience reductions in the turnover rate among young workers. If workers are concerned by relative pay, turnover among young workers should be higher in firms that age-discriminate across workers by passively adapting their wages to the minimum wage legislation. Evidence of turnover reflecting peer-to-peer comparisons in wages in a low-wage setting have been documented by Dube, Giuliano and Leonard (2019). We do not find evidence of lower turnover in firms where the NLW had a stronger effect on older workers' wages (Appendix Table A8).

[19] Datta, Giupponi and Machin (2020) find that the wage cost shock induced by the NLW resulted in increased use of zero hours contracts in the English social care sector as a whole, and in low wage sectors of the UK labor market more generally.

6. Determinants of wage spillovers

The wage and employment effects that we have documented so far are inconsistent with the predictions of the standard competitive spot market model. Rather, they suggest that the labor market is characterized by a degree of monopsonistic competition whereby firms have wage setting power. This notion is corroborated by strong evidence that wages in the sector do not reflect workers' marginal product of labor. If the market was competitive, we would expect workers of a given quality to be paid the same market wage. This implies that workers of identical quality should receive the same wage in different firms, and workers of different quality should receive different wages even if employed by the same firm. One way to test this argument is to decompose the total variance of wages and of proxies of workers' quality into their within- and between-firm components (Machin and Manning, 2004). We focus on care assistants and use tenure as our preferred proxy for workers' quality. Tenure has been shown to improve patients' outcomes significantly more than experience, in team-production environments within the health care system (Bartel et al., 2014). Conditional on local authority fixed effects, the proportion of total wage variance that is intra-firm is approximately half of that of worker's quality (approximately 44 versus 82 percent).[20] The combination of remarkably little variation in wages and large variation in workers' productivity (as proxied by tenure) within firms substantiates the notion that wages are not set competitively in this low-wage labor market.

In addition to evidence of a degree of monopsony power by firms, the results that we have presented so far provide a clear indication of uniform wage setting across workers. But why do firms set wages uniformly across employees? What are the drivers of their model of wage determination? The determination of wages by firms and issues involved therein have long been of interest to economists in labor economics and industrial relations. Quoting Hilde Behrend's 1960 paper, "[c]ompany wage-policies, it seems, aim to fulfill one or more of the following objectives: (*a*) To attract and retain employees of the right quality, and in the right quantity. (*b*) To maintain or increase standards of effort. (*c*) To avoid or reduce frictions and discontent by meeting expectations and conceptions of fairness, especially with regard to standard of living, and differentials for status, merit and skills. (*d*) To control costs and reduce administrative complexity" (Behrend, 1960, p. 122).

Building on Behrend (1960)'s paradigm, our conceptual framework distinguishes two macro drivers of the observed wage spillovers: *inter*-firm factors and *intra*-firm factors. Inter-firm factors reflect the dynamics of competition between firms to attract and retain workers. If wage spillovers are driven by these inter-firm dynamics, we should observe larger wage spillovers among workers with better outside options. A worker's outside option is the amount of compensation they could receive from different employers (or as unemployed individuals). Intra-firm factors reflect, instead, a cost to the firm of keeping a diversified wage structure. Wage

[20] Similarly, we find large proportions of the total variance of age and weekly hours that is intra-firm (90 and 76 percent respectively).

dispersion can be costly to the firm for various reasons. We identify three such reasons: (i) the time and resource cost of having to bargain individualized wages, (ii) the administrative cost of keeping track of a diversified wage structure, and (iii) pay equity concerns. Note that pay equity concerns may have two different meanings: on the one hand, fairness norms may dictate to pay the same wage to workers performing the same job, regardless of efficiency considerations (we label this notion as 'pure fairness' hypothesis); one the other hand, pay equity concerns may be driven by efficiency considerations, based on the idea that a 'fair' wage is required to extract the right amount of effort from a worker (we label this notion as 'fair wage-effort' hypothesis). For the moment, we condense both angles in the single notion of pay equity concerns, but we will come back to a discussion of its nuances later in the paper.

In the remainder of this section, we attempt to assess empirically the relevance of these potential drivers of the observed wage spillovers. While it may be difficult to single out a specific factor, if anything because firms may try to achieve multiple objectives with their wage setting policies, we can nonetheless gauge the relative importance of the various determinants.

6.1 Inter-firm factors

If wage spillovers are driven by competition for workers among firms, we would expect that firms with more 'attractive' workers have larger wage spillovers. A worker's outside option is not observable, but theoretically it depends on both their individual characteristics and the characteristics of their local labor market. In fact, the latter have been empirically shown to systematically correlate with workers' outside options (Caldwell and Danieli, 2021). Local labor markets also appear to be the relevant geography within which firms can reasonably compete for workers. It follows that a simple way to test the relevance of inter-firm factors in determining the emergence of wage spillovers is to estimate our reduced-form and IV wage spillover regressions – respectively model 2 and 3 – with and without local-labor-market fixed effects. If inter-firm competition is the main driver of wage spillovers, we would expect the inclusion of local-labor-market fixed effects to attenuate our parameter estimate of firm-level wage spillovers.

Table 5 reports the reduced-form estimate $\sum_{t=3n,n\in\{1,\ldots,4\}} \hat{\beta}_{1,t}$ from model 2 in odd-numbered columns, and the IV estimate $\hat{\gamma}_1$ from model 3 in even-numbered columns. All estimates are conditional on firm-level controls, but only estimates in columns (3) to (6) are conditional on local labor market fixed effects. We consider two different definitions of local labor markets: local authority districts in columns (3) and (4), and travel to work areas (TTWA) in columns (5) and (6). Local authorities are the level of subnational division of England used for the purposes of local government and have statutory responsibility for social care services. There is a total of 326 local authority districts in England, of which 322 covered by our sample. TTWAs are the official British definition of local labor market areas. The main criterion for defining TTWAs is that at least 75 percent of the area's resident workforce work in the area and at least 75 percent of the people who work in the area also live in the area. As such, TTWAs are based on statistical analysis rather than administrative boundaries. There is a total of 152 TTWAs in our sample. The inclusion of either type of local labor market fixed effects does not affect our parameter estimates. If anything, the estimated coefficients become slightly larger. These results suggest that local labor market factors do not seem to drive wage spillovers.

To further corroborate the idea that wage spillovers are not driven by inter-firm competition, we show that firm-level wage spillovers do not correlate with proxies for the average outside option of young workers in the firm. To this end, we first need a definition of wage spillovers at the firm level. Adapting the formula proposed by Butcher, Dickens and Manning (2012) for upward spillovers, we define downward wage spillovers in firm j, as follows:

$$\theta_j(w^{NMW}) = \frac{F_j^*(w^{NMW}) - F_j(w^{NMW})}{F_j^*(w^{NMW})} \tag{4}$$

where $F_j(\cdot)$ is the *observed* cumulative distribution function of gross hourly wages of workers aged under 25 in firm j in the post-NLW period; $F_j^*(\cdot)$ is the *counterfactual* cumulative distribution function of gross hourly wages of workers aged under 25 in firm j in the post-NLW period, *absent* wage spillovers; and w^{NMW} is the NMW rate legally binding for workers aged under 25 in the post-NLW period. Since the counterfactual wage distribution cannot be observed, we take the distribution in March 2016 as our counterfactual. Appendix Figure A6 illustrates the components of θ_j for a representative firm in March 2017: the solid line corresponds to $F_j^*(\cdot)$ as represented by the March 2016 distribution, and the dashed line corresponds to $F_j(\cdot)$ in March 2017. The red vertical line indicates the level of w^{NMW} in March 2017. The variable θ_j is an increasing function of the size of wage spillovers on young workers over the $[0, 1]$ interval. If a firm implements a no-spillover policy, we would expect the solid and dashed lines in Appendix Figure A6 to overlap in the range $w_{ij} < w^{NMW}$ (i.e. $F_j^*(w^{NMW}) = F_j(w^{NMW})$), resulting in $\theta_j = 0$. On the other hand, in case a firm operates a full-fledged spillover policy, the dashed line would lay entirely to the left of the red vertical line (i.e. $F_j(w^{NMW}) = 0$), leading to $\theta_j = 1$.[21] In all the analyses that follow, we consider the value of θ_j in March 2017.

Appendix Figure A7 reports a set of binned scatter plots that visualize the relationship between θ_j and proxies for the average outside option of workers aged under 25 in firm j. All correlations are conditional on $MIN^{25+}_{j,Mar16}$ and $X_{j,Mar16}$, with the exclusion of local labor market fixed effects. Each graph reports the estimated coefficient (and associated standard error in parenthesis) of an OLS regression of $\theta_j = 1$ on the variable reported on the x-axis. Panel A proxies the outside option with the average hourly wage of carers aged under 25 in the local authority of firm j in March 2016, excluding wages in firm j from the computation of the average. Panel B uses the median hourly wage of private-sector employees in the local authority in March 2016.[22] Panel C employs a measure of the 'potential' wage of carers in the TTWA. To construct it, we take the average of gross hourly wages of workers aged under 25 in each 4-digit occupation and TTWA,

[21] We assume $\theta_j = 0$ in firms with $F_j^*(w^{NMW}) = 0$.

[22] The median hourly wage of private-sector employees in the local authority is based on ASHE data elaborated by the UK Office for National Statistics.

and we compute a weighted average of occupation-specific wages, weighted by the probability of yearly transition of a care worker to that occupation.[23] Panel D uses the unemployment insurance claimant rate among individuals aged under 25 as an indirect measure of workers' outside option. The claimant rate is computed as the ratio of the number of people aged 16-24 claiming Jobseeker's Allowance or Universal Credit for the reason of being unemployed, as a percent of the population in the TTWA in March 2016.[24] Conditional on the same level of direct exposure to the NLW introduction (as measured by $MIN^{25+}_{j,Mar16}$), the size of firm-level wage spillovers is uncorrelated with measures of workers' outside option in the local labor market. Taken together, the evidence presented so far rules out inter-firm dynamics as a relevant driver of wage spillovers.

6.2 Intra-firm factors

We now turn to investigate the role of intra-firm factors in generating wage spillovers.

Cost of individual bargaining. Firms might decide to implement a uniform wage structure to avoid the cost of bargaining individualized wages with its employees. Before taking this hypothesis to the test, it is important to re-emphasize that the adult social care sector in the UK has been traditionally very low unionized. We can therefore exclude any role for collective bargaining in the determination of wages, especially among young workers. Turning to individual bargaining, the survey evidence that we collected through the ASC-SPP reveals that, when a job offer is made, the offer is in the vast majority of times 'take-it-or-leave-it', while individual bargaining remains sporadic (Appendix Table C5). As such, the labor market model that seems to best characterize wage setting in social care is that of wage posting, in which the cost of individual bargaining is likely immaterial.

Administrative complexity. Keeping track of a diversified wage structure can be administratively burdensome and costly to the employer, up to the point that she may find it more convenient to pay all workers a uniform, productivity-unrelated wage rate. The impact of downward wage spillovers on firm costs is twofold: (i) there is a positive wage-bill cost of raising younger workers' wages to the NLW; (ii) there is a cost saving in reducing administrative complexity. The wage-bill cost is a linear, increasing function of the share of young workers in the firm. The administrative cost of dealing with a diversified wage structure can be modeled as a fixed cost, e.g. the fixed cost of hiring human resource staff or of outsourcing payroll administration. It seems plausible that this fixed cost will be more negligible, as a share of total costs, for larger firms. Hence, if wage spillovers are used to lower administrative costs, we would expect larger wage spillovers in smaller firms, conditional on the wage-bill cost.

[23]Transition probabilities are calculated using Labor Force Survey five-quarter longitudinal data for the UK. To boost sample size, we use data from 2010 to 2016. The vector of transition probabilities from care assistant in year t to occupation k 12 months after includes the probability of remaining in the same occupation. Occupation- and TTWA-specific gross hourly wages are calculated using ASHE data.

[24]The data, based on Department for Work and Pensions administrative data elaborated by the by the UK Office for National Statistics.

Panel A of Appendix Figure A8 is a binned scatter plot of the conditional correlation of θ_j and the size of the parent organization of firm j (in natural logarithm), conditional on $MIN^{25+}_{j,Mar16}$, $X_{j,Mar16}$, the proportion of under 25s paid below the NLW in March 2016, and a measure of the wage-bill cost of wage spillovers.[25] The latter is the percent increase in wage-bill costs required to increase all younger workers' wages to the NLW as of March 2016.[26] Contrary to what the 'administrative cost' hypothesis would predict, we find a mild positive correlation between the magnitude of wage spillovers and organization size. This suggests that administrative cost savings are unlikely to be a major driver of wage spillovers.[27] This notion is confirmed by our survey results: of the respondents who declared to pay the NLW rate to at least some under 25s, only 3 percent said that they do so because it is administratively simpler or cheaper (Appendix Table C3).

Pay equity concerns. Common wisdom, as well as anecdotal and empirical evidence, suggest that internal equity is important for an organization to operate efficiently and smoothly. The lack of pay equity within the firm can have disruptive effects and impose implicit costs to employers, either in the form of efficiency losses or of a 'utility' cost for departing from social preferences for fairness. To assess the role of preferences for fairness in generating wage spillovers, we ideally would like to have a measure of fairness norms at the firm level and correlate it with the size of wage spillovers within the firm. Not having a direct measure of norms at our disposal, we provide four pieces of indirect evidence of the role of fairness norms.

Panel A of Figure 7 is a binned scatter plot of the conditional correlation between θ_j and $MIN^{25+}_{j,Mar16}$, conditional on $X_{j,Mar16}$ (including local authority fixed effects) and – importantly – conditional on the proportion of under 25s paid below the NLW in March 2016. By conditioning on the latter, we are implicitly comparing the size of wage spillovers across firms with an identical share of young workers 'eligible' for wage spillovers, but with different shares of older workers directly affected by the policy. The graph reveals a positive and linear association, which is strongly statistically significant as shown by the coefficient estimate and standard error reported in the bottom right corner of the chart. The evidence indicates that, for an equal share of eligible young workers, wage spillovers are larger in those firms in which a larger share of older workers have their wages increased as a consequence of the NLW introduction. In other

[25] Results are basically unchanged if we replace parent-organization size with provider size.

[26] Formally, the wage-bill gap in firm j at time t is defined as $\frac{\sum_{i\in j|age_i<25} h_{i,j,t}\cdot \max\{NLW_{t+1}-w_{i,j,t}\ ,0\}}{\sum_{i\in j} h_{i,j,t}\cdot w_{i,j,t}}$.

[27] The administrative cost of keeping a diversified wage structure could also – albeit less plausibly – be modeled as a variable cost. In this case, the administrative cost of wage spillovers can be describes ad an inverse u-shaped function of the share of workers aged under 25 and paid below the NLW: the administrative cost is low when there are few young workers, highest when the age-composition of the firm is very mixed, and low again when young workers make up the majority of the firm. If this were the case, conditional on the wage-bill cost, we would expect wage spillovers to have the same inverse u-shaped relationship with the share of young workers in the firm. Panel B of Appendix Figure A8 is a binned scatter plot of the conditional correlation of θ_j and the share of workers aged under 25 paid below the NLW in firm j in March 2016. The correlation is conditional on $MIN^{25+}_{j,Mar16}$, $X_{j,Mar16}$, the wage-bill cost of wage spillovers and the logarithm of parent organization size. We find a statistically significant, negative association between spillovers and the youth share, which is partly in line with our predictions. We are, however, little inclined to interpret this as evidence of the administrative cost channel: firstly, because we do not find the variable-cost characterization appealing; and, secondly, because the evidence is also consistent with the pay equity channel, which we discuss below.

words, it is precisely in those firms in which the NLW disrupts the wage structure of older workers the most that we see larger wage increases among younger workers. This is a first piece of evidence consistent with pay equity norms within the firm.

Preferences for fairness can be modeled by making one's utility depend on that of other individuals or their outcomes. In their model of fairness norms, skills segregation and wage dynamics, Cabrales, Calvó-Armengol and Pavoni (2008) sensibly characterize the group of individuals to which the utility comparison applies as the *reference group*, that is the group of individuals whom a worker more closely identifies with. Workers are likely to identify the most with co-workers at their same level, as opposed to superiors or workers of lower rank. As a result, the relevant group over which fairness norms apply does not coincide with all workers inside the firm, but only with individuals with similar job roles. Consistent with this notion, we can show that wage spillovers arise not simply within the firm, by actually within a 'job role' or 'occupation' within the firm. Table 6 reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among carers aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is gross hourly wage growth among older workers in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)).[28] In our IV model, we instrument each $\Delta \ln w_{j,t}^{under25,k}$ with $MIN_{j,Mar16}^{25+,k}$, using $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments.[29] The results in Table 6 show that young carers' wages are only responsive to wage growth among older carers, but not among older workers in other job roles. Similar results are obtained for senior carers (Appendix Table A10) and ancillary staff (Appendix Table A11), the other two job roles with a relatively high fraction of workers paid around the minimum. This is a second piece of evidence consistent with pay equity concerns. For completeness, we also report estimates of the within- and cross-occupation wage spillovers for administrative staff and nurses in Appendix Tables A12 and A13. The within-occupation wage elasticities are imprecisely estimated and not statistically significant. It is worth noting that, due to the relatively high wages in these occupations (see Table 1), the IV estimation may be suffering from a weak instrument problem, as revealed by the partial F-statistics on the excluded instrument reported in Appendix Table A9. The results may also reflect differences in inequality aversion between 'low' and 'high' wage earners, with the former holding stronger preferences for equal treatment, as shown in prior work (Fehr and Schmidt, 1999).

A direct consequence of the wage compression generated by inequality aversion within a job type is that the occupation-specific wage-tenure profile will be flatter in organizations with

[28] Sample size varies across the different specifications since not all firms have all job roles represented among their workers.

[29] Appendix Table A9 reports the first-stage estimates of the IV models. The dependent variable is gross hourly wage growth among older workers between March 2016 and March 2017 for carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each of these variables is regressed against the set of included and excluded instruments. As can be seen from the table, the excluded instrument – that is $MIN_{j,Mar16}^{25+,k}$ – is highly predictive of wage growth in job role k across all specifications.

stronger preferences for fairness. We can use this simple prediction to indirectly characterize providers with relatively stronger/weaker fairness norms on the basis of the steepness of the wage-tenure profile of carers and senior carers in the firm in the pre-NLW period. To this end, we estimate firm-specific Mincerian regressions of the natural logarithm of the hourly wage on a quadratic function of tenure for the sample of carers and senior carers in the pre-NLW period.[30] For each firm, we compute the estimated return to a one year of tenure, and use it as an inverse proxy of the degree of fairness of the firm. Panel B of Figure 7 reports a binned scatter plot of the conditional correlation between θ_j and the firm-specific wage-tenure gradient, conditional on $MIN^{25+}_{j,Mar16}$, $MIN^{under25}_{j,Mar16}$ and $X_{j,Mar16}$. Consistent with the prediction that flatter wage-tenure profiles signal stronger preferences for fairness, we see larger spillovers among firms with lower returns to tenure.

