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IZA DP No. 17895

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ISSN: 2365-9793

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ABSTRACT

An Overworked Leave? Health Care Workforce Effects of Brexit*

We study the impact of the Brexit referendum on the quality of employment and working conditions of workers in the National Health Service (NHS). Using a difference-in-differences (DiD) design and propensity score matching to compare NHS employees with a control group referring to occupations less exposed to employees from the European Union (EU) before Brexit. We document that Brexit led to the average reduction of job satisfaction by 1.39% - largest for physicians (2.6%) and nurses (2.4%) - and an increase of both paid (1.75 hours/week) and unpaid working hours (8.3 hours/week). Nonetheless, the effect was heterogeneous despite the general rise in working time. Indeed, job satisfaction fell by 2.6% among British workers but increased by 3% among overseas workers. These changes were accompanied by a comparable reduction in leisure time and a higher likelihood of workers intending to leave their jobs, suggesting broader behavioural effects that may undermine NHS productivity.

JEL Classification: I12, J22, J45

Keywords: job satisfaction, workforce motivation, Brexit, health care workforce, workforce composition, leisure satisfaction, NHS

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* We are especially grateful to the participants in the First Croatian Health Economics Conference, and the participants of Seminar at LSE, Resolution Foundation, Pompeu Fabra University and Oxford University, as well as discussions with colleagues. This includes Giuseppe Moscelli, Victoria Serra-Sastre, Osea Guintella, Judit Vall, Mathew Sutton, Maarten Lindeboom, Guillem Lopez-Casasnovas, Helena Hernandez Pizarro, Peter Ibern, Sergi Jimenez, Gregory Thwaites, Catia Nicodemo. However, the authors are solely responsible for the manuscript and the usual disclaimer applies.

1. Introduction

The National Health Service (NHS) is one of the largest employers in the world, with a workforce of around 1.2 million people (The King's Fund, 2023; Rolewicz et al., 2024). However, from the 12 months to September 30th, 2022, about 12.5% of staff left their jobs at hospitals and community centres, a figure never seen before (NHS Workforce Statistics, 2023). The large vacancy rate is a long-lasting problem facing the NHS, which might have been affected by the uncertainty, social and employment conditions after the time of the referendum on the United Kingdom (UK) membership in the European Union (EU), the so-called 'Brexit' referendum in 2016. Before Brexit, the NHS was already experiencing a shortage of doctors in 75% of the existing specialities (Fahy, 2019). Although funding for the NHS was one of the main issues at stake in the Brexit referendum campaign, limited research has examined whether leaving the EU, a significant institutional shock, ameliorated or intensified the pre-existing NHS understaffing and affected staff working conditions[2].

Since 2016, there has been a steep decline in the healthcare workforce from the EU in the NHS. Between September 2016 and September 2021, the number of nurses trained in the European Economic Area (EEA) and registered in the UK dropped by 28% (McCarey et al., 2022)[3]. Similarly, after Brexit, prospective healthcare workers considering moving to the UK face larger uncertainty in their career prospects (Ungoed-Thomas, 2023)[4], which can depress the intention to leave the NHS among pre-existing

[2] The electoral campaign suggested that the UK's contribution to the EU budget could alternatively be used to support the NHS, which was facing pressures (long waiting lists) that were in turn linked to immigration. The campaign highlighted that "*hospital redundancies and closures continue across the UK*" because "*money is running out*", stoking fears about whether "*your local NHS [could] survive*" (Office for National Statistics, 2019).

[3] This estimate is despite NHS workers benefiting from cheaper visas and reimbursement of the NHS surcharge costs (NHS Employers, 2023).

[4] Conversely, after Brexit, healthcare workers from other parts of the world now make up a majority of newly registered doctors in certain specialties. For instance, the number of international medical graduates joining the GP register nearly tripled from 2018 to 2022 (General Medical Council, 2023).

employees[5]. A study of Nursing and Midwifery Council reveals document evidence of a rise in the number of nurses with less than five years of experience (see Figure A1) and a sharp decline in the rolling percentage of nurses that remained in their jobs at the end of 12 months compared to the beginning (see Figure A2). The high turnover of trained healthcare staff is a significant concern, as less experienced employees require more training and are less familiar with hospital processes, leading to potential bottlenecks in some processes (Nursing and Midwifery Council, 2023)[6]. However, the higher turnover may be explained by declining incomes, as specifically between August 2010 and December 2019, real-term earnings fell by 6.8% for nurses and medical visitors, 10.9% for junior doctors, and 15.4% for consultants (see Figure A3)[7].