Finally, responses to the ASC-SPP questionnaire also lend support to inequality aversion being the main driver of wage spillovers. According to the results reported in Appendix Table C3, of the 60 percent of respondents who do not pay under 25s below the NLW, 54 percent say that they do so because it would otherwise be 'unfair to the workers', and 11 percent to 'motivate workers'. Thus, 65 percent of those who practice a full wage-spillover policy declare to do so for reasons ascribable to fairness norms. This is the fourth piece of evidence of the importance of pay equity concerns.

Two main results emerge from the evidence presented in this section. First, that intra-firm factors are the main determinant of wage spillovers. Second, that – among intra-firm factors – pay equity concerns offer the most plausible explanation for the emergence of wage spillovers within firms.

7. Discussion

7.1 Notions of fairness

In the previous section, we noted that, in this context, pay-related fairness norms can have two acceptations: (i) the 'pure fairness' one, which calls for an identical wage being paid to workers performing the same job, regardless of efficiency considerations, and (ii) the 'fair wage-effort' one, according to which paying a 'fair' wage is necessary to extract the right amount of effort from a worker. So far, we have not discerned between the two concepts. In this subsection, we attempt to provide a deeper characterization of the notion of fairness that is at play.

The fair wage-effort hypothesis is a version of the efficiency wage theory first introduced in Akerlof and Yellen (1990). According to this hypothesis, workers have an idea of what a fair wage is; if the wage they receive is less than the fair wage, workers supply a proportional fraction of normal effort and a wage increase can raise workers' effort, which in turn should translate in productivity gains. A simple way to test the relevance of this hypothesis is to investigate

[30]The Mincerian regressions are conditional on calendar month fixed effects.

whether spillovers are associated with productivity improvements at the firm level. Following Machin, Manning and Rahman (2003), we measure productivity as the number of residents per worked hour in the firm. Columns (1) and (2) of Appendix Table A14 report reduced-form estimates of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ in model 2, using the change in the natural logarithm of residents per hour worked as outcome variable. The estimates are, respectively, unconditional and conditional on covariates. Column (3) reports the IV estimate of parameter γ_1 of model 3 using productivity as outcome. The IV estimate is positive, but statistically insignificant. Column (4) reports the estimated coefficient of a regression of productivity on younger workers' wage growth, where the latter is instrumented with $MIN^{25+}_{j,Mar16}$. Similar to the results in column (3), we obtain a positive effect, but not statistically significant.

In the minimum wage literature, the efficiency wage theory has traditionally provided a rationale for the emergence of *upward* wage spillovers following a minimum wage increase. Upward spillovers emerge when the wages of workers previously paid at the new minimum are raised above the minimum, and the wages of workers earning in a neighborhood above the minimum are also increased to a higher level. Evidence on the existence and size of spillovers in mixed. However, a common justification of their emergence is the need to restore wage differentials across workers in order to keep the previously higher paid motivated. We compute two measures of wage spillovers at the firm level: (i) intermediate and (ii) upward wage spillovers. Both are computed on workers aged 25 and over in March 2017. Intermediate spillovers are measured as $\theta_j(w^{NLW})$ and upward spillovers as $\theta_j(£7.7)$, where $\theta_j(w)$ is defined as in formula 4. As such, intermediate wage spillovers measure the size of wage spillovers on individuals who were paid up to the NLW in March 2016; upward wage spillovers capture instead the extend to which spillovers reached individuals already paid £0.50 above the new minimum. Appendix Figure A9 reports a binned scatter plot of the conditional correlation between downward spillovers on workers aged under 25 (x-axis), and intermediate or upward spillovers on workers aged 25 and over (y-axis). Correlations are conditional on the set of firm-level covariates $X_{j,Mar16}$, including local authority fixed effects. We observe a positive relationship between downward and intermediate spillovers, and an almost nil one between downward and upward spillovers.[31]

The lack of evidence of significant productivity improvements and the limited upward spillovers associated with wage increases among young workers appear inconsistent with the 'fair wage-effort' hypothesis, and rather in favor of a pure 'fairness' acceptation of pay-equity concerns. The survey results in Appendix Table C3 give further credit to this interpretation, given that

[31] Appendix Table C4 reports answers to ASC-SPP questions on intermediate and upward wage spillovers. 52 percent of respondents state that their organization raised the wage of workers previously paid between the old and new NLW above the NLW, with an additional 17 percent saying that this would depend on a worker's role and performance. When asked about whether they gave a pay rise to workers already paid above the new NLW, 63 percent answered 'yes' and an additional 19 percent that it would depend on the worker's role and performance. While this may look slightly at odds with our quantitative evidence, in fact the Pearson's correlation between downward spillovers and intermediate/upward spillovers is in line with our quantitative findings. According to Pearson's chi-squared tests, the correlation between downward and intermediate spillovers is positive and significant, while we cannot reject the independence between the likelihood of downward and upward wage spillovers. Results available upon request.

they emphasize the fairness dimension of wage spillovers ('Unfair to the workers') more than the efficiency one ('To motivate workers').

7.2 Workers' and employers' preferences for equal pay

It seems plausible that if workers' preferences for fairness were entirely responsible for the emergence of wage spillovers, the latter should be stronger for employees working in team or at least with direct sight of their colleagues while working. In order to test the relevance of workers' – as opposed to employers' – preferences in generating wage spillovers, we replicate our analysis of within-firm wage spillovers on organizations in the domiciliary care sector for which we have data in the ASC-WDS. 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 hours contracts, since work tends to be organized into short and fragmented home visits. Given the nature of work, workers employed by domiciliary care agencies 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 residential care one, ceteris paribus.

Appendix Table A15 reports summary statistics at the firm level for the sample of care homes and domiciliary care agencies. 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 hours contracts is five times as large in the domiciliary care sector and average weekly hours worked are lower by a third. Similarly the proportion of workers employed with temporary, bank or agency contracts, is larger in the domiciliary care sector (14 against 9 percent). These differences corroborate the notion that domiciliary care work schedules are inherently fragmented as the nature of the job would suggest.

We replicate the analysis of wage spillover effects on the sample of domiciliary care agencies. Results analogous to those in Table 3 are reported in Appendix Table A16 for the sample of domiciliary care providers. The IV estimate of the elasticity of younger workers' wages to older workers' (corresponding to γ_1 in model 3) reported in column (3) exceeds 0.9 and is highly statistically significant. It indicates that for every 1 percent increase in older workers' wages, younger workers' ones increase by 0.9 percent. Therefore, in spite of the remarkably different working arrangements documented above, domiciliary care workers experience wage spillovers similar to those that we identified in the care home sector. The evidence seems to exclude that workers' preferences alone play a major role in within-firm wage setting.

8. Conclusion

In this paper, we focus on the low-wage section of the labor market, and investigate (i) what models of wage determination are at play and (ii) how they interact with the policy environment. Our policy focus is placed on minimum wages, which are a prominent example of wage policy that can interact with wage setting by firms at the low-end of the pay spectrum. We exploit a sizable and salient age-specific minimum wage change in the United Kingdom – the National living Wage (NLW) introduction – which raised the minimum wage rate applying to workers aged 25 and over from £6.70 to £7.20 an hour (a 7.5 percent increase) from April 1, 2016, while leaving unchanged the minimum wage rates for younger workers. The unexpected nature and the size of this age-specific minimum wage change provide a unique 'natural experiment' to study the general-equilibrium wage (and employment) response to a quasi-exogenous wage change targeting a subset of the low-wage workforce.

At the market level, we document large, positive wage spillovers of the NLW on workers aged under 25. Younger workers' wages are shown to have risen in tandem with those of older workers, with no detrimental effects on youth employment. At the firm level, we provide evidence that wage spillovers arise within rather than between firms, and that wage spillovers on younger workers are stronger in firms with a larger fraction of older workers whose wages are directly affected by the NLW introduction. Both the market-level and firm-level results provide a clear indication of uniform wage setting across workers in the low-wage labor market. We discuss potential drivers of wage spillovers and assess their relative importance. Based on empirical tests and qualitative evidence from an ad-hoc survey of pay practices, we conclude that fairness norms offer the most plausible explanation for the emergence of wage spillovers. Consistent with this finding, we show that wage spillovers arise not simply within the firm, but rather within a job role within the firm, coherently with the notion that fairness norms are set in relation to a reference group.

These results are relevant for models of the low-wage labor market, since they provide direct evidence that wages are not set individually, but rather at the reference-group level and based on a principle of fairness. The evidence is also informative of how public policies interact with wage setting within the firm. As such, it can be relevant for the design of a host of wage policies with the potential of affecting the within-firm wage structure (e.g. payroll taxes or minimum wages). In this respect, it is worth noting that, even though the policy change that we are exploiting is quite singular in nature, the existence of an age-specific minimum wage structure is rather common in countries with minimum wage regulations in place. Hence, the labor market policy considerations drawn from the analysis in this paper are likely widely applicable to similar institutional contexts.

References

Akerlof, George A., and Janet L. Yellen. 1990. "The Fair Wage-Effort Hypothesis and Unemployment." *The Quarterly Journal of Economics*, 105(2): 255–283.

Autor, David H., Alan Manning, and Christopher L. Smith. 2016. "The Contribution of the Minimum Wage to US Wage Inequality over Three Decades: A Reassessment." *American Economic Journal: Applied Economics*, 8(1): 58–99.

Bartel, Ann P., Nancy D. Beaulieu, Ciaran S. Phibbs, and Patricia W. Stone. 2014. "Human Capital and Productivity in a Team Environment: Evidence from the Healthcare Sector." *American Economic Journal: Applied Economics*, 6(2): 231–59.

Behrend, Hilde. 1960. "Some Aspects of Company Wage Policy." *The Journal of Industrial Economics*, 8(2): 122–132.

Böckerman, Petri, and Roope Uusitalo. 2009. "Minimum Wages and Youth Employment: Evidence from the Finnish Retail Trade Sector." *British Journal of Industrial Relations*, 47(2): 388–405.

Breza, Emily, Supreet Kaur, and Yogita Shamdasani. 2017. "The Morale Effects of Pay Inequality." *The Quarterly Journal of Economics*, 133(2): 611–663.

Butcher, Tim, Richard Dickens, and Alan Manning. 2012. "Minimum Wages and Wage Inequality: Some Theory and an Application to the UK." Department of Economics, University of Sussex Business School Working Paper Series 4512.

Cabrales, Antonio, Antoni Calvó-Armengol, and Nicola Pavoni. 2008. "Social Preferences, Skill Segregation, and Wage Dynamics." *Review of Economic Studies*, 75(1): 65–98.

Caldwell, Sydnee, and Oren Danieli. 2021. "Outside Options in the Labor Market." University of California Berkeley Working Paper.

Card, David, Alexandre Mas, Enrico Moretti, and Emmanuel Saez. 2012. "Inequality at Work: The Effect of Peer Salaries on Job Satisfaction." *American Economic Review*, 102(6): 2981–3003.

Card, David, Ana Rute Cardoso, Joerg Heining, and Patrick Kline. 2018. "Firms and Labor Market Inequality: Evidence and Some Theory." *Journal of Labor Economics*, 36(S1): S13–S70.

Card, David, Jörg Heining, and Patrick Kline. 2013. "Workplace Heterogeneity and the Rise of West German Wage Inequality." *The Quarterly Journal of Economics*, 128(3): 967–1015.

Datta, Nikhil, Giulia Giupponi, and Stephen Machin. 2020. "Zero-hours contracts and labour market policy." *Economic Policy*, 34(99): 369–427.

Davison, Sarah, and Gary Polzin. 2016. "The state of the adult social care sector and workforce in England." Skills for Care.

DiNardo, John, Nicole M. Fortin, and Thomas Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica*, 64(5): 1001–1044.

Dube, Arindrajit, Laura Giuliano, and Jonathan Leonard. 2019. "Fairness and Frictions: The Impact of Unequal Raises on Quit Behavior." *American Economic Review*, 109(2): 620–63.

Fehr, Ernst, and Klaus M. Schmidt. 1999. "A Theory of Fairness, Competition, and Cooperation." *The Quarterly Journal of Economics*, 114(3): 817–868.

Giuliano, Laura. 2013. "Minimum Wage Effects on Employment, Substitution, and the Teenage Labor Supply: Evidence from Personnel Data." *Journal of Labor Economics*, 31(1): 155–194.

Kabátek, Jan. 2020. "Happy Birthday, You're Fired! Effects of an Age-Dependent Minimum Wage on Youth Employment Flows in the Netherlands." *ILR Review*.

Kreiner, Claus Thustrup, Daniel Reck, and Peer Skov. 2020. "Do Lower Minimum Wages for Young Workers Raise Their Employment? Evidence from a Danish Discontinuity." *The Review of Economics and Statistics*, 102(2): 339–354.

Lee, David S. 1999. "Wage Inequality in the United States During the 1980s: Rising Dispersion or Falling Minimum Wage?" *The Quarterly Journal of Economics*, 114(3): 977–1023.

Leonardi, Marco, Michele Pellizzari, and Domenico Tabasso. 2019. "Wage Compression within the Firm: Evidence from an Indexation Scheme." *The Economic Journal*, 129(624): 3256–3291.

Machin, Stephen, Alan Manning, and Lupin Rahman. 2003. "Where the Minimum Wage Bites Hard: Introduction of Minimum Wages to a Low Wage Sector." *Journal of the European Economic Association*, 1(1): 154–180.

Machin, Stephen, and Alan Manning. 2004. "A Test of Competitive Labor Market Theory: The Wage Structure among Care Assistants in the South of England." *ILR Review*, 57(3): 371–385.

Manning, Alan. 2003. *Monopsony in Motion: Imperfect Competition in Labor Markets.* Princeton University Press.

Rosen, Sherwin. 1986. "Chapter 12 The theory of equalizing differences." In . Vol. 1 of *Handbook of Labor Economics*, 641–692. Elsevier.

Saez, Emmanuel, Benjamin Schoefer, and David Seim. 2019. "Payroll Taxes, Firm Behavior, and Rent Sharing: Evidence from a Young Workers' Tax Cut in Sweden." *American Economic Review*, 109(5): 1717–63.

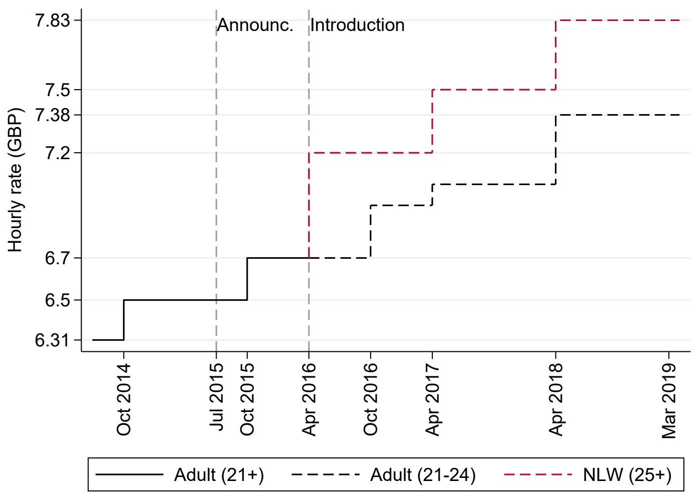
Saez, Emmanuel, Manos Matsaganis, and Panos Tsakloglou. 2012. " Earnings Determination and Taxes: Evidence From a Cohort-Based Payroll Tax Reform in Greece." *The Quarterly Journal of Economics*, 127(1): 493–533.

Sobel, Joel. 2005. "Interdependent Preferences and Reciprocity." *Journal of Economic Literature*, 43(2): 392–436.

Song, Jae, David J Price, Fatih Guvenen, Nicholas Bloom, and Till von Wachter. 2018. "Firming Up Inequality." *The Quarterly Journal of Economics*, 134(1): 1–50.

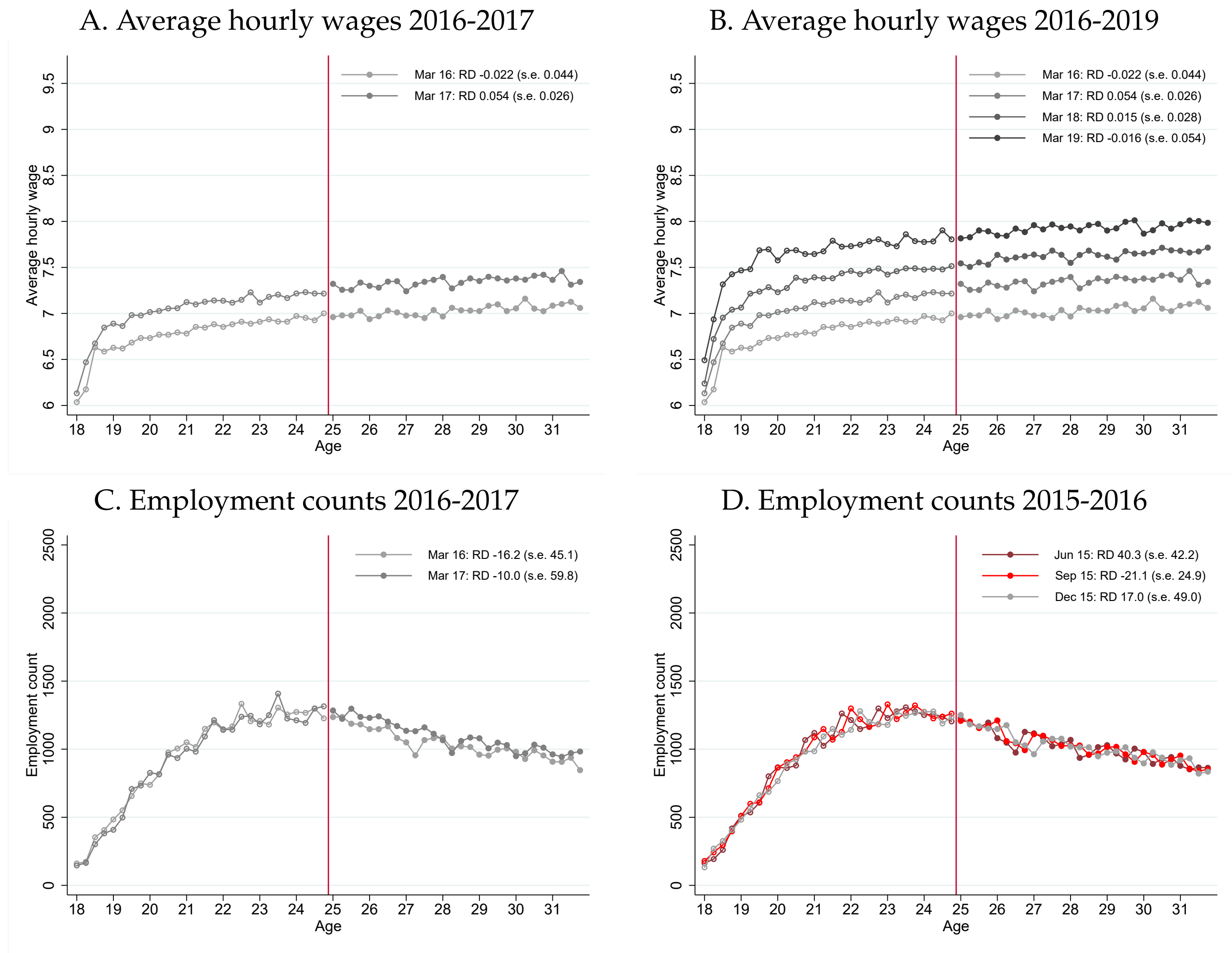
Figures

Figure 1. National Living Wage (NLW) Introduction



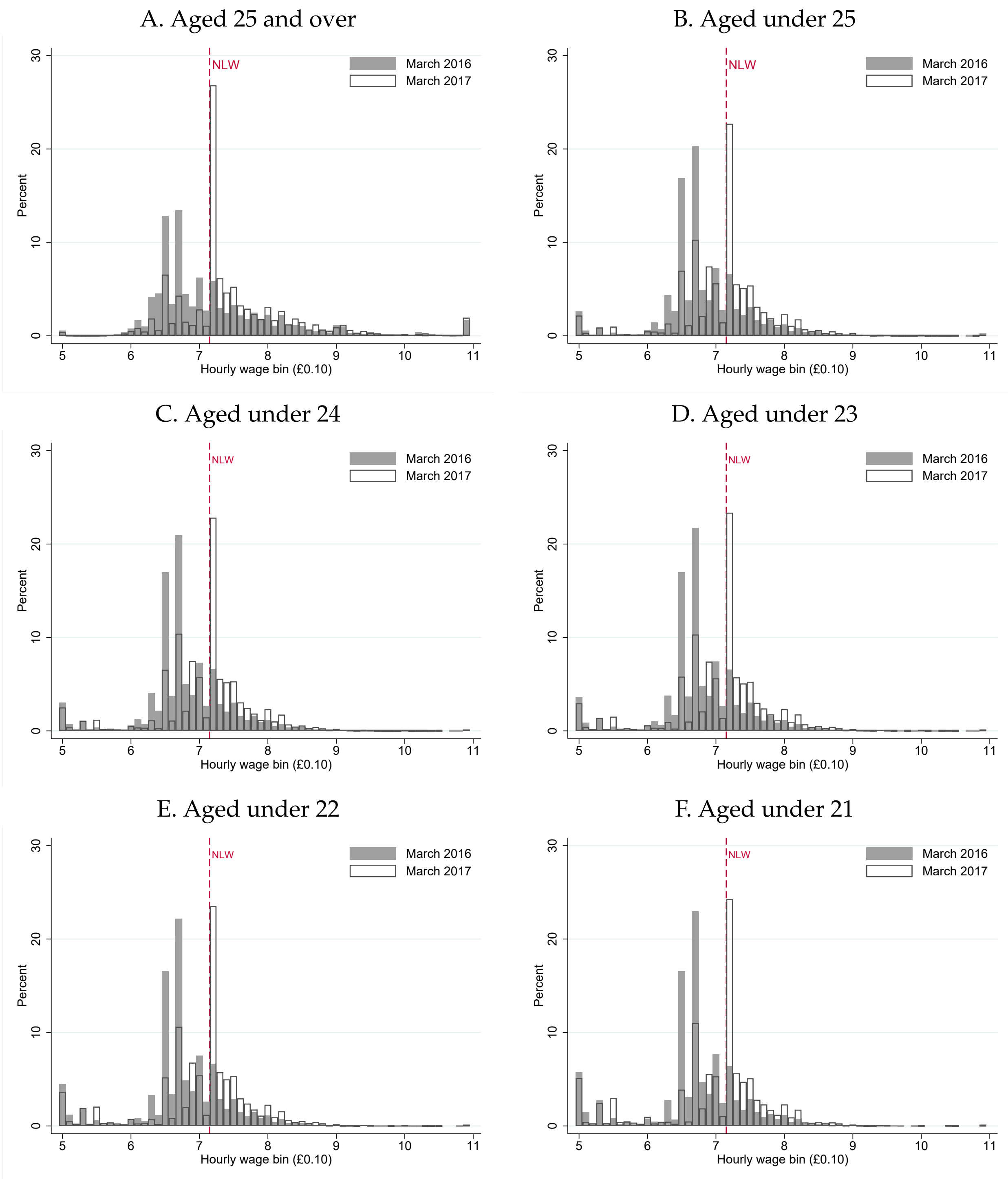
Notes: The graph reports the level of the UK minimum wage applying to the adult population aged 21 and over from September 2014 to March 2019. The solid black line corresponds to the National Minimum Wage (NMW) applying to workers aged 21 and over until April 2016. The dashed black line corresponds to the NMW applying to workers aged 21-24 starting from April 1, 2016. The dashed red line represents the National Living Wage (NLW), which was introduced on April 1, 2016 and applies to workers aged 25 and over. The vertical dashed lines illustrate the time of announcement (July 8, 2015) and introduction (April 1, 2016) of the NLW.

Figure 2. MARKET-LEVEL EFFECT OF NLW INTRODUCTION ON CARE ASSISTANTS' WAGES AND EMPLOYMENT BY AGE



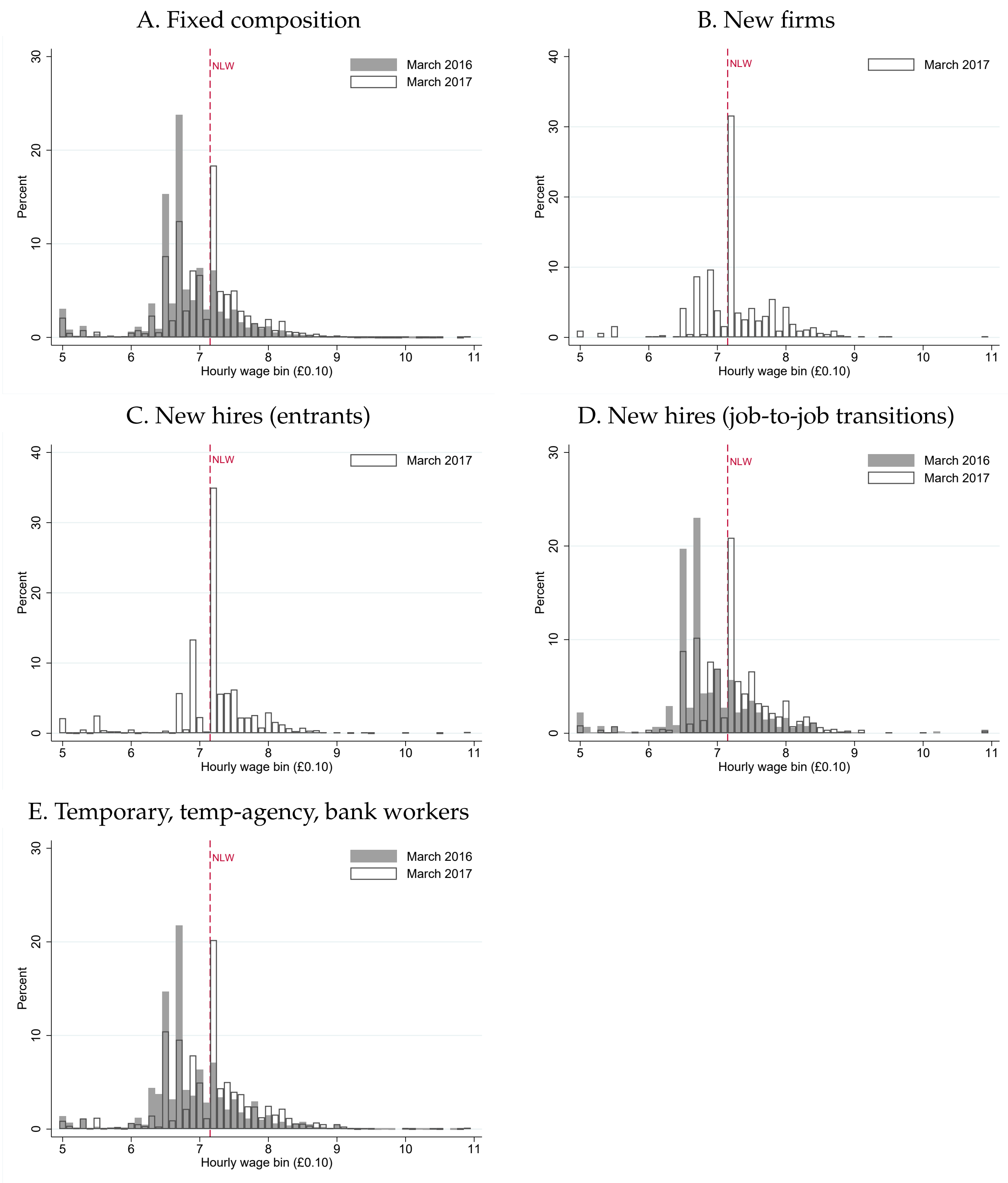
Notes: Panel A reports the average gross hourly wage by age bin (with age measured in quarters) in March 2016 and in March 2017. The graph is based on the market-level sample of care assistants. The non-parametric RD estimate of α_1 of model 1 and the associated robust standard error are reported in the top right corner, for March 2016 and March 2017 respectively. The red vertical line indicated the 25 age threshold. Panel B is an extension of Panel A, including data for March 2018 and March 2019. Panel C is constructed in an analogous way as Panel A, but reports the employment count of care assistant by age bin at the market level in March 2016 and March 2017. Panel D reports similar data and estimates for June, September and December 2015.

Figure 3. Distribution of Hourly Wages of Care Assistants



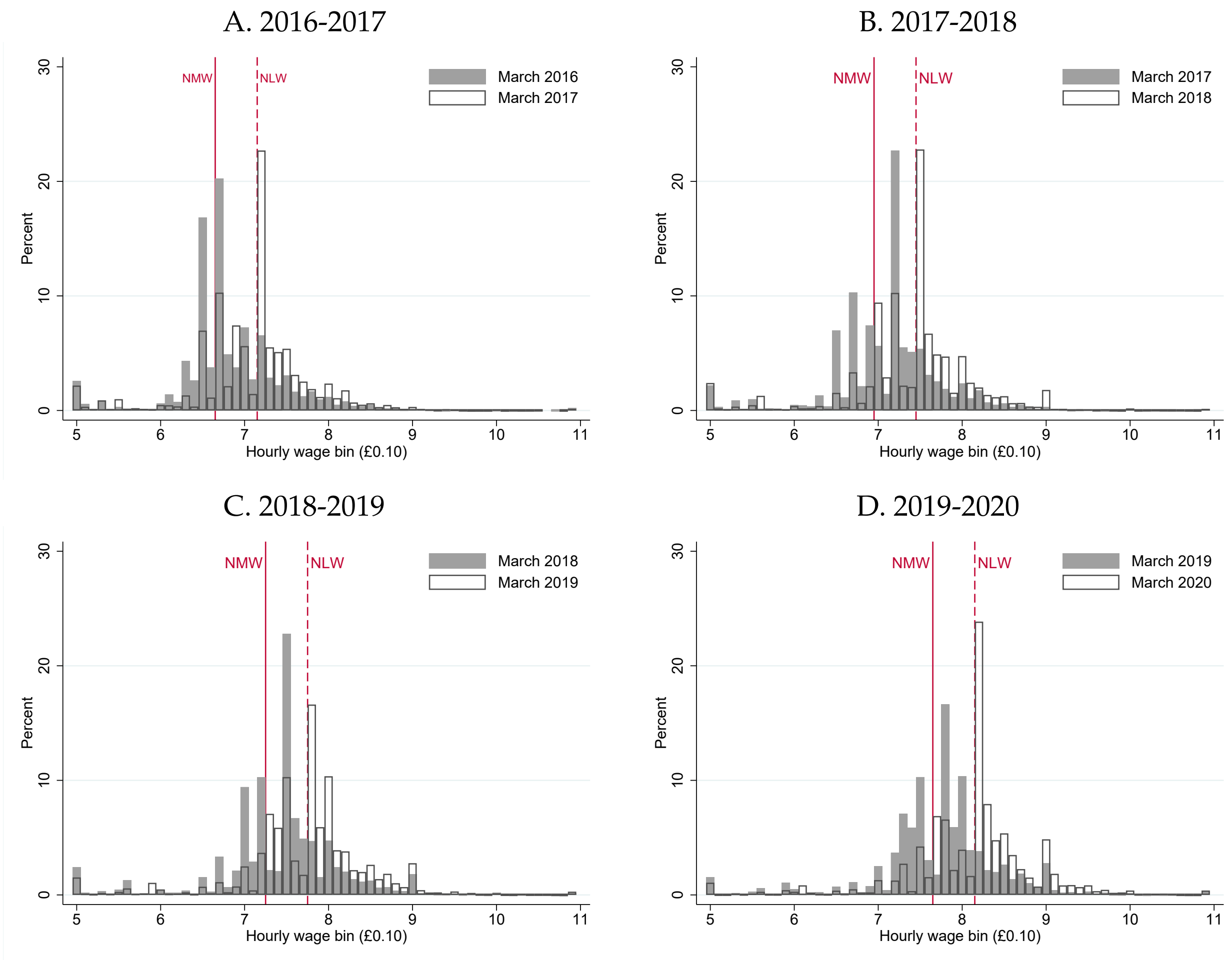
Notes: The figure reports a set of hourly wage distributions for care assistants in March 2016 (gray bars) and March 2017 (unfilled bars). Hourly wages are binned into £0.10 bins. The red dashed vertical line indicates the level of the NLW in March 2017. Panel A reports the hourly wage distribution for care assistants aged 25 and over, Panel B for those aged under 25, Panel C for those under 24, Panel D for those under 23, Panel E for those under 22 and Panel F for those under 21.

Figure 4. Distribution of Hourly Wages of Care Assistants: Testing for Compositional Changes and Contractual Rigidities



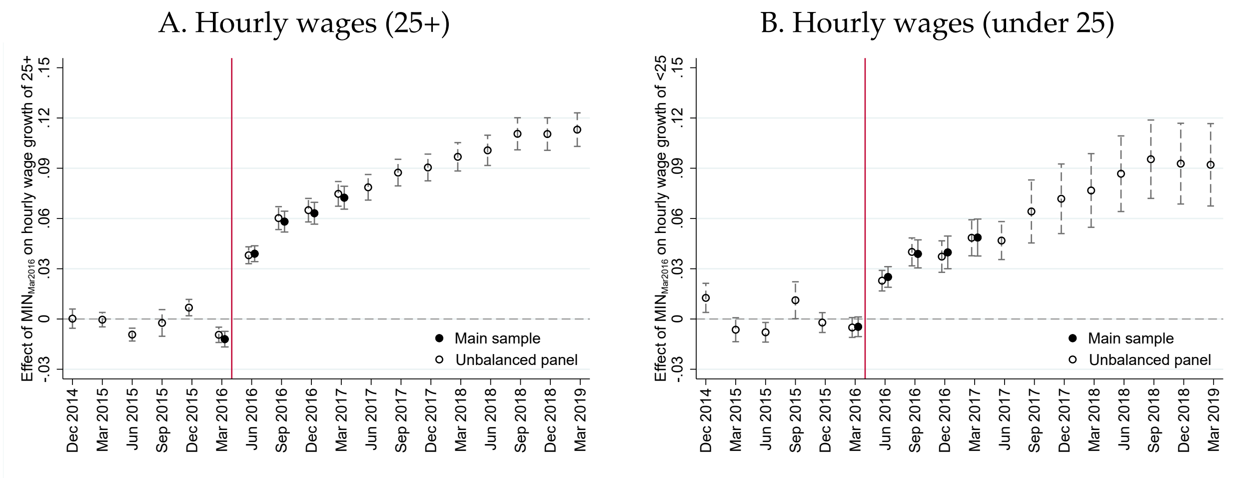
Notes: The figure reports a set of hourly wage distributions for care assistants aged under 25 in March 2016 (gray bars) and March 2017 (unfilled bars). Hourly wages are binned into £0.10 bins. The red dashed vertical line indicates the level of the NLW in March 2017. Panel A is based on the sample of workers who are observed both in March 2016 and March 2017, and who were aged under 24 in March 2016. Panel B is based on the sample of workers employed by firms that established their activity after the NLW introduction. Panel C is based on the sample of workers hired after March 2016 and with no prior experience in adult social care. Panel D also refers to new hires, but considering workers who were previously employed in adult social care. Panel E restricts the sample to temporary, temp-agency and bank – i.e. casual – workers.

Figure 5. DISTRIBUTION OF HOURLY WAGES OF CARE ASSISTANTS: DYNAMICS



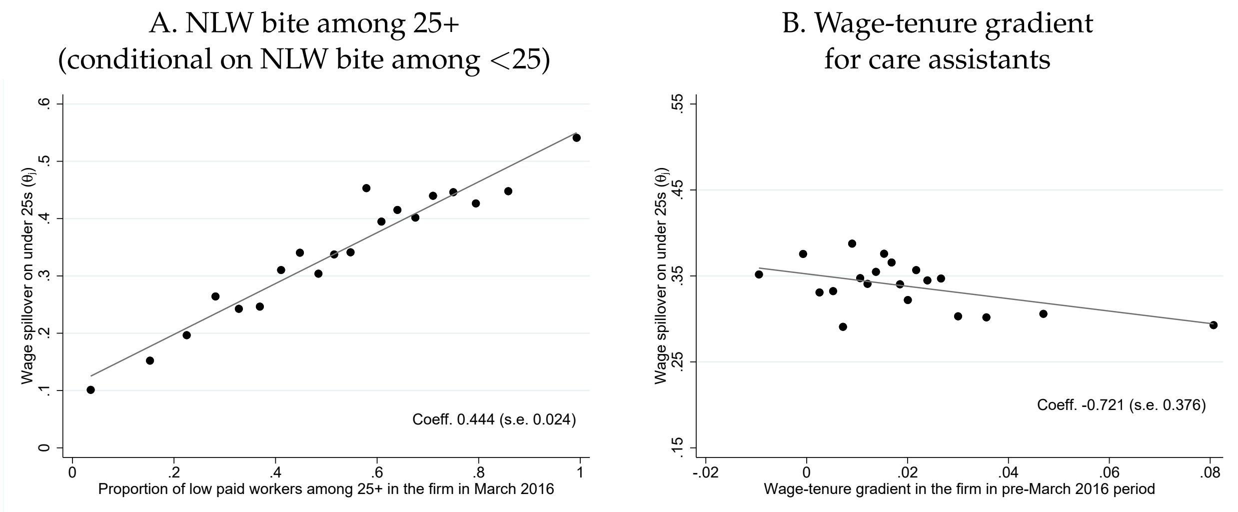
Notes: The figure traces out the dynamics of wage spillovers over time. Each panel reports the hourly wage distributions for care assistants aged under 25 in year t (gray bars) and $t+1$ (unfilled bars). Hourly wages are binned into £0.10 bins. The red solid vertical line indicates the level of the NMW in $t+1$, while the red dashed vertical line the level of the NLW in $t+1$. Panel A refers to March 2016 and March 2017, Panel B to March 2017 and March 2018, Panel C to march 2018 and March 2019, Panel D to March 2019 and March 2020.