Brexit increased legal requirements to stay and work in the UK (Appendix A5) and unleashed a climate of great uncertainty in the anticipation that the EU working hours directive may no longer be binding, even after government reassurances and salary exceptions to stay in the UK. Consistently, Figure A4 show that the share of NHS workers joining from the EU decreased from 10.5% (2015) to 5% in 2020. This trend is even more pronounced among nurses, from 19.5% (2015) to 5% (2020). This trend contrasts with the shares from the rest of the world, where there is the reverse trend, increasing from 11% (2015) to 19.5% (2020).

The reduction of the EU workforce after Brexit exerted a significant effect on employment quality. It increased the workloads of all NHS employees, which contributed

[5] Key reasons for voluntary resignations include work-life balance challenges, concerns on career progression, the pursuit of better pay or further study opportunities elsewhere (NHS England, 2023; NHS Digital, 2023).
[6] When NHS staff drop out, the investment in their training is lost, with replacement costs such as the £26,000 needed to train a new nurse (Palmer et al., 2021). In A&E departments, a higher proportion of senior doctors can make a difference to patient flows and enable quicker treatment decisions. In contrast, their time spent training new staff can create inefficiencies (NHS Improvement, 2018).
[7] Financial concerns have grown to the extent that some NHS hospitals have established on-site food banks specifically for their staff (NHS Charities Together, 2023).

to a burnout cycle where staff departures rose the pressure on remaining employees, with NHS sickness absence rates rising from 4.5% in 2015 to 5% in December 2017 (Health and Safety Executive, 2024; NHS Digital, 2023)[8]. Persistent staff shortages after Brexit exacerbated the widespread culture of unpaid overtime in employment categories with a high proportion of European workers before Brexit. By 2018, nearly 270,000 NHS employees worked an average of 2.3 hours of unpaid overtime weekly, and by 2022, 66% of nurses and midwives, 79% of doctors and dentists, and 83% of general management staff reported regularly working unpaid hours (Kinman et al., 2018; Hunter et al., 2019; NHS Survey Coordination Centre, 2022)[9]. Some evidence suggests that such workload expansion increased stress and turnover, with only 42% of NHS staff in 2022 feeling able to meet all their job demands (NHS Survey Coordination Centre, 2022).

This paper examines the effect of the Brexit referendum (which we refer generically as 'Brexit'), an institutional shock restricting the working conditions of EU nationals, on the employment quality and the working conditions of NHS workers, and more specifically on job satisfaction and the total paid and unpaid working hours. The Brexit referendum was an event that qualified as a quasi-experiment, as the outcome of the referendum was 'unexpected'[10]. Given such an unexpected outcome, we initially rely on evidence from an event study and a difference-in-difference design to document robust evidence of the effect of the Brexit referendum and its subsequent events up to triggering

[8] To compensate for staff shortages, the NHS draws heavily on costly temporary agency staff, with spending on agency fees reaching £3 billion (NHS England, 2023).

[9] Unpaid working hours among managers and physicians are usually the result of the performance of administrative tasks, meetings, planning and operational stuff that tend to take place behind closed doors. A survey from the Royal College of Midwives (RCM) has revealed that midwives across England work around 100,000 extra unpaid hours a week to keep maternity services safe. Midwives give 100,000 hours of free labour to the NHS per week to keep England's maternity services safe says RCM - Royal College of Midwives. There is evidence that a large part of these unpaid extra hours came from workers having either skipped taking full breaks altogether or taken them on rare occasions (Senek et al., 2023).

[10] The BSA (British Social Attitudes) survey for the period of July–November 2015 showed that 60% backed the option to continue as a member and 30% backed withdrawal, and some relevant media had anticipated an opposite result the day before the referendum (The Independent, 2016). In fact, the idea of a member state leaving the EU was seen as impossible (Oliver, 2017).

Article 50[11], on job satisfaction and understaffing. We further examine the effects on leisure satisfaction as well as on a number of proxies for the NHS worker motivation[12].