Figure 6. Firm-Level Effect of NLW on Workers' Hourly Wages



Notes: Panel A reports the estimated coefficient $\hat{\beta}_{1,t}$ for $t = \{-15, -12, ..., 0\}$, and the cumulative sum $\sum_{t=3n} \hat{\beta}_{1,t}$ for $n = \{1, ..., 12\}$ from model 2, using the firm-level change in log average hourly wages of workers aged 25 and over as outcome. Panel B reports the same coefficients or combinations thereof from model 2, using the firm-level change in log average hourly wages of workers aged under 25 as outcome. The dots indicate the estimated coefficients and the capped vertical bars report 95 percent confidence intervals based on robust standard errors. Results are displayed for the balanced (black circles) and unbalanced (hollow circles) firm-level samples.

Figure 7. Wage Spillovers and Proxies for Fairness Norms



Notes: Panel A is a binned scatter plot of the conditional correlation between θ_j (as defined in equation 4) and $MIN^{25+}_{j,Mar16}$, conditional on the set of firm-level covariates $X_{j,Mar16}$ (the proportion of female workers, average workers' age, and the proportion of carers, senior carers, ancillary staff, nurses and administrative staff in the firm) including local authority fixed effects, and the proportion of under 25s paid below the NLW in March 2016 $MIN^{under25}_{j,Mar16}$. Panel B reports a binned scatter plot of the conditional correlation between θ_j and the firm-specific wage-tenure gradient, conditional on $MIN^{25+}_{j,Mar16}$, $MIN^{under25}_{j,Mar16}$ and $X_{j,Mar16}$. Firm-specific returns to tenure are estimated via firm-specific Mincerian regressions of the natural logarithm of the hourly wage on a quadratic function of tenure, for the sample of carers and senior carers in the pre-NLW period. The Mincerian regressions are conditional on calendar month fixed effects.

Tables

Table 1. DESCRIPTIVE STATISTICS

	Full sample [Worker-level]		Balanced panel [Worker-level]		Balanced panel [Firm-level]	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(5)	(6)
Firm size					45.18	34.43
Share under 25	0.12	0.33	0.15	0.35	0.15	0.09
Hourly wage	7.91	2.56	7.86	2.47	7.78	0.94
Paid below NLW (25+)	0.51	0.50	0.52	0.50	0.52	0.32
Paid hourly wage	0.85	0.36	0.87	0.33	0.85	0.30
Weekly hours	28.01	13.21	28.07	13.02	28.70	5.28
Female	0.84	0.37	0.84	0.37	0.84	0.12
Age	42.20	13.45	41.38	13.64	41.24	4.03
Tenure (months)	64.92	65.94	60.14	63.40	61.78	26.65
Carer	0.55	0.50	0.55	0.50	0.57	0.19
Senior carer	0.09	0.28	0.08	0.28	0.10	0.09
Ancillary staff	0.15	0.36	0.17	0.37	0.14	0.17
Nurse	0.06	0.24	0.06	0.24	0.04	0.07
Administrative staff	0.02	0.14	0.02	0.14	0.02	0.02
Wage carer	7.20	1.35	7.13	1.11	7.09	0.76
Wage senior	8.05	1.73	8.08	1.61	8.16	1.64
Wage ancillary	7.13	1.46	7.17	1.49	7.07	0.86
Wage nurse	12.82	2.43	12.87	2.59	12.99	1.66
Wage admin	8.62	2.38	8.63	2.44	8.51	1.98
ZHC	0.08	0.27	0.08	0.27	0.07	0.12
Permanent	0.88	0.32	0.89	0.32	0.90	0.11
Temporary	0.01	0.12	0.02	0.12	0.02	0.05
Bank	0.08	0.27	0.08	0.27	0.07	0.09
Agency	0.00	0.05	0.00	0.03	0.00	0.02
Other	0.01	0.09	0.01	0.09	0.01	0.04
Local authority funded	0.07	0.25	0.05	0.22	0.05	0.21
Private	0.75	0.43	0.78	0.41	0.79	0.41
Voluntary	0.16	0.36	0.15	0.35	0.14	0.35
Other type of provider	0.02	0.14	0.02	0.15	0.02	0.14
Observations	332,671		209,219		4,631	

Notes: The table reports the mean and standard deviation of a set of individual and firm characteristics for workers in the market-level sample in columns (1) and (2), and for workers and firms in the firm-level sample in columns (3) to (6). All figures are as of March 2016.

Table 2. First Stage

	Change in log average hourly wage (25+)			
	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.061***	0.072***		
	(0.003)	(0.003)		
Wage-bill gap (25+)			0.283***	0.301***
			(0.088)	(0.090)
Observations	4,631	4,631	4,631	4,631
Controls	No	Yes	No	Yes
Mean of dep. var.	0.035			
F-stat	432.91	432.02	10.367	11.230

Notes: The first two columns of the table report the point estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$, obtained from estimating model 2 using the firm-level change in the log average hourly wage of workers aged 25 and over between March 2016 and March 2017 as outcome variable. Estimates are unconditional on $X_{j,Mar16}$ in column (1) and conditional on covariates in column (2). Columns (3) and (4) of the table use an alternative measure of $MIN^{25+}_{j,Mar16}$, the 'wage-bill gap', which captures the mechanical percent effect of the NLW introduction on the wage bill of the firm. Formally, the gap in firm j at time t is defined as $\frac{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot\max\{NLW_{t+1}-w_{i,j,t}\ ,0\}}{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot w_{i,j,t}}$. The gap measures by how much the wage bill of the firm would have to increase in percent to comply with the NLW regulations, assuming no changes in employment at the extensive or intensive margin, and no wage spillover effects as a result of the NLW introduction. Estimates in column (3) are unconditional on firm-level covariates, while those in column (4) are conditional on firm-level characteristics and local authority fixed effects. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN^{25+}_{j,Mar16}$, the excluded instrument in IV model 3.

Table 3. Wage Spillover Equations

	Change in log average hourly wage (under 25)		
	(1)	(2)	(3)
Initial low-paid proportion (25+)	0.037***	0.049***	
	(0.005)	(0.006)	
Change in log avg hourly wage (25+)			0.672***
			(0.073)
Observations	4,631	4,631	4,631
Controls	No	Yes	Yes
Mean of dep. var.	0.035		
Model	OLS	OLS	IV

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in log average hourly wages of workers aged under 25 between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis.

Table 4. Employment Spillover Equations

Change in share of employees aged under 25	(1)	(2)	(3)
Initial low-paid proportion (25+)	-0.007**	0.005	
	(0.003)	(0.004)	
Change in log avg hourly wage (25+)			0.070
			(0.047)
Observations	4,631	4,631	4,631
Controls	No	Yes	Yes
Mean of dep. var.	-0.009		
Model	OLS	OLS	IV

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n, n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in the share of employees aged under 25 between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis.

Table 5. Wage Spillovers and Local Labor Market Factors

	Change in log average hourly wage (under 25)					
	(1)	(2)	(3)	(4)	(5)	(6)
Initial low-paid proportion (25+)	0.041***		0.049***		0.049***	
	(0.005)		(0.006)		(0.006)	
Change in log average hourly wage (25+)		0.620***		0.672***		0.675***
		(0.073)		(0.073)		(0.074)
Observations	4,631	4,631	4,631	4,631	4,631	4,631
Adjusted R-squared	0.018	0.075	0.033	0.074	0.019	0.065
Firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes
Local authority FE	No	No	Yes	Yes	No	No
TTWA FE	No	No	No	No	Yes	Yes
Model	OLS	IV	OLS	IV	OLS	IV
F-stat		69.92		74.73		75.17

Notes: The odd columns in the table report the reduced-form estimate of $\sum_{t=3n, n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2. The outcome variable is the firm-level change in log average hourly wages of workers aged under 25 between March 2016 and March 2017. The even columns report the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. Columns (1) and (2) are conditional on firm-level covariates, but do not include local labor market fixed effects. Columns (3) and (4) include firm-level covariates and local authority district fixed effects. Columns (5) and (6) include firm-level covariates and travel-to-work area (TTWA) fixed effects. The bottom row reports the F-statistics on $MIN^{25+}_{j,Mar16}$, the excluded instrument in IV model 3.

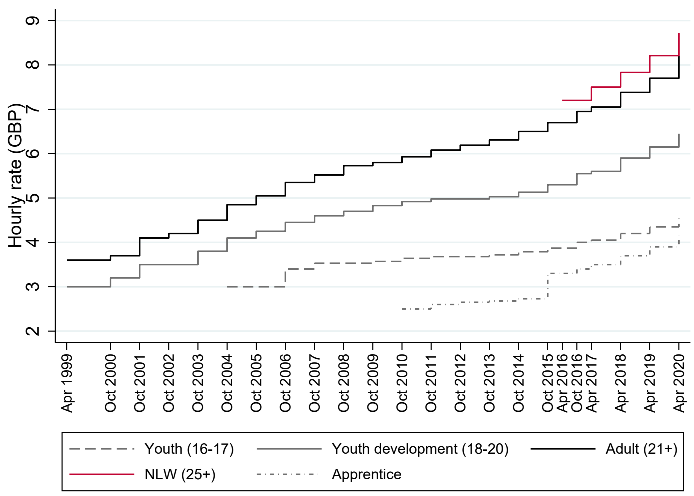
Table 6. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: CARE ASSISTANTS

	Change in log average hourly wage of carers under 25				
	(1)	(2)	(3)	(4)	(5)
Change in log average hourly wage of carers (25+)	0.754***				
	(0.072)				
Change in log average hourly wage of senior carers (25+)		-0.362*			
		(0.194)			
Change in log average hourly wage of ancillary staff (25+)			0.165		
			(0.123)		
Change in log average hourly wage of admin staff (25+)				-0.067	
				(0.095)	
Change in log average hourly wage of nurses (25+)					-0.050
					(0.050)
Observations	3,939	2,954	2,600	1,874	1,181
Controls	Yes	Yes	Yes	Yes	Yes
Mean of dep. var.	0.035				

Notes: The table reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among carers aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is the average hourly wage growth among workers aged 25 and over in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each $\Delta \ln w_{j,t}^{under25,k}$ is instrumented using $MIN_{j,Mar16}^{25+,k}$ as excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments. Robust standard errors are reported in parenthesis.

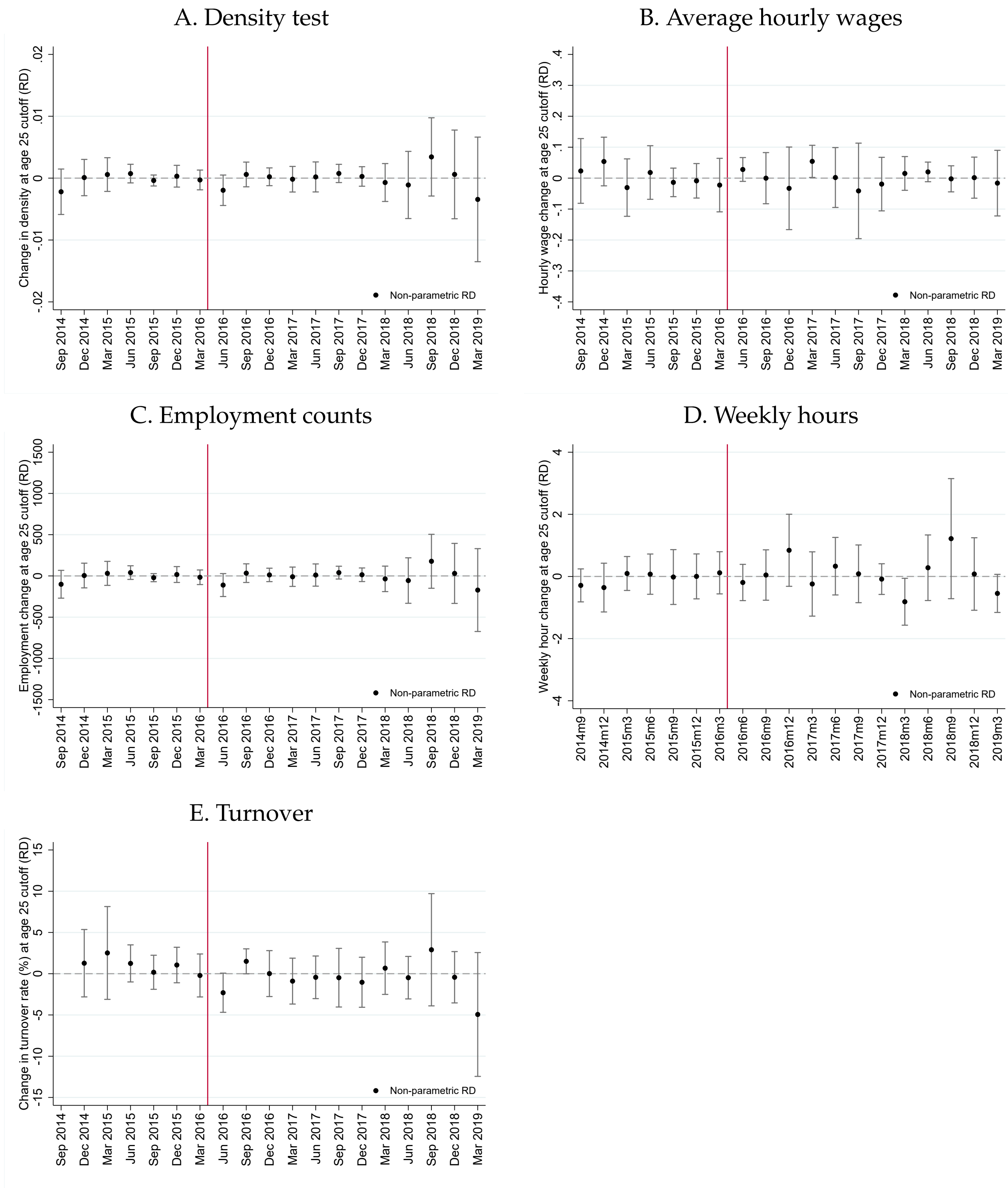
Appendix A. Additional Figures and Tables

Figure A1. MINIMUM WAGE RATES IN THE UK 1999-2020



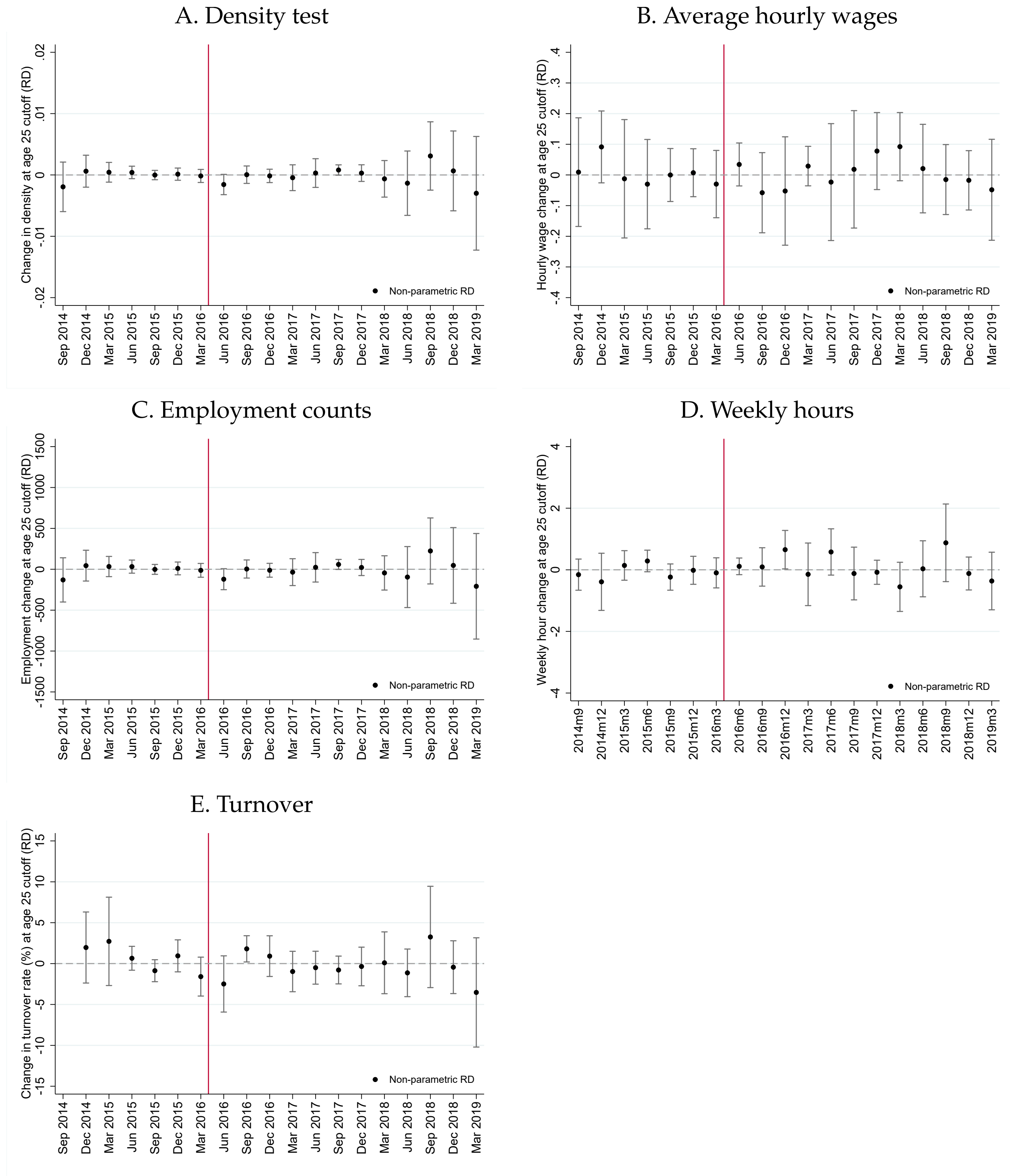
Notes: The graph reports the levels of the minimum wage rates applying to workers of different ages in the UK between April 1999 and April 2020. The apprentice rate applies to apprentices. The 16-17 year-old rate to workers aged 16 and 17. The youth development rate to workers aged 18-20. The adult rate (National Minimum Wage) applied to workers aged 21 and over until March 2016. From April 2016, the NMW applies to workers aged 21-24 and the National Living Wage (NLW) to those aged 25 and over.

Figure A2. MARKET-LEVEL EFFECT OF NLW INTRODUCTION ON WAGE AND EMPLOYMENT OUTCOMES FOR CARE ASSISTANTS



Notes: The figure reports a set of RD estimates (indicated by dots) and associated 95 percent confidence intervals (capped vertical bars). The sample analyzed is the market-level sample of care assistants. Panel A reports the RD estimates of a set of McCrary tests for a discontinuity in the density function of age at the age-25 cutoff for the end-month of each quarter in the sample period. Panel B reports the RD estimate of α_1 from model 1 using average gross hourly wages as outcome variable. Panels C, D and E are analogous to Panel B, but use employment counts, average weekly hours worked and the turnover rate as outcome variable, respectively. Turnover is measured as the sum of the hiring and separation rates.

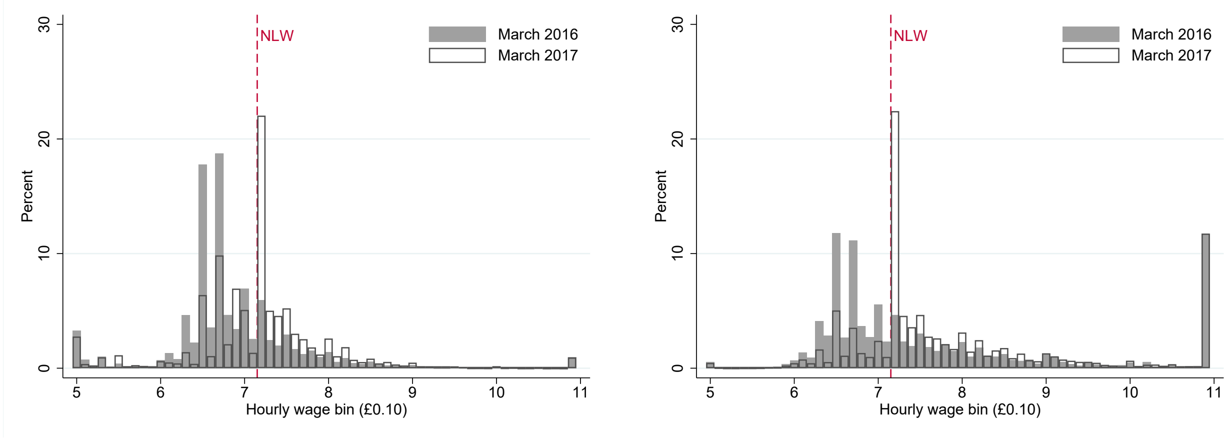
Figure A3. MARKET-LEVEL EFFECT OF NLW INTRODUCTION ON WAGE AND EMPLOYMENT OUTCOMES FOR WORKERS IN THE CARE HOME SECTOR



Notes: The figure reports a set of RD estimates (indicated by dots) and associated 95 percent confidence intervals (capped vertical bars). The sample analyzed is the market-level sample of workers in the residential care home sector. Panel A reports the RD estimates of a set of McCrary tests for a discontinuity in the density function of age at the age-25 cutoff for the end-month of each quarter in the sample period. Panel B reports the RD estimate of α_1 from model 1 using average gross hourly wages as outcome variable. Panels C, D and E are analogous to Panel B, but use employment counts, average weekly hours worked and the turnover rate as outcome variable, respectively. Turnover is measured as the sum of the hiring and separation rates.

Figure A4. Distribution of Hourly Wages for Workers in the Care Home Sector

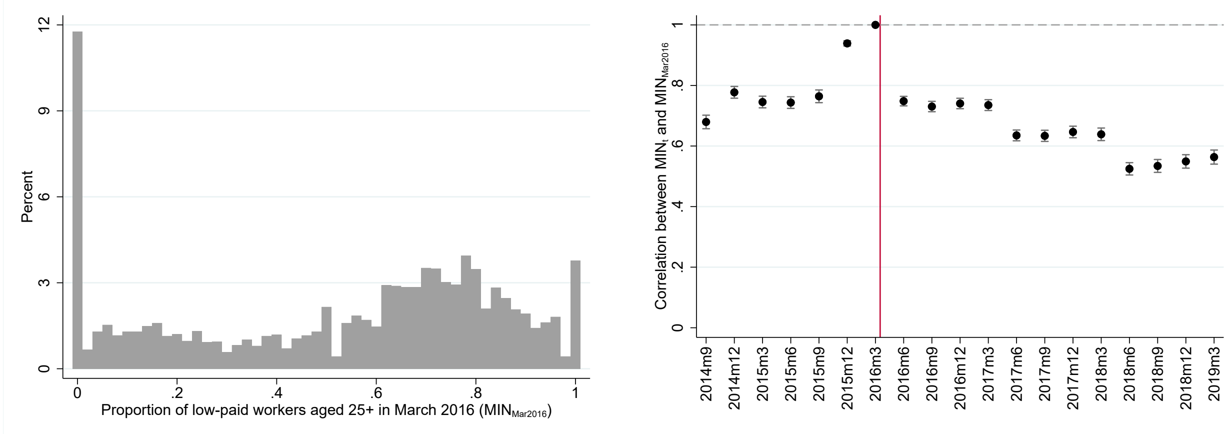
A. Aged under 25 | B. Aged 25 and over



Notes: The figure reports a set of hourly wage distributions for workers in the care sector (any occupation) in March 2016 (gray bars) and March 2017 (unfilled bars). Hourly wages are binned into £0.10 bins. The red dashed vertical line indicates the level of the NLW in March 2017. Panel A reports the hourly wage distribution for workers aged 25 and over, Panel B for those aged under 25.

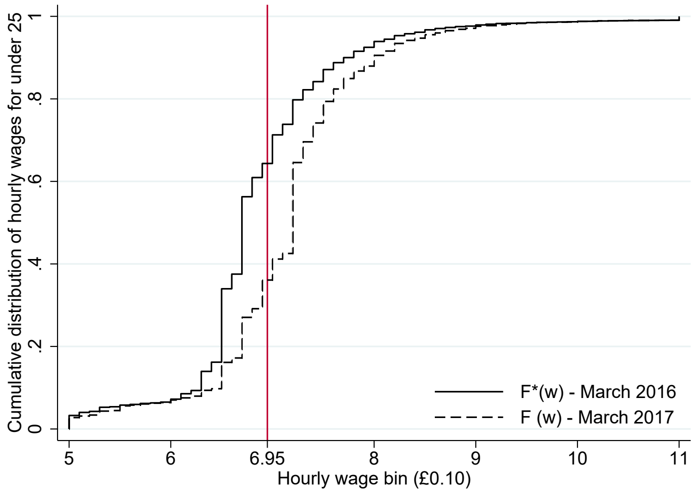
Figure A5. Distribution and Persistence of Firm-Level NLW Bite

A. Distribution of MIN | B. Persistence of MIN



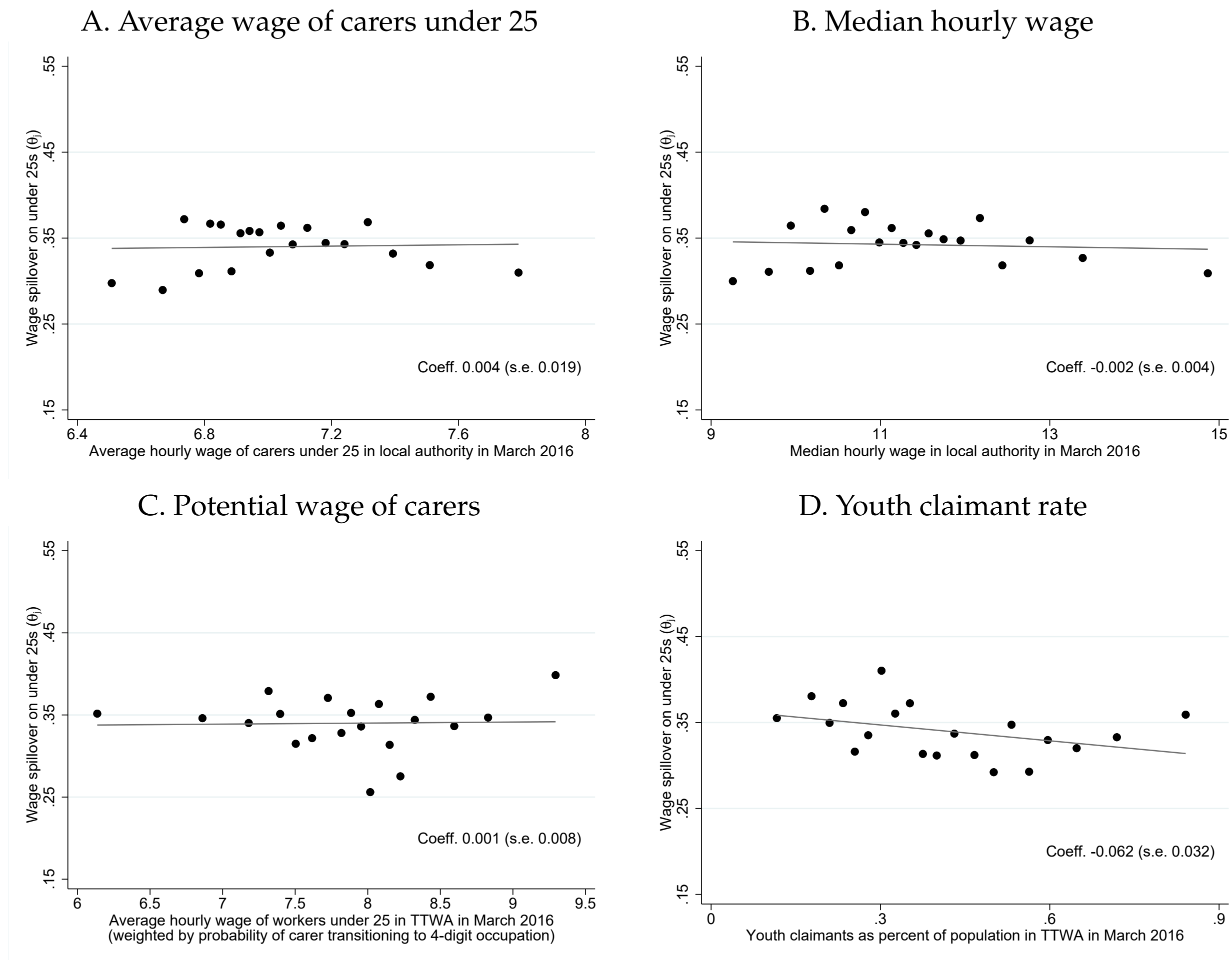
Notes: Panel A reports the density distribution of the variable $MIN^{25+}_{j,Mar16}$. The variable $MIN^{25+}_{j,Mar16}$ is constructed as the proportion of workers aged 25 and over that in March 2016 were paid below the age-specific minimum wage rate that would become effective on April 1, 2016. The average value of $MIN^{25+}_{j,Mar16}$ in the sample is 0.52 (with a standard deviation of 0.32). Panel B reports the correlation between $MIN^{25+}_{j,Mar16}$ and $MIN^{25+}_{j,t}$ for $t = \{-15, -12, ..., 0, 3, ..., 36\}$.

Figure A6. MEASURE OF WAGE SPILLOVERS AT THE FIRM LEVEL



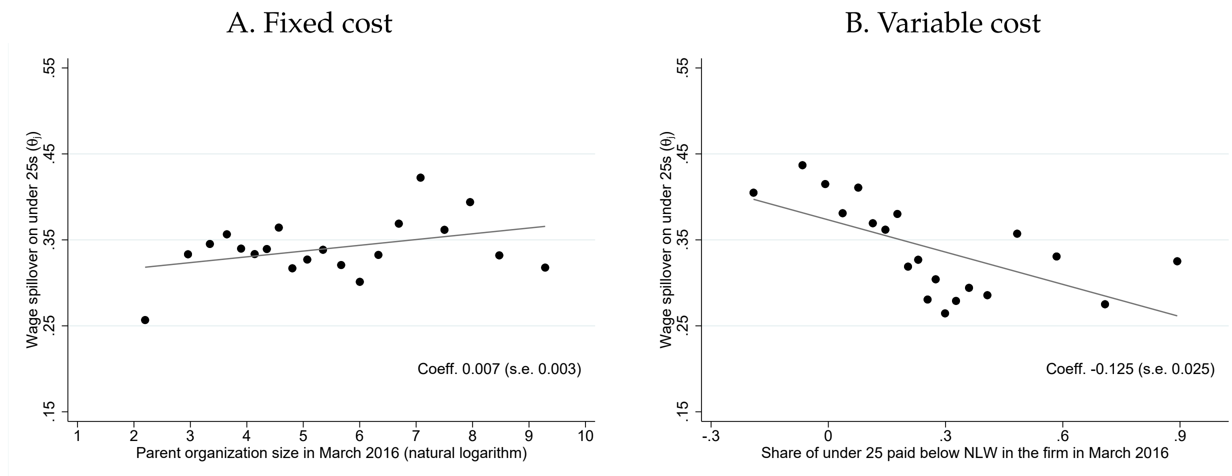
Notes: The figure illustrates the components of θ_j – defined as $\theta_j(w^{NMW}) = \frac{F_j^*(w^{NMW}) - F_j(w^{NMW})}{F_j^*(w^{NMW})}$ in 4 – for a representative firm in March 2017. The solid line corresponds to $F_j^*(\cdot)$ as represented by the March 2016 distribution, and the dashed line corresponds to $F_j(\cdot)$ in March 2017. The red vertical line indicates the level of w^{NMW} in March 2017. The variable θ_j is an increasing function of the size of wage spillovers on young workers over the $[0, 1]$ interval. If a firm implements a no-spillover policy, we would expect the solid and dashed lines to overlap in the range $w_{ij} < w^{NMW}$ (i.e. $F_j^*(w^{NMW}) = F_j(w^{NMW})$), resulting in $\theta_j = 0$. On the other hand, in case a firm operates a full-fledged spillover policy, the dashed line would lay entirely to the left of the red vertical line (i.e. $F_j(w^{NMW}) = 0$), leading to $\theta_j = 1$.

Figure A7. WAGE SPILLOVERS AND WORKERS' OUTSIDE OPTION



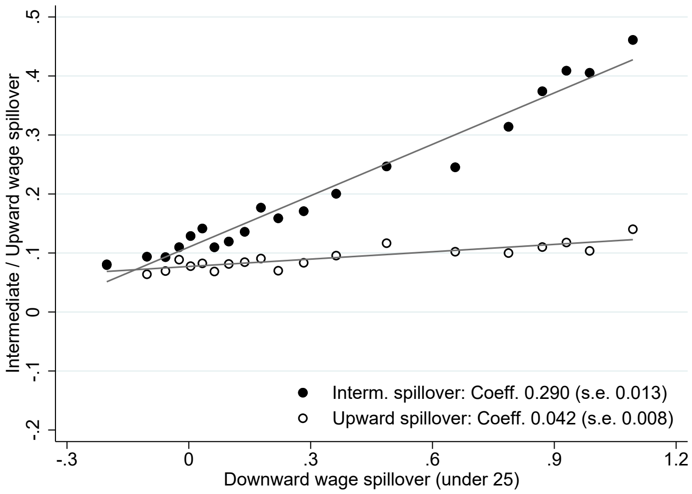
Notes: The figure reports a set of binned scatter plots of the relationship between θ_j (as defined in equation 4) and proxies for the average outside option of workers aged under 25 in firm j. All correlations are conditional on $MIN^{25+}_{j,Mar16}$ and $X_{j,Mar16}$, with the exclusion of local labor market fixed effects. Each graph reports the estimated coefficient (and associated standard error in parenthesis) of an OLS regression of $\theta_j = 1$ on the variable reported on the x-axis, conditional on covariates. Panel A proxies the outside option with the average hourly wage of carers aged under 25 in the local authority of firm j in March 2016, excluding wages in firm j from the computation of the average. Panel B uses the median hourly wage of private-sector employees in the local authority in March 2016. The median hourly wage of private-sector employees in the local authority is based on ASHE data elaborated by the UK Office for National Statistics. Panel C employs a measure of the 'potential' wage of carers in the TTWA. To construct it, we take the average of gross hourly wages of workers aged under 25 in each 4-digit occupation and TTWA, and we compute a weighted average of occupation-specific wages, weighted by the probability of yearly transition of a care worker to that occupation. Transition probabilities are calculated using Labor Force Survey five-quarter longitudinal data for the UK. To boost sample size, we use data from 2010 to 2016. The vector of transition probabilities from care assistant in year t to occupation k 12 months after includes the probability of remaining in the same occupation. Occupation- and TTWA-specific gross hourly wages are calculated using ASHE data. Panel D uses the unemployment insurance claimant rate among individuals aged under 25 as an indirect measure of workers' outside option. The claimant rate is computed as the ratio of the number of people aged 16-24 claiming Jobseeker's Allowance or Universal Credit for the reason of being unemployed, as a percent of the population in the TTWA in March 2016. The data, based on Department for Work and Pensions administrative data elaborated by the by the UK Office for National Statistics.

Figure A8. WAGE SPILLOVERS AND PROXIES FOR THE ADMINISTRATIVE COST OF KEEPING A DIVERSIFIED WAGE STRUCTURE



Notes: Panel A is a binned scatter plot of the conditional correlation of θ_j (as defined in equation 4) and the size of the parent organization of firm j (in natural logarithm), conditional on $MIN^{25+}_{j,Mar16}$, $X_{j,Mar16}$, the proportion of under 25s paid below the NLW in March 2016, and a measure of the wage-bill cost of wage spillovers. The latter is the percent increase in wage-bill costs required to increase all younger workers' wages to the NLW as of March 2016. Formally, the wage-bill gap in firm j at time t is defined as $\frac{\sum_{i \in j | age_i < 25} h_{i,j,t} \cdot \max\{NLW_{t+1} - w_{i,j,t}\ , 0\}}{\sum_{i \in j} h_{i,j,t} \cdot w_{i,j,t}}$. Panel B of Appendix Figure A8 is a binned scatter plot of the conditional correlation of θ_j and the share of workers aged under 25 paid below the NLW in firm j in March 2016. The correlation is conditional on $MIN^{25+}_{j,Mar16}$, $X_{j,Mar16}$, the wage-bill cost of wage spillovers and the logarithm of parent organization size. Each graph reports the estimated coefficient (and associated standard error in parenthesis) of an OLS regression of $\theta_j = 1$ on the variable reported on the x-axis, conditional on covariates.