Nonetheless, it is plausible that the impact of Brexit varies by an individual's nationality. While EU nationals had the choice to stay or leave the UK, NHS professionals from non-EU countries had already been subject to stricter work restrictions since 2010[13]. Hence, Brexit might have corrected a relative disadvantage compared to EU workers. Furthermore, we examine whether the effect of the Brexit referendum might have been different depending on an individual's political ideology and the local political preferences in their area of residence[14]. Finally, to complete the picture, we examine whether the Brexit referendum exerted a significant effect on the intention to leave the NHS and employment attitudes, and we evaluate the impact of Brexit on attitudinal measures of perceived quality of employment, such as whether they found their job less attractive or felt unable to manage their workload.

We exploit individual level longitudinal variation for the period 2009-2019 using the 'Understanding Society' or UKLS survey[15]. Given that the Brexit referendum was a one-off event, we draw on a difference-in-difference identification strategy, alongside an event study to substantiate the parallel trend assumption, comparing the treatment group

[11] Although the formal terms of Brexit did not materialize until January 31th, 2020, the entire transition period was immersed in an environment of a high degree of uncertainty (Wielechowski and Czech, 2016). The negative impact of this unease (and the possibility of a no-deal-Brexit) on life satisfaction mental health have been already established (Kinari et al., 2019; Powdthavee et al., 2019).

[12] Such measures of employment quality are important as have been shown to influence patient quality of care (Ball et al., 2014; Griffith et al., 2016), unnecessary referrals (Williams et al., 2007), prescription drugs use (Grol et al., 1985; Kravitz, 2012), and medical errors (Williams et al., 2001).

[13] Kavetsos et al. (2021) observe a general decline in subjective well-being among UK residents with positive attitudes toward the EU. Conversely, Powdthavee et al. (2019) note an overall rise in average mental distress after the referendum, with an increase in life satisfaction only among those in favour of leaving the EU.

[14] Some authors report a relationship between election outcome and partisan voters' well-being (Kavetsos et al., 2021; Kinari et al., 2019; Saville, 2020).

[15] Understanding Society provides clear advantages over alternative datasets as the NHS Staff Survey. First, UKLS is a panel dataset with limited attrition that includes a specific question on job satisfaction, not included in the NHS Staff Survey. In contrast, the NHS staff survey is a cross-section with a large attrition. Second, UKLS allows us to compare the job satisfaction of NHS employees and workers in other occupations, as well as to follow the same workers before and after Brexit.

(NHS employees) with a control group made up of individuals in those occupations that exhibited a limited exposure European employee before Brexit, based on two entropy indices. Furthermore, our estimates are adjusted on observables using a propensity score matching. Our strategy is robust to the sensitivity analysis proposed by Rambachan and Roth (2024) to test for pre-trend violations in the pre-Brexit period to bound the treatment effect.

We make three different contributions to the literature. First, we examine the effect of a major institutional labour market disruption on employment quality and working times in the NHS, namely a well-defined, monopsonistic and standardised market environment. We show that the Brexit referendum increased both the number of paid and unpaid extra working hours and led to a significant deterioration of employment quality measured by job satisfaction. Second, we contribute to the literature on health care labour markets, especially where a large monopsonistic employer is facing financial constraints, such as the NHS, which faced significant austerity reforms before Brexit[16]. Finally, we contribute to the employment quality literature by showing evidence of how sensitive labour satisfaction is to changes in the institutional environment. Previous research has documented that job satisfaction influences burnout, low self-esteem and symptoms associated with depression (Koutsimani et al., 2019), organisational commitment, absenteeism and job performance (Shobe, 2018).

Our estimates suggest that *the Brexit referendum reduced the average job satisfaction of treated health care workers (-1.4%)*, which was expectedly more intense for physicians (-2.6%) and nurses (-2.4%). Such an effect is explained by *an increase in weekly working hours* (4.8%). Consistently, such effect is higher among physicians (6.01%), followed by

[16] Evidence form the British Social Attitudes (BSA) already suggest that accident and emergency waiting times are the worst they have been since current records began, a sign of a system that is struggling to keep up with demand (Morris and Davies, 2020). Almost two-thirds of people (62%) said they were dissatisfied due to staff shortages (57%).

nurses (4.6%). Furthermore, the effects on job satisfaction differ by an individual's age, type of contract and by an individual's political stance. Furthermore, we document a different impact among NHS employees from overseas. These results hold despite the number of paid hours, and the probability of working unpaid hours is higher for workers in absolute terms, although the opposite is true in relative terms for UK employees.

The next section reports the related literature, followed by section three, which reports the data and methods, and section four, which describes the results. Next, section five reports the mechanisms and heterogeneity, and a final section concludes.

2. Related Literature

2.1 Brexit and the labour market

The NHS employs individuals from over 200 nationalities, and *one in eight employees is not British* (King's Fund, 2019), which makes it highly vulnerable to migration shocks[17]. The turnover rates in non-professionally regulated direct care roles increased from 28% in 2012%-2013% to 34% in 2016-2017 (Skills for Care, 2017a), and since the Brexit referendum, the number of new nurses joining the regulatory register from the European Economic Area (EEA) has fallen by 91% (NMC, 2018)[18].

Employment quality might have deteriorated after Brexit[19], as it made working for the NHS less attractive[20]. Consistently, McKinley et al. (2020) found that one-third of UK doctors showed symptoms of secondary traumatic stress, especially emergency staff

[17] Appendix A5 describes the requirements for healthcare professionals from the EU and other non-EU countries, and the changes introduced after Brexit

[18] This uncertainty and deterioration in the expectations of EU healthcare workers has received extensive media coverage (Boffley, 2017; Campbell, 2017; Triggle, 2017).

[19] Brexit opened the door to the reconsideration of established labour market regulations such as the Working Time Directive (WTD) increased the obstacles to hiring from neighbouring European countries. Treaty articles have addressed mutual recognition of training and have restricted governments from favouring domestic suppliers and maintaining an open labour market for competition (Costa-Font, 2017).

[20] Specifically, the Royal College of Nursing (2017) has drawn attention to the importance of keeping the WTD to 'reduce fatigue' which can stand out as a risk to patients. In other words, Brexit opens the door to hardening the working conditions of NHS employees at the 'critical moment' of fiscal consolidation.

and general practitioners, and approximately 10% of the sample were experiencing a high risk of burnout. Official figures show that the NHS has vacancies for 10,582 doctors in England. The British Medical Association (BMA), the main doctors' union, is concerned with the severe staff shortages in the NHS, including almost 11,000 medical vacancies in English hospitals alone. EU-trained doctors who want to work in the UK are currently facing additional bureaucracy and higher costs as a direct consequence of Brexit.

2.2 Job satisfaction and the labour market of health care professionals

Low job satisfaction might steer individuals to leave their job or even exit the industry altogether. Newman et al. (2002) identifies understaffing as the primary contributor to job dissatisfaction. Sibbald et al. (2003) previously reported that one in ten physicians aged 50 years and under intended to leave direct patient care within five years, with job satisfaction being the primary predictor of this intention. Similarly, Storey et al. (2009) anticipated that nurses considered factors such as high administrative workload, challenges in balancing work with family commitments, and lack of workplace support when considering leaving their positions[21].

Brexit took place in the midst of a "motivation crisis" of NHS workers, with many physicians being uncertain about their long-term commitment to medicine. Interviews with doctors three years after graduation found that 60% had no definite plans to stay, 50% considered working abroad, and 10% were contemplating leaving medicine entirely, citing better pay, working conditions, and dissatisfaction with the NHS culture (Lambert et al., 2018). Work-related stress is a significant issue, with 44% of NHS staff reporting

[21] Doran et al. (2016) conducted interviews with family physicians under the age of 50 who had left the English list of medical professionals within the previous five years (2009-2014). They found that they had left the NHS due to increased administrative tasks and workload. In contrast, UK emigrant doctors in New Zealand were happier with their jobs than their UK-based counterparts, and few wanted to return because they felt they could better reconcile work with other aspects of their personal lives in New Zealand (Sharma et al., 2012).

feeling unwell due to job pressures in 2020, an increase from 40% in 2019 (Waters, 2022). GPs, work beyond their contracted hours, with 54% of consultants in England working more than 10% extra, which correlates with lower engagement, job dissatisfaction, and a higher likelihood of stress-related illness (NHS England, 2018). Professional development opportunities influence retention (Coombs et al., 2010), but these may have declined post-Brexit, particularly as EU nationals comprise 9% of registered doctors and 4% of registered nurses in the UK. Job satisfaction impacts physicians' decisions to leave direct patient care, though high satisfaction alone does not guarantee retention (Hann et al., 2011).