Figure A9. CORRELATION BETWEEN UPWARD AND DOWNWARD WAGE SPILLOVERS



Notes: The figure reports a binned scatter plot of the conditional correlation between downward spillovers on workers aged under 25 (x-axis), and intermediate or upward spillovers on workers aged 25 and over (y-axis), where spillovers are measured in March 2017. Downward spillovers are measured as $\theta_j(w^N MW)$, intermediate spillovers as $\theta_j(w^{NLW})$ and upward spillovers as $\theta_j(£7.7)$, where $\theta_j(w)$ is defined as in formula 4. Downward spillovers are computed on the sample of workers aged under 25, while intermediate and upward spillovers are both based on the sample of workers aged 25 and over in March 2017. As such, intermediate wage spillovers measure the size of wage spillovers on individuals who were paid up to the NLW in March 2016; upward wage spillovers capture instead the extend to which spillovers reached individuals already paid £0.50 above the new minimum. Correlations are conditional on the set of firm-level covariates $X_{j,Mar16}$, including local authority fixed effects.

Table A1. TESTING FOR SAMPLE SELECTION: CONDITIONALITY ON SURVIVAL

	Probability of firm being active in:		
	March 2017	March 2018	March 2019
	(1)	(2)	(3)
Initial low-paid proportion (25+)	-0.020**	-0.020	-0.015
	(0.010)	(0.013)	(0.015)
Observations	6,519	6,519	6,519
Controls	Yes	Yes	Yes
Mean of dep. var.	0.953	0.912	0.877

Notes: The table reports linear probability models for the probability of the organization being active in March 2017, March 2018 and March 2018, on the sample of all firms active (and employing workers under 25) in March 2016. The estimates are based on the reduced-form model illustrated in equation 2 and are conditional on firm-level characteristics and local authority district fixed effects. Robust standard errors are reported in parenthesis.

Table A2. TESTING FOR SAMPLE SELECTION: CONDITIONALITY ON YOUTH EMPLOYMENT

	Probability of employing under 25s in:			
	March 2016	March 2017	March 2018	March 2019
	(1)	(2)	(3)	(4)
Low-paid prop. (25+)	0.027*	0.000	-0.019	-0.024
	(0.014)	(0.013)	(0.017)	(0.020)
Observations	8,293	5,712	5,027	4,750
Controls	Yes	Yes	Yes	Yes
Mean of dep. var.	0.786	0.927	0.891	0.865

Notes: The table reports linear probability models for the probability of employing workers aged under 25 in March 2016, March 2017, March 2018 and March 2018. The estimates are based on the reduced-form model illustrated in equation 2 and are conditional on firm-level characteristics and local authority district fixed effects. The estimate in column (1) is based on the sample of firms active in March 2016, irrespective of whether they employ workers aged under 25 or not. The estimates in columns (2) to (4) are instead based on firms active and employing young workers in March 2016, and still active in March 2017 (column (2)), March 2018 (column (3)) and March 2019 (column (4)). Robust standard errors are reported in parenthesis.

Table A3. MARKET-LEVEL WAGE SPILLOVERS

	Care assistants		All workers	
	Hourly wage (1)	Counterf. hourly wage (2)	Hourly wage (3)	Counterf. hourly wage (4)
$\hat{\alpha}_1$	0.020	0.195***	0.024	0.301***
	(0.023)	(0.017)	(0.029)	(0.030)
Observations	168	168	168	168
Mean of dep. var.	7.509	7.339	7.712	7.458
Spillover onto under 25		0.897		0.920

Notes: The table displays estimates of the coefficient α_1 in model 1 for different wage outcomes. We estimate the model pooling data for March 2017, March 2018 and March 2019, and including time fixed effects in the estimation. Column (1) reports the estimated α_1 using hourly wages of care assistants as outcome variable. In column (2), the outcome variable is a measure of the counterfactual hourly wage that care assistants would have received absent wage spillovers. For workers aged 25 and over, the counterfactual wage is equivalent to their actual wage $w_{i,t}$, where t indexes a calendar year. For younger workers, it is defined as $\max(w_{i,t-1}\ ;\ NMW_t^{21-24})$ if $w_{i,t-1} < NLW_t$, and $w_{i,t}$ otherwise. The counterfactual wage for new hires aged under 25 is assumed to be equivalent to NMW_t^{21-24}. The magnitude of wage spillovers is measured as $\frac{\hat{\alpha}_1^{counterf} - \hat{\alpha}_1^{actual}}{\hat{\alpha}_1^{counterf}}$, and is reported in the bottom row of the table. Columns (3) and (4) report analogous estimates for all workers in residential care. Robust standard errors are reported in parenthesis.

Table A4. WAGE SPILLOVER EQUATIONS: WAGE-BILL GAP AS IV

Change in log average hourly wage (under 25)	(1)	(2)	(3)
Wage-bill gap (25+)	0.112**	0.131**	
	(0.048)	(0.055)	
Change in average hourly wage (25+)			0.436***
			(0.111)
Observations	4,631	4,631	4,631
Controls	No	Yes	Yes
Mean of dep. var.	0.035		
Model	OLS	OLS	IV
F-stat			11.230

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in log average hourly wages of workers aged under 25 between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the the 'wage-bill gap' in the firm in March 2016. Formally, the gap in firm j at time t is defined as $\frac{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot \max\{NLW_{t+1}-w_{i,j,t}\ ,\ 0\}}{\sum_{i\in j|age_i\geq 25} h_{i,j,t}\cdot w_{i,j,t}}$. The gap measures by how much the wage bill of the firm would have to increase in percent to comply with the NLW regulations, assuming no changes in employment at the extensive or intensive margin, and no wage spillover effects as a result of the NLW introduction. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on the wage gap, the excluded instrument in IV model 3.

Table A5. WAGE SPILLOVER EQUATIONS: LEVEL EFFECTS

Change in average hourly wage (under 25)	(1)	(2)	(3)
Initial low-paid proportion (25+)	0.253***	0.343***	
	(0.039)	(0.044)	
Change in average hourly wage (25+)			0.636***
			(0.076)
Observations	4,631	4,631	4,631
Controls	No	Yes	Yes
Mean of dep. var.	0.240		
Model	OLS	OLS	IV
F-stat			317.09

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in average hourly wages of workers aged under 25 between March 2016 and March 2017, in levels. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN^{25+}_{j,Mar16}$, the excluded instrument in IV model 3.

Table A6. WEEKLY HOUR SPILLOVER EQUATIONS

Change in log average weekly hours (under 25)	(1)	(2)	(3)
Initial low-paid proportion (25+)	0.023	0.026	
	(0.017)	(0.020)	
Change in log average hourly wage (25+)			0.363
			(0.273)
Observations	4,453	4,453	4,453
Controls	No	Yes	Yes
Mean of dep. var.	0.004		
Model	OLS	OLS	IV
F-stat			413.92

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in log average weekly hours worked by workers aged under 25 between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w_{j,t}^{25+}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN_{j,Mar16}^{25+}$, the excluded instrument in IV model 3.

Table A7. ZERO HOURS CONTRACT EQUATIONS

Change in share on a zero hours contract (under 25)	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.028***	0.025**		
	(0.010)	(0.012)		
Change in log average hourly wage (25+)			0.354**	
			(0.162)	
Change in log average hourly wage (<25)				0.529**
				(0.250)
Observations	4,399	4,399	4,399	4,399
Controls	No	Yes	Yes	Yes
Mean of dep. var.	0.013			
Model	OLS	OLS	IV	IV
F-stat			387.61	65.409

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in the share of workers aged under 25 employed with a zero hours contract between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w_{j,t}^{25+}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN_{j,Mar16}^{25+}$, the excluded instrument in IV model 3.

Table A8. TURNOVER EQUATIONS

	Change in turnover rate (under 25)		
	(1)	(2)	(3)
Initial low-paid proportion (25+)	-0.005	0.006	
	(0.020)	(0.024)	
Change in log average hourly wage (25+)			0.082
			(0.333)
Observations	4,519	4,519	4,519
Controls	No	Yes	Yes
Mean of dep. var.	-0.021		
Model	OLS	OLS	IV
F-stat			435.825

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in turnover among workers aged under 25 between March 2016 and March 2017. Turnover is measured as the sum of the hiring and separation rates. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN^{25+}_{j,Mar16}$, the excluded instrument in IV model 3.

Table A9. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: FIRST STAGE

Change in log average hourly wage of 25+	Carer	Senior carer	Ancillary staff	Admin staff	Nurse
	(1)	(2)	(3)	(4)	(5)
Initial low paid prop. among carers (25+)	0.051***	0.000**	0.000	0.000	0.000**
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Initial low paid prop. among senior carers (25+)	-0.000	0.041***	-0.000	-0.000*	-0.000***
	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)
Initial low paid prop. among ancillary staff (25+)	0.000	0.000	0.066***	0.000	0.000**
	(0.000)	(0.000)	(0.006)	(0.000)	(0.000)
Initial low paid prop. among admin staff (25+)	0.000***	0.000	-0.000	0.061***	-0.000
	(0.000)	(0.000)	(0.000)	(0.008)	(0.000)
Initial low paid prop. among nurses (25+)	-0.000	-0.000	0.000	-0.000	0.220***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.037)
Observations	4,168	3,225	2,771	2,097	1,244
Controls	Yes	Yes	Yes	Yes	Yes
Partial F-stat	460.956	130.729	133.455	64.995	36.439
F-stat	106.161	33.948	27.964	13.769	16.013

Notes: The table reports the first-stage estimates of versions of IV model 3, in which the outcome variable is gross hourly wage growth among workers aged under 25 in occupation k ($\Delta \ln w_{j,t}^{under25,k}$), and the main regressor of interest is average hourly wage growth among workers aged 25 and over in different job roles k and $-k$ ($\Delta \ln w_{j,t}^{under25,k}$ and $\Delta \ln w_{j,t}^{under25,-k}$). In the first stage reported in the table, the dependent variable is gross hourly wage growth among older workers between March 2016 and March 2017 for carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each of these variables is regressed against the set of included and excluded instruments. In particular, $MIN_{j,Mar16}^{25+,k}$ is the excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – are the included instruments. Robust standard errors are reported in parenthesis. The penultimate row reports the partial F-statistics on $MIN_{j,Mar16}^{25+,k}$, the excluded instrument. The bottom row reports the F-statistics on the excluded and the included instruments $MIN_{j,Mar16}^{25+,-k}$.

Table A10. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: SENIOR CARE ASSISTANTS

	Change in log average hourly wage of senior carers under 25				
	(1)	(2)	(3)	(4)	(5)
Change in log average hourly wage of carers (25+)	0.108				
	(0.249)				
Change in log average hourly wage of senior carers (25+)		0.814**			
		(0.384)			
Change in log average hourly wage of ancillary staff (25+)			-0.287		
			(0.326)		
Change in log average hourly wage of admin staff (25+)				-0.087	
				(0.148)	
Change in log average hourly wage of nurses (25+)					2.159
					(1.615)
Observations	446	442	331	259	131
Controls	Yes	Yes	Yes	Yes	Yes
Mean of dep. var.	0.033				

Notes: The table reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among senior carers aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is the average hourly wage growth among workers aged 25 and over in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each $\Delta \ln w_{j,t}^{under25,k}$ is instrumented using $MIN_{j,Mar16}^{25+,k}$ as excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments. Robust standard errors are reported in parenthesis.

Table A11. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: ANCILLARY STAFF

	Change in log average hourly wage of ancillary staff under 25				
	(1)	(2)	(3)	(4)	(5)
Change in log average hourly wage of carers (25+)	0.034				
	(0.286)				
Change in log average hourly wage of senior carers (25+)		-0.370			
		(0.500)			
Change in log average hourly wage of ancillary staff (25+)			0.639***		
			(0.162)		
Change in log average hourly wage of admin staff (25+)				-0.149	
				(0.150)	
Change in log average hourly wage of nurses (25+)					0.081
					(0.097)
Observations	1,022	786	1,023	790	551
Controls	Yes	Yes	Yes	Yes	Yes
Mean of dep. var.	0.038				

Notes: The table reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among ancillary staff aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is the average hourly wage growth among workers aged 25 and over in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each $\Delta \ln w_{j,t}^{under25,k}$ is instrumented using $MIN_{j,Mar16}^{25+,k}$ as excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments. Robust standard errors are reported in parenthesis.

Table A12. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: ADMINISTRATIVE STAFF

Change in log average hourly wage of administrative staff under 25	(1)	(2)	(3)	(4)	(5)
Change in log average hourly wage of carers (25+)	0.770				
	(1.008)				
Change in log average hourly wage of senior carers (25+)		-23.91			
		(24.80)			
Change in log average hourly wage of ancillary staff (25+)			244.3		
			(7,051)		
Change in log average hourly wage of admin staff (25+)				-0.314	
				(0.216)	
Change in log average hourly wage of nurses (25+)					0.831
					(1.154)
Observations	122	90	102	113	83
Controls	Yes	Yes	Yes	Yes	Yes
Mean of dep. var.	0.059				

Notes: The table reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among administrative staff aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is the average hourly wage growth among workers aged 25 and over in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each $\Delta \ln w_{j,t}^{under25,k}$ is instrumented using $MIN_{j,Mar16}^{25+,k}$ as excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments. Robust standard errors are reported in parenthesis.

Table A13. CROSS-OCCUPATION WAGE SPILLOVER EQUATIONS: NURSES

Change in log average hourly wage of nurses under 25	(1)	(2)	(3)	(4)	(5)
Change in log average hourly wage of carers (25+)	3.008**				
	(1.401)				
Change in log average hourly wage of senior carers (25+)		1.377			
		(1.400)			
Change in log average hourly wage of ancillary staff (25+)			2.030		
			(3.023)		
Change in log average hourly wage of admin staff (25+)				0.151	
				(0.449)	
Change in log average hourly wage of nurses (25+)					0.560
					(0.424)
Observations	57	33	53	48	57
Controls	Yes	Yes	Yes	Yes	Yes
Mean of dep. var.	0.090				

Notes: The table reports IV estimates of γ_1 from versions of model 3 in which the outcome variable is gross hourly wage growth among nurses aged under 25 ($\Delta \ln w_{j,t}^{under25,carer}$), and the main regressor of interest is the average hourly wage growth among workers aged 25 and over in different job roles k ($\Delta \ln w_{j,t}^{under25,k}$), specifically carers (column (1)), senior carers (column (2)), ancillary staff (column (3)), administrative staff (column (4)) and nurses (column (5)). Each $\Delta \ln w_{j,t}^{under25,k}$ is instrumented using $MIN_{j,Mar16}^{25+,k}$ as excluded instrument and $MIN_{j,Mar16}^{25+,-k}$ – i.e. the fraction of older workers paid below the NLW in each of the other job roles – as included instruments. Robust standard errors are reported in parenthesis.

Table A14. PRODUCTIVITY EQUATIONS

Change in log residents per worked hour	(1)	(2)	(3)	(4)
Initial low-paid proportion (25+)	0.015	0.007		
	(0.013)	(0.015)		
Change in log average hourly wage (25+)			0.101	
			(0.207)	
Change in log average hourly wage ($<$25)				0.143
				(0.292)
Observations	4,567	4,567	4,567	4,567
Controls	No	Yes	Yes	Yes
Mean of dep. var.	-0.017			
Model	OLS	OLS	IV	IV
F-stat			427.37	81.71

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,\ldots,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change log residents per hour worked between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w_{j,t}^{25+}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The bottom row reports the F-statistics on $MIN_{j,Mar16}^{25+}$, the excluded instrument in IV model 3.

Table A15. Firm-Level Descriptive Statistics: Care Homes and Domiciliary Care Agencies

	Domiciliary care agencies Mean (1)	Care homes Mean (2)	Difference in means (3)	P-value of difference (4)
Firm size	74.15	45.18	28.971	0.000
Share under 25	0.14	0.15	-0.013	0.000
Hourly wage	7.87	7.78	0.091	0.002
Paid below NLW (25+)	0.35	0.52	-0.168	0.000
Paid hourly wage	0.84	0.85	-0.009	0.318
Weekly hours	17.97	28.70	-10.734	0.000
Female	0.86	0.84	0.024	0.000
Age	41.10	41.24	-0.145	0.262
Tenure (months)	45.31	61.78	-16.462	0.000
Carer	0.77	0.57	0.191	0.000
Senior carer	0.05	0.10	-0.052	0.000
Ancillary staff	0.01	0.14	-0.128	0.000
Nurse	0.00	0.04	-0.038	0.000
Admin staff	0.03	0.02	0.011	0.000
Wage carer	7.52	7.09	0.427	0.000
Wage senior	8.22	8.16	0.067	0.285
Wage ancillary	7.69	7.07	0.626	0.000
Wage nurse	13.51	12.99	0.517	0.068
Wage admin	8.32	8.51	-0.185	0.028
ZHC	0.39	0.07	0.318	0.000
Permanent	0.83	0.90	-0.062	0.000
Temporary	0.05	0.02	0.033	0.000
Bank	0.05	0.07	-0.018	0.000
Agency	0.04	0.00	0.036	0.000
Other	0.02	0.01	0.011	0.000
Local auth funded	0.07	0.05	0.020	0.004
Private	0.77	0.79	-0.013	0.301
Voluntary	0.14	0.14	-0.002	0.853
Other provider type	0.02	0.02	-0.004	0.305
Observations	1,320	4,631		

Notes: The table reports the mean of a set of firm-level characteristics for firms in the firm-level sample. The estimates in column (1) are based on the sample of domiciliary care agencies, while those in column (2) on the sample of residential care homes. Column (3) reports the difference in means and column (4) the p-value of a two-sided test of equality of the means. All figures are as of March 2016.

Table A16. WAGE SPILLOVER EQUATIONS IN THE DOMICILIARY CARE SECTOR

Change in log average hourly wage (under 25)	(1)	(2)	(3)
Initial low-paid proportion (25+)	0.046***	0.051***	
	(0.006)	(0.009)	
Change in log avg hourly wage (25+)			0.927***
			(0.132)
Observations	1,320	1,320	1,320
Controls	No	Yes	Yes
Mean of dep. var.	0.035		
Model	OLS	OLS	IV
F-stat			31.910

Notes: Columns (1) and (2) report the reduced-form estimate of $\sum_{t=3n,n\in\{1,...,4\}} \hat{\beta}_{1,t}$ from model 2, respectively unconditional and conditional on covariates. The outcome variable is the firm-level change in log average hourly wages of workers aged under 25 between March 2016 and March 2017. Column (3) reports the IV estimate of parameter γ_1 from model 3, where $\Delta \ln w^{25+}_{j,t}$ is instrumented using the proportion of low-paid workers aged 25 and over in the firm in March 2016. Robust standard errors are reported in parenthesis. The estimates are based on the sample of domiciliary care agencies. The bottom row reports the F-statistics on $MIN^{25+}_{j,Mar16}$, the excluded instrument in IV model 3.