2.3 Heterogeneity across health care workers

The impact of the deterioration of working conditions can vary based on several factors. According to Shields and Ward (2001), job dissatisfaction was notably higher among young, male, ethnic minority, and highly educated NHS nurses.

Wages remain a contentious issue. Frijters et al. (2007) found that a 10% increase in gross hourly pay for NHS nurses could reduce annual nurse turnover from about 9.4%. Meanwhile, Ikenwilo and Scott (2007) analysed a labour supply model for hospital consultants in Scotland, suggesting that wage increases under new contracts led to modestly increased working hours, particularly among those already working above median hours. Shields and Ward (2001) also highlighted the importance of relative pay, noting that nurses' perception of lower salaries compared to other public sector employees significantly affects job satisfaction.

Beyond wages, working hours play a critical role in job satisfaction. Ball et al. (2017) demonstrated that nurses working shifts longer than 12 hours reported higher rates of poor or no care, contrasting with higher self-reported care quality from nurses on shifts shorter than 8 hours.

Gender differences also impact job satisfaction and mental health outcomes, with men generally reporting lower job satisfaction (Sibbald et al., 2003), but women experiencing more pronounced mental health deterioration due to work-life balance challenges (Leese et al., 2002). Several other factors contribute to low job satisfaction among healthcare workers, including loss of autonomy in clinical practice, increased workload, job manageability issues, and high burnout levels (Khan et al., 2018; Sansom et al., 2018; Croxson et al., 2017; Imo, 2017).

Regulatory changes, such as the European Working Time Directive, have also impacted job satisfaction, particularly among senior doctors, leading to concerns about shifts and rest periods (Clarke et al., 2014). Finally, it's worth mentioning that significant pay differentials exist among NHS doctors, with notable gaps identified based on ethnicity and gender, underscoring ongoing challenges in achieving pay equity (Dacre et al., 2020; Woodhams et al., 2021).

3. Data and Empirical Strategy

3.1 The Data

We draw on data from Understanding Society, the United Kingdom Household Longitudinal Study (UKHLS), which is a longitudinal survey of approximately 40,000 households in the United Kingdom (England, Scotland, Wales and Northern Ireland). Households recruited in the first round of data collection are visited each year to collect information on changes in their family and individual circumstances. Interviews are usually conducted face-to-face in respondents' homes by trained interviewers. From wave 3 onwards, a small number of respondents are interviewed by telephone and from wave 7 onwards, part of the sample provides their information in a web interview. The main Understanding Society survey sample consists of a new large General Population Sample

(GPS) plus three other components[22]: the Ethnic Minority Booster Sample (EMBS), the former BHPS sample, and the Immigrant and Ethnic Minority Booster Sample (IEMBS). The design of the first three components is described in more detail in an Understanding Society working paper see Lynn (2009).

Alternative datasets such as the NHS Staff Survey although have a significantly large sample, are problematic because it is not a panel survey, exhibits significant attrition and it relies on voluntary responses from a staff that exhibits a large turnover, whilst in our sample we can continue to observe the people that exit the NHS[23]. Finally, it's worth mentioning that we cannot employ the same eremitical strategy as it does not identify the EU nationality of employees.

3.2 Job satisfaction and working times.

Job satisfaction: we define an ordered variable from the question '*All things considered, which number best describes how satisfied or dissatisfied you are with your present job overall?' whose answers are (7) Completely satisfied, (6) Mostly satisfied, (5) Somewhat satisfied, (4) Neither satisfied or dissatisfied, (3) Somewhat dissatisfied, (2) Mostly dissatisfied and (1) Completely dissatisfied*.

For working hours, we define three variables:

[22] (1) The GPS is based on two separate samples of residential addresses in England, Scotland and Wales and Northern Ireland. The England, Scotland and Wales sample is a proportionally stratified (equal probability), pooled sample of addresses selected from the Postal Address File. The Northern Ireland sample is an unclustered systematic random sample of addresses selected from the Land and Property Services Agency's domestic address list. (2) The EMBS was designed to provide at least 1,000 adults from each of five groups: Indian, Pakistani, Bangladeshi, Caribbean and African. (3) The sample issued in Cycle 2 consisted of all members of the BHPS sample who were still active in Cycle 18 of the BHPS and who had not refused consent to be issued as part of the Understanding Society sample. (4) The IEMBS was introduced in Cycle 6. It includes people born outside the UK ('immigrants') and members of five ethnic minority groups: Indians, Pakistanis, Bangladeshis, Caribbeans and Africans. Some people, of course, belong to both categories. This sample therefore covers, for the first time, people who have entered the UK since the first wave of the study ('new immigrants'), while increasing the number of immigrants who arrived earlier and ethnic minorities who arrived earlier or were born in the UK. The IEMBS was designed for about 2,000 adult immigrants and about 2,500 from minority ethnic groups to respond.

[23] However, we don't have the granularity to identify the exact trust where individuals work, and the sample to focus on specific subsamples of health professionals which is the object of companion research.

i. *Total paid working hours per week*.

ii. *Works unpaid extra hours (intensive margin):* binary variable taking the value 1 in the individual reports having worked unpaid extra hours last week, 0 otherwise.

iii. *Number of unpaid extra hours (extensive margin):* (only defined for those who have answered affirmatively about having worked extra hours).

3.3 *Explanatory variables*

Job satisfaction is typically influenced by three different drivers, namely demographic, situational and organisational influences. Demographic effects include an individual's gender (Clark, 1997) though the effect is contentious[24], age (Clark et al., 1996) and education (Bender and Heywood, 2006). We have also included the number of children, although there is no conclusive evidence on this variable (Kankaanranta et al, 2007). Situational capture whether individuals are on a temporary contract (Busk et al., 2017); and organisational determinants includes the role of managerial relations (Flickinger et al., 2016), such as the influence of coordinating roles (Gittell et al., 2008), human resource practices (Kampkötter, 2017) and the level of autonomy (Wheatley, 2017). We have proxied the degree of complexity of the organisation in which one works using the number of employees. Finally, we consider a group of variables that include the region of residence, the political orientation and residing in a 'Leave EU' or 'Remain EU' majority region, as individuals were less inclined to move when their preferences were aligned with the Brexit preferences of their district (Pickard et al., 2022). Powdthavee et

[24] While McElwain et al. (2005) did not find a difference between men's and women's work-family conflict and their job satisfaction, Grandey et al. (2005) found that work-family conflict is a significant predictor of job satisfaction for women, but not for men.

al. (2019), Saville (2020) and Kavetsos et al. (2021), document that those who report lower levels of life satisfaction were more likely to show a preference for leaving the EU.

Summarizing, we include the following explanatory variables: (1) age, sex, citizenship, and highest level of education attained, marital status, number of adults and children in the household, difficulties in paying bills, mortgage and council tax. (2) type of contract (temporary or permanent), number of employees in the company (less than 25, 25-99, 100-499, 500 or more), (3) *region of residence*[25], political party affiliation[26] and regions of residence considering voting result in the referendum[27], namely *leave* and remain *regions*[28]. Such heterogeneity might be given the effect of the referendum result on mental health.

3.4 *Treatment and control group*

Our treatment group (defined as "NHS-employee") consists of NHS workers, classified according to the Standard Occupational Classification (SOC2000) exposed to a significant EU workforce before Brexit[29]. Our identification strategy examines the effect of Brexit on employment via changing the workforce composition due to EU

[25] East Midlands, East of England, London, Northeast, Northwest, Northwest, Northern Ireland, Scotland, Southeast, Southwest, Wales, West Midlands and Yorkshire and the Humber.
[26] The following categories have been defined by grouping the parties according to their political orientation left (Green Party, Sinn Fein and Plaid Cymru, Labour, Scottish National Party and Social Democratic and Labour Party, Liberal Democrat Party and Alliance Party) and right (Conservatives and Ulster Unionists, Democratic Unionists, United Kingdom Independence Party and British National Party). We define an additional category corresponding to those who claim not to support any political party.
[27] The position of the political parties with respect to the referendum on remaining in the EU was as follows, remain in EU (Green Party, Labour Party, Liberal Democrats, Plaid Cymru, Scottish National Party, Alliance Party, Sinn Fein, Social Democratic and Labour Party, Ulster Unionist), leave EU (UK Independence Party, Democratic Unionist, British National Party) or neutral (Conservative Party).
[28] That is: (i) Leave EU: East of England, East Midlands, Northeast, Northwest, Southeast, Southwest, Wales, West Midlands, Yorkshire and the Humber and (ii) Remain EU: London, Northern Ireland and Scotland.
[29] This includes the following: "118. Health and social services managers", "221. Health professionals", "321. Health associate professionals" and "611. Healthcare and related professionals". Table B1 shows the details of the occupations included in each of these headings, which include "118. Managers", "221. Physicians and healthcare providers", "321. Nurses and related professionals" and "611. Other personal care professionals". The initial sample of NHS health workers contains 5,412 observations.