Appendix B. Market-level effects for the entire UK labor market

B.1 Annual Survey of Hours and Earnings (ASHE)

The Annual Survey of Hours and Earnings (ASHE) is the most comprehensive data source on the structure and distribution of earnings in the UK. ASHE is based on a 1 percent sample of public- and private-sector employee jobs taken from HM Revenue and Customs' (HMRC) Pay As You Earn (PAYE) records. PAYE is the system used by HMRC to collect income tax and national insurance contributions from employment. Once the sample of individual identifiers is drawn from the HMRC records, the ASHE survey is sent to their respective employers to complete. Run on an annual basis, the survey is dispatched in the second week of April and has to be returned by the second week of May each year. The final sample covers approximately 140,000-185,000 individuals per year.

ASHE provides information about the levels, distribution and make-up of earnings (e.g. basic pay and incentive pay), and about paid hours worked for employees in all industries and occupations, and in both the public and private sector. The dataset also includes variables for age, gender, contract type and full/part-time status. Since information on a given individual is collected over time, the data have longitudinal form starting from 1997.

B.2 Market-level effects based on ASHE

We replicate the market-level analysis presented in Section 4 on ASHE data for the entire UK labor market, which allows us to assess the external validity of the market-level effects identified in the adult social care sector. The analyses reported in this section are based on private-sector employee records from ASHE for the years 2015-2019.

In Appendix Figure B1, each panel reports the estimated discontinuity and associated 95 percent confidence interval at the age-25 cutoff in each year for a set of outcomes. All estimates are based on a parametric quadratic RD design in age measured in years.[32] Panel A reports the estimates of a test for the absence of a discontinuity in the density of the running variable at the age-25 threshold. The results support the key assumption of no discontinuity in the density function at the relevant cutoff. Panels B, C and D show, respectively, the RD estimates for hourly wages, employment counts and paid weekly hours. No discontinuity is detected for wages and employment throughout the period analyzed. A positive and significant discontinuity is estimated for weekly hours in 2015 and 2016, but not thereafter.

Appendix Figure B2 shows a set of histograms of finely-binned hourly wage distributions for private sector workers of different age groups. The gray bars report the hourly wage distribution discretized in bins of £0.10 in April 2015; the unfilled bars show the distribution in April 2016. The distributions are left-censored and, for visual purposes, right-trimmed. The red vertical bars

[32]The discontinuity is estimated on individual data collapsed at the age level, with a symmetric bandwidth of 9.

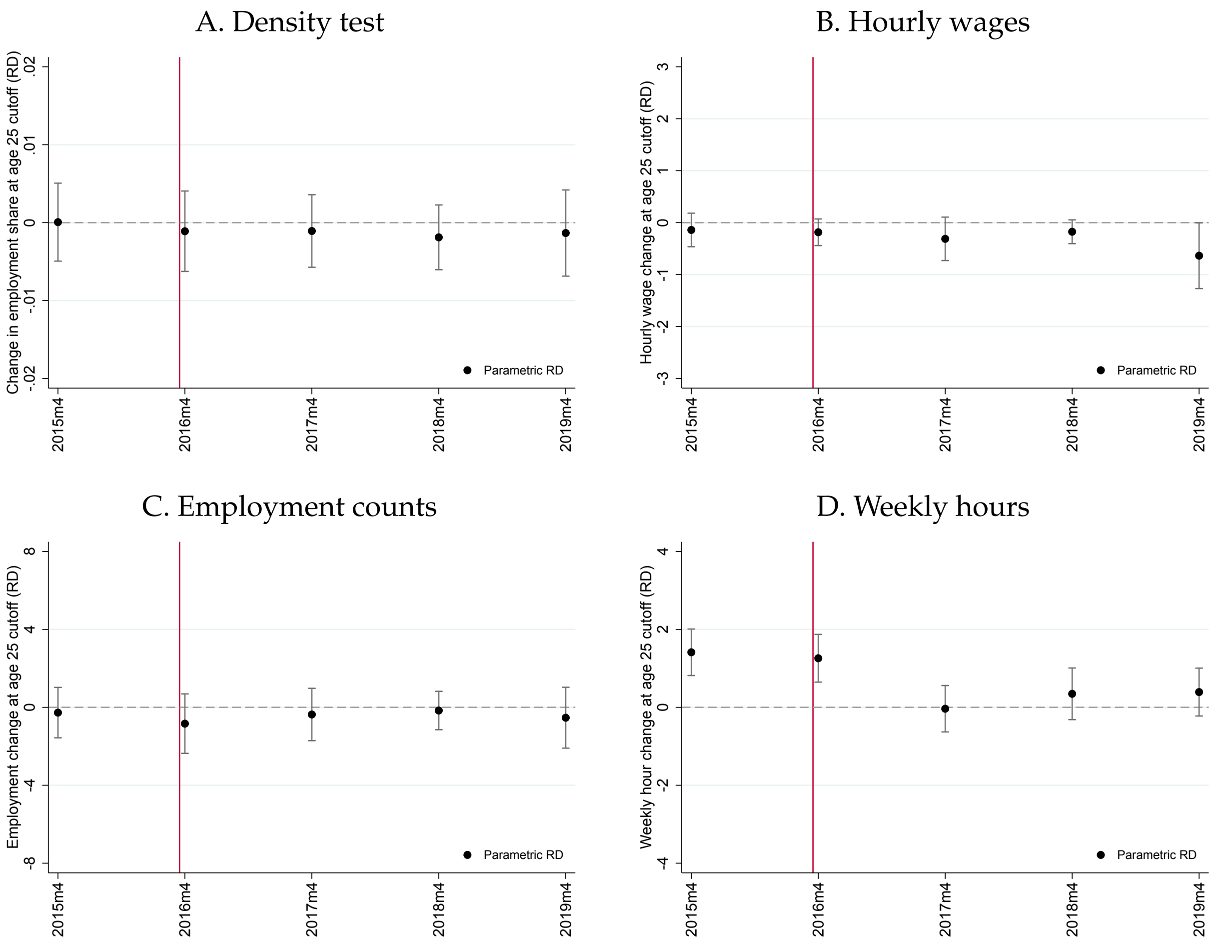
indicate the level of the National Minimum Wage applying to workers aged 21-24 (solid line) and of the National Living Wage (dashed line) in April 2016. Panel A illustrates the evolution of the hourly wage distribution for workers aged 25 and over, showing a spectacular spike at prevailing minimum in both years. Panel B reveals that the downward wage spillovers that we document for the adult social care sector extend to the entire UK labor market. The hourly wage distribution for workers aged under 25 features a spike at the NLW, albeit smaller than for older workers. Panels C to F confirm that the spillovers apply consistently to workers aged well below 25, rejecting the hypothesis that spillovers are simply due to aging out effects.

Appendix Figure B3 shows that the conclusion that wage spillovers are not due to compositional changes or contractual rigidities holds on the UK-wide labor market. The spike at the NLW persists when fixing the sample analyzed (Panel A), when looking at new entrants (Panel B) and individuals who moved to a new firm (Panel C), and finally when looking at workers on temporary contracts who are traditionally considered the outsiders of the labor market (Panel D). Moreover, as shown in Appendix Figure B4, wage spillovers are found not to die out over time.

Finally, Panel A of Figure B5 restricts the sample to workers employed in industries or occupations defined as low-paying by the Low Pay Commission.[33] Panel B instead restricts the sample to workers employed as carers in the care industry. As we would expect, in both charts the size of the spikes is more pronounced as compared to what found for all industries and occupations in the UK.

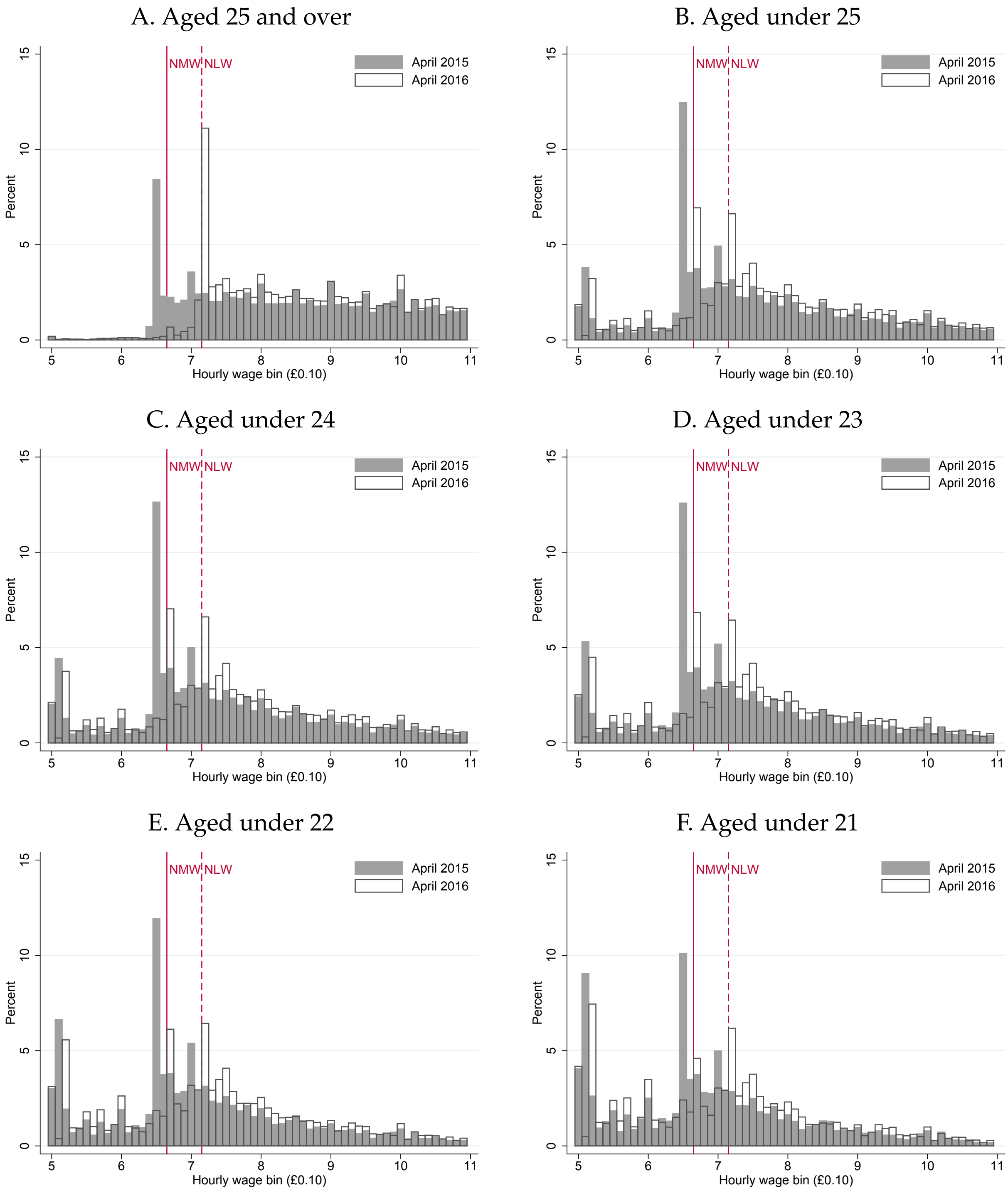
[33]The list of SIC 2007 and SOC 2010 codes defining low-paying industries and occupations is set out in Table A3.1 of the Low Pay Commission Report 2017 (Low Pay Commission, 2017).

Figure B1. MARKET-LEVEL EFFECT OF NLW INTRODUCTION ON WAGE AND EMPLOYMENT OUTCOMES FOR UK PRIVATE-SECTOR EMPLOYEES



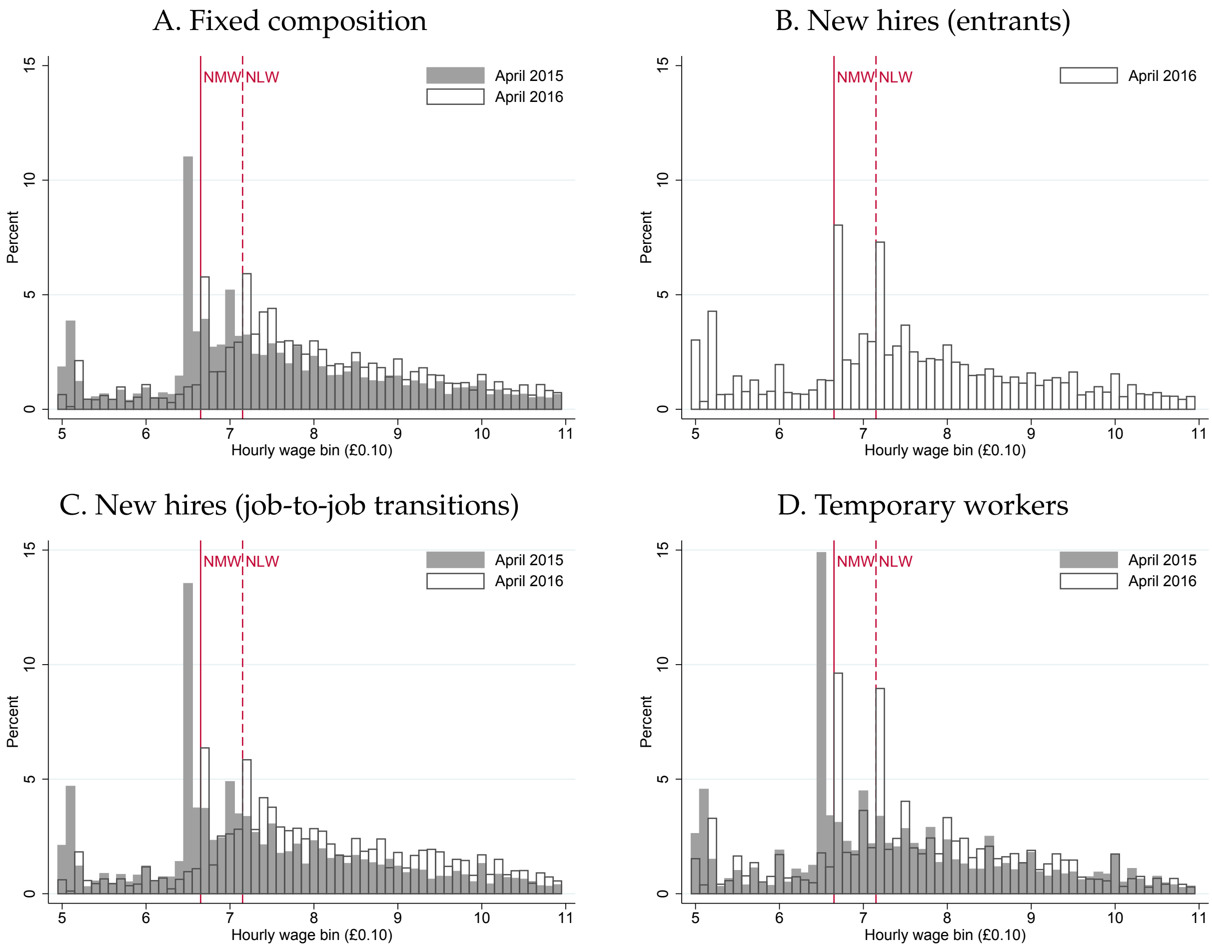
Notes: The figure reports a set of RD estimates (indicated by dots) and associated 95 percent confidence intervals (capped vertical bars). The sample analyzed is the ASHE sample of UK private-sector employees. All estimates are based on a parametric quadratic RD design in age measured in years. Panel A reports the RD estimates of a set of McCrary tests for a discontinuity in the density function of age at the age-25 cutoff from April 2015 to April 2019. Panel B reports the RD estimate at the age-25 cutoff for average gross hourly wages. Panels C and D are analogous to Panel B, but use employment counts and average weekly hours worked as outcome variable, respectively.

Figure B2. Distribution of Hourly Wages of UK Private-Sector Employees



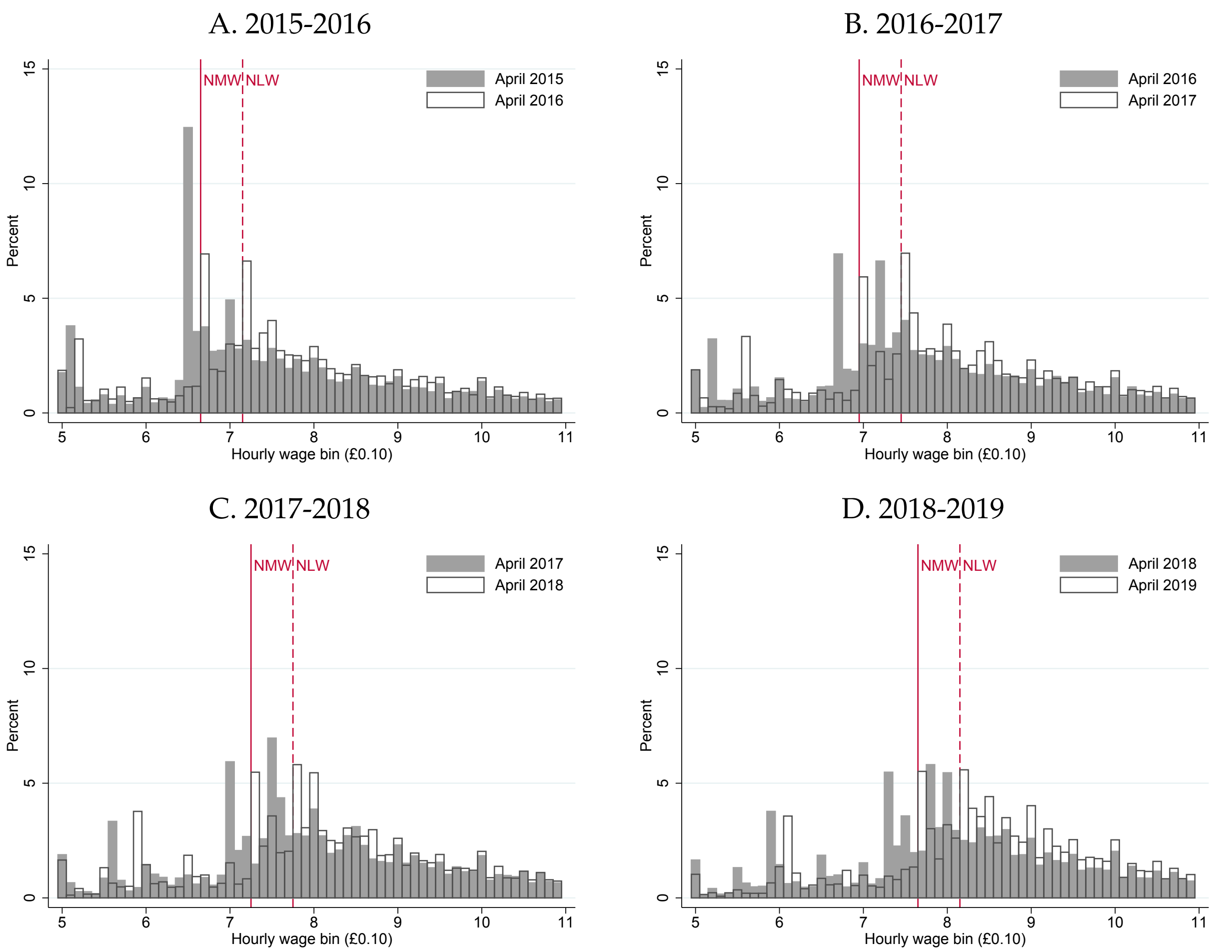
Notes: The figure reports a set of hourly wage distributions for employees in the UK private sector in April 2015 (gray bars) and April 2016 (unfilled bars). Hourly wages are binned into £0.10 bins. The red solid vertical line indicates the level of the NMW in April 2016, while the red dashed vertical line indicates the level of the NLW in April 2016. Panel A reports the hourly wage distribution for employees aged 25 and over, Panel B for those aged under 25, Panel C for those under 24, Panel D for those under 23, Panel E for those under 22 and Panel F for those under 21.

Figure B3. DISTRIBUTION OF HOURLY WAGES OF UK PRIVATE-SECTOR EMPLOYEES: TESTING FOR COMPOSITIONAL CHANGES AND CONTRACTUAL RIGIDITIES



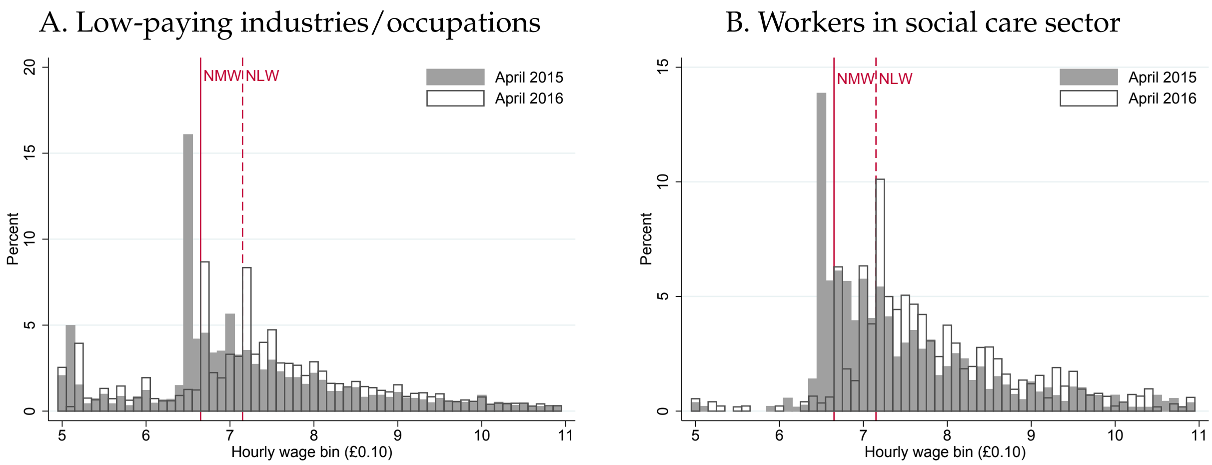
Notes: The figure reports a set of hourly wage distributions for employees in the UK private sector in April 2015 (gray bars) and April 2016 (unfilled bars). Hourly wages are binned into £0.10 bins. The red solid vertical line indicates the level of the NMW in April 2016, while the red dashed vertical line indicates the level of the NLW in April 2016. Panel A is based on the sample of workers who are observed both in April 2015 and April 2016, and who were aged under 24 in April 2015. Panel B is based on the sample of new hires and who appear for the first time in the sample in April 2016. Panel C is based on the sample of employees who have been hired by their firm after April 2015, but who were employed in another firm in April 2015. Panel D restricts the sample to temporary workers.

Figure B4. DISTRIBUTION OF HOURLY WAGES OF UK PRIVATE-SECTOR EMPLOYEES: DYNAMICS



Notes: The figure traces out the dynamics of wage spillovers over time. Each panel reports the hourly wage distributions for UK private-sector employees aged under 25 in year t (gray bars) and $t+1$ (unfilled bars). Hourly wages are binned into £0.10 bins. The red solid vertical line indicates the level of the NMW in $t+1$, while the red dashed vertical line the level of the NLW in $t+1$. Panel A refers to April 2015 and April 2016, Panel B to April 2016 and April 2017, Panel C to April 2017 and April 2018, Panel D to April 2018 and April 2019.

Figure B5. Distribution of Hourly Wages of UK Private-Sector Employees: Low-Paying Industries and Occupations, and Social Care Workers



Notes: The figure reports a set of hourly wage distributions for UK private-sector employees aged under 25 in April 2015 (gray bars) and April 2016 (unfilled bars). Hourly wages are binned into £0.10 bins. The red solid vertical line indicates the level of the NMW in April 2016, while the red dashed vertical line indicates the level of the NLW in April 2016. Panel A reports the hourly wage distribution for employees in low paying industries and occupations as defined by the Low Pay Commission, Panel B for employees in the social care sector.

Appendix C. Adult Social Care Survey of Pay Practices (ASC-SPP)

C.1 Survey design and implementation

The Adult Social Care Survey of Pay Practices (ASC-SPP) has been designed to investigate the pay setting, vacancy posting and hiring practices of organizations in the English adult social care sector. The survey was conducted online and distributed via email by Skills for Care in September 2020. The survey questionnaire is reported in Appendix C.4 below and includes 17 questions. The average completion time was 5 minutes (median 7 minutes). The sampling frame for the survey includes all care homes and domiciliary care agencies registered in ASC-WDS and employing at least one worker under 25 as of July 2020. For establishments with ASC-WDS accounts managed by a parent organization, the survey was distributed only to the parent organization. The sample of survey recipients comprised 5,073 providers, of which 284 completed the questionnaire leading to a 6 percent response rate.[34] The survey has been undertaken in accordance with the London School of Economics ethics review procedure and ethics approval has been obtained from the Centre for Economics Performance at the London School of Economics.

C.2 Representativeness of survey respondents

Out of the 284 respondents, 97 provided their ASC-WDS Workplace ID, which allows us to identify them in the July 2020 ASC-WDS data. We assess the representativeness of the sample of respondents in Appendix Table C1. The table reports the mean of a set of firm-level characteristics for the sample of surveyed providers in column (1) and for the sample of respondents matched to the ASC-WDS data in column (2). Column (3) reports the difference in means and column (4) the p-value of a two-sample t-test of equality in means.

The t-tests do not reject the null hypothesis of equality in means in the vast majority of cases. The sample of matched respondents has a higher fraction of domiciliary care agencies compared to the surveyed sample. As a consequence of that it displays slightly higher hourly wages among carers and a larger fraction of workers on zero hours contracts. All other characteristics are aligned in the two groups, indicating a good degree of representativeness of the survey respondents.

[34]Due to the continued pressure of the COVID-19 pandemic on the adult social care sector, in agreement with Skills for Care, it was deemed appropriate to minimize additional pressure on the sector by sending many survey reminders. For this reason only one reminder could be sent and the survey was open for two weeks.

Table C1. REPRESENTATIVENESS OF SURVEY RESPONDENTS

	Survey sample Mean (1)	Matched respondents Mean (2)	Difference in means (3)	P-value of difference (4)
Care home	0.626	0.464	0.162	0.001
Firm size	50.215	48.938	1.277	0.804
Share under 25	0.116	0.123	-0.006	0.431
Hourly wage	9.067	9.381	-0.314	0.006
Paid hourly wage	0.936	0.935	0.001	0.946
Weekly hours	25.921	25.439	0.481	0.620
Female	0.864	0.871	-0.008	0.506
Age	42.599	42.643	-0.044	0.919
Tenure (months)	60.504	55.469	5.035	0.072
Carer	0.639	0.673	-0.035	0.092
Wage carer	8.509	8.830	-0.320	0.000
Wage senior	9.145	9.307	-0.162	0.272
Wage ancillary	8.330	8.544	-0.214	0.172
Wage nurse	16.103	17.215	-1.112	0.094
Wage admin	9.658	9.467	0.190	0.547
Zero hours contract	0.234	0.324	-0.091	0.008
Permanent	0.896	0.920	-0.025	0.189
Temporary	0.026	0.014	0.012	0.294
Bank	0.052	0.040	0.012	0.220
Agency	0.013	0.018	-0.005	0.615
Other	0.014	0.007	0.006	0.437
Local auth funded	0.015	0.021	-0.005	0.667
Private	0.885	0.887	-0.002	0.955
Voluntary	0.077	0.093	-0.015	0.574
Other provider type	0.023	0.000	0.023	0.134
London area	0.066	0.093	-0.027	0.287
Observations	5,073	97		

Notes: The table reports the mean of a set of firm-level characteristics for the sample of surveyed providers in column (1) and for the sample of respondents matched to the ASC-WDS data in column (2). Column (3) reports the difference in means and column (4) the p-value of a two-sample t-test of equality in means.

C.3 Survey results

Table C2. CHARACTERISTICS OF SURVEY RESPONDENT AND POLICY AWARENESS

	Fraction (1)	Observations (2)
Respondent's job role		
Admin staff in charge of pay	0.14	283
Human resources manager	0.09	283
Manager/Owner/Director	0.68	283
Other	0.09	283
Respondent's job tenure		
Less than one year	0.06	283
One to four years	0.24	283
More than four years	0.70	283
Respondent's firm tenure		
Less than one year	0.05	284
One to four years	0.20	284
More than four years	0.75	284
Aware that NLW only applies to 25+		
Before receiving questionnaire	0.94	284
When NLW introduced	0.87	281

Notes: The table reports survey answers to questiona Q1, Q2, Q3, Q4 and Q5 of the ASC-SPP questionnaire reported in Appendix C.4.

Table C3. DOWNWARD WAGE SPILLOVERS

	Fraction (1)	Observations (2)
Does organization pay at least some under 25s below NLW?		
Yes, it pays at least some under 25s below NLW	0.41	282
No, it does not pay under 25s below NLW	0.59	
Reason for paying NLW to under 25s		
Unfair to the workers	0.54	153
To attract/retain qualified workers	0.23	153
To motivate workers	0.11	153
Administratively simpler/cheaper	0.03	153
Do not know about the law	0.00	153
Other	0.09	153
Reason for not paying NLW to under 25s		
It is fair	0.31	100
To contain labour costs	0.26	100
Compensates for additional training provided	0.27	100
Younger workers typically less effective	0.04	100
Other	0.12	100

Notes: The table reports survey answers to questiona Q6, Q7 and Q9 of the ASC-SPP questionnaire reported in Appendix C.4.

Table C4. UPWARD WAGE SPILLOVERS

	Fraction (1)	Observations (2)
Pay rise for worker 25+ paid between old and new NLW?		
Raised above NLW and maintained wage differential	0.40	273
Raised above NLW, but reduced wage differential	0.12	273
Raised exactly to NLW	0.28	273
Depends on role and performance	0.17	273
Don't know	0.03	273
Pay rise for worker 25+ paid above new NLW?		
Yes	0.63	280
No	0.15	280
Depends on role and performance	0.19	280
Don't know	0.03	280
Organization had to cut back on pay scales above NLW?		
Yes	0.35	280
No	0.55	280
Don't know	0.10	280

Notes: The table reports survey answers to questiona Q10, Q11 and Q12 of the ASC-SPP questionnaire reported in Appendix C.4.

Table C5. JOB-VACANCY POSTING AND WAGE BARGAINING

	Fraction (1)	Observations (2)
How are job vacancies typically advertised?		
Online platforms	0.93	284
Word of mouth	0.63	284
Newspapers	0.12	284
Employment agencies	0.22	284
Other	0.03	284
Is a wage rate or salary usually specified in job ad?		
Yes	0.77	284
No	0.23	284
Is compensation tied to the applicant's age in job ad?		
If specified, wage tied to applicant's age	0.09	214
Even if wage not specified, pay tied to applicant's age	0.09	66
When making a job offer, is there bargaining over pay?		
Mostly bargain	0.03	284
Mostly take-it-or leave-it	0.75	284
Both happen equally often	0.16	284
Don't know	0.06	284

Notes: The table reports survey answers to questiona Q13, Q14, Q15, Q16 and Q17 of the ASC-SPP questionnaire reported in Appendix C.4.

C.4 ASC-SPP questionnaire

Skills for Care, in partnership with the Centre for Economic Performance at the London School of Economics, would like you to take part in a research study on pay setting in care homes. This survey should take around 10 minutes to complete.

The survey asks about your job role and about your views on how your organisation has responded to minimum wage changes in recent years. If you feel you are not the correct person to contact from your organisation, please forward this email to the relevant person.

There are no risks associated with participation in this survey. Your responses will not be used to identify you or your organisation. All information collected for this study is confidential and will be used only for the purposes of this research study. If you have questions, please contact [redacted].

I understand the information above and that:

A. My participation is voluntary and I may withdraw my consent and discontinue participation in the project at any time. My refusal to participate will not result in any penalty.
B. By agreeing to take this survey, I do not waive any legal rights or release the Centre for Economic Performance, its agents, or you from liability for negligence.

Do you agree to take part in this survey?

- ○ Yes, I agree to take part in this research → Go to Q1
- ○ No, I do not give my consent to participate in your research → Thank-you page

[Insert page break here]

The following questions ask about your job role and tenure in your current organisation:

Q1. What is your job role in the organisation?

- ○ Registered manager
- ○ Human resources manager
- ○ Administrative staff in charge of pay-related matters
- ○ Other. Please specify: ____________

Q2. How long have you been in this position in this organisation?

- ○ Less than one year
- ○ One to four years
- ○ More than four years

Q3. How long have you been working in this organisation?

- ○ Less than one year
- ○ One to four years
- ○ More than four years

[Insert page break here]

On April 1, 2016 the National Living Wage was introduced. The National Living Wage sets a higher minimum wage for workers aged 25 and over. Lower minimum wage rates apply to workers aged under 25.

Q4. Before receiving this questionnaire, were you aware that the National Living Wage is legally binding only for workers aged 25 and over?

- ○ Yes

○ No

Q5. At the time in which the National Living Wage was introduced in April 2016, were you aware that the National Living Wage is legally binding only for workers aged 25 and over?

○ Yes
○ No

[Insert page break here]

IMPORTANT NOTE: when responding to the following questions, please base your answers on how your organisation used to operate before the onset of the COVID-19 crisis.

The minimum wage rates that apply to workers under 25 are lower than the National Living Wage. The following table shows what minimum wage rates were in place from April 2019 to March 2020, and from April 2020 to today:

	April 2019 to March 2020	April 2020 (current)
Aged 16 to 17	£4.35	£4.55
Aged 18 to 20	£6.15	£6.45
Aged 21 to 24	£7.70	£8.20
Aged 25 and over	£8.21	£8.72

Q6. Does your organisation follow the provision of the law by paying at least some workers under 25 a minimum wage below £8.72?

○ Yes → Go to Q8
○ No → Go to Q7

If Q6=No, ask Q7
Q7. If no, what is the main reason for this? [Randomise order of answers, leave 'Other' last]

○ We did not know about the law
○ It is too difficult/costly to pay different wages from an administrative perspective
○ It is unfair to the workers
○ It is necessary to attract and retain qualified workers
○ It is necessary to motivate workers
○ Other. Please specify: ___________

If Q6=Yes, ask Q8 and Q9
Q8. If yes, to which age groups does your organisation apply the lower minimum wage? Tick all that apply.

☐ Aged 16 to 17
☐ Aged 18 to 20
☐ Aged 21 to 24

Q9. What is the main reason why your organisation applies lower minimum wages to workers under 25? [Randomise order of answers, leave 'Other' last]

○ It is fair
○ It allows our organisation to contain labour costs
○ It compensates for the additional training we provide to younger workers
○ Younger workers are typically less effective at their job
○ Other. Please specify: ___________

[Insert page break]

From April 2019 to March 2020, the National Living Wage was £8.21 for workers aged 25 and above. In April 2020 this increased to £8.72.

Q10. If you had workers aged 25 or over who were paid between £8.21 and £8.72 in 2019/20, how did their wage change when the National Living Wage increased in April 2020?

- ○ We raised it to exactly £8.72 per hour
- ○ We raised it above £8.72 per hour and maintained the differential with the National Living Wage
- ○ We raised it above £8.72 per hour, but reduced the differential with the National Living Wage
- ○ It depends on the worker's role and performance
- ○ I don't know

Q11. If you had a worker aged 25 and over who was already paid above £8.72 an hour before the National Living Wage increased to £8.72 in April 2020, did you increase that worker's pay after April 2020?

- ○ Yes
- ○ No
- ○ It depends on the worker's role and performance
- ○ I don't know

Q12. Since the National Living Wage was introduced, has your organisation had to cut back on pay scales above the minimum wage level? This could be either through lower pay rises or slower career progression.

- ○ Yes
- ○ No
- ○ I don't know

[Insert page break here]

We would like to now ask you how your organisation recruits workers and sets wages. In answering the following questions, please think about recruitment and compensation of carers and senior carers.

Q13. How are job vacancies typically advertised by your organisation? Tick all that apply. [Randomise order of answers, leave 'Other' last]

- ☐ Online platforms
- ☐ Word of mouth
- ☐ Newspapers
- ☐ Employment agencies
- ☐ Other. Please specify: ____________

Q14. When advertising a job, is a wage rate or salary usually specified?

- ○ Yes → Go to Q15
- ○ No → Go to Q16

If Q14=Yes
Q15. If so, is the wage rate or salary offered in the ad explicitly tied to the applicant's age?

- ○ Yes
- ○ No

If Q14=No
Q16. Even though a wage rate or salary is not usually specified, is the compensation offered in the ad explicitly tied to the applicant's age?

- ○ Yes
- ○ No

Q17. When offering a job to a prospective worker, does your organisation typically make a 'take-it-or leave-it' offer or does some bargaining take place over pay?

- ○ Mostly 'take-it-or-leave-it'
- ○ Mostly 'bargain'
- ○ Both happen equally often
- ○ I don't know

[Insert page break here]

With your consent, we would like to link your responses to this survey with information your organisation has provided to the Adult Social Care Workforce Dataset (ASC-WDS). If you consent, please provide your ASC-WDS Workplace ID:

- ○ I am happy for my responses to be linked to the ASC-WDS. Your ASC-WDS Workplace ID is one letter followed by five, six or seven numbers. E.g. E##### ____________
- ○ I do not wish to provide / don't know my Workplace ID.

[Thank-you page]

Thank you for your time spent taking this survey.
Your feedback will be a valuable input into our research.