migration. This is a reasonable assumption given that the UK did not belong to the Schengen area before Brexit, hence the immigration rights of non-EU workers were always treated separately from the rest of the EU[30]. This implies that non-EU workers were not affected by the political uncertainty surrounding Brexit[31]. Our empirical strategy is similar to that of Ahlfeldt and Kavetsos (2014) and Kavetsos et al. (2021), which draws on observable characteristics to '*search*' for a control group that compare NHS workers with a control group selected using two entropy indices that allow the identification of individuals as far away as possible from the treatment group. To achieve this, we use Shannon's index and Simpson's index to distinguish occupational groups by origin.

The Shannon Index, also known as the Shannon-Wiener index (Shannon and Weaver, 1963)[32], and is a metric that quantifies the diversity within a given biological community. The Shannon index formula integrates the number of groups and the proportion of individuals belonging to each group within the community $SH = -\sum_{i=1}^{N} p_i ln p_i$. A higher value of the index symbolises a more diverse community, indicating both a greater number of different groups and an even distribution of individuals among those species.

The Simpson's Index, on the other hand, focuses on measuring dominance within a population (Simpson, 1949). It is particularly suited to scenarios where a few groups or categories may dominate, providing information on the concentration or prevalence of

[30] The entry of non-EU workers is governed by a 5-tier point system: high-skilled workers (1), sponsored skilled workers (2), low-skilled workers (3), students (4) and special categories of temporary migrants (short-term or voluntary visas) (5). Non-EU workers need a suitable offer of employment or prospects of working in the UK, a visa sponsored by a UK-based employer and must demonstrate their qualifications and language proficiency. Source: Work in the UK - GOV.UK

[31] During the referendum campaign, although "Vote Leave" promised on multiple occasions that the situation of EU migrants would not change substantially regardless of the outcome of the referendum, after the referendum the political messaging around the status of EU workers changed dramatically. A December 2016 report by the House of Commons and House of Lords Joint Committee on Human Rights warned about the use of EU citizens' rights as a "bargaining chip" in withdrawal negotiations (House of Commons, 2016).

[32] The U.S. Department of Housing and Urban Development used it to assess diversity in neighbourhoods, offering a perspective beyond simple racial percentages (U.S. Department of Housing and Urban Development, 2007) and the USC used Simpson's index to assess the 2020 Census results and analyse the extent of racial and ethnic diversity in a population (U.S. Census Bureau, 2021).

specific attributes in each dataset $SI = \sum_{i=1}^{N} p_i^2$. The index ranges from 0 to 1, where zero denotes uniformity in racial and ethnic characteristics across the population, while a value close to one suggests maximum diversity. For this reason, Simpson's index is often referred to as its complement (1-index). Thus, higher values in both indices indicate more diversity.

Table B2 shows the values of the Shannon index and the Simpson index before and after Brexit[33]. Figure B1 depict the distribution of the Shannon and Simpson indices for each occupation in the pre-/post post-Brexit period. The red vertical line display is the separation between some occupations with very low values of both indices and the rest; these five occupations form our control group (N=784 observations). Nonetheless, the reliability of the resulting estimates hinges on the validity of the parallel trend assumption, namely that the job satisfaction (working hours) of NHS workers and control group workers follow parallel pre-trends (Angrist and Pischke, 2008).

A critical issue is whether the treatment and control groups differ in some observables over time (Imbens and Wooldridge, 2009). To limit further possible selection bias between groups, we rely on the use of propensity score matching (PSM) in the context of parametric DiD models, where observations are weighted to ensure similarity in some observed characteristics (Stuart et al., 2014). More specifically, we have matched the treatment and control groups using the most used propensity score matching technique[34], and we have chosen the PSM technique that had the lowest values on relevant

[33] In both periods, there are four occupations that reach the lowest values for both indexes: "117 Protective service officers", "245 Librarians and related professionals", "352 Legal associate professionals", "355 Conservation associate professionals" and "613 Animal care services". We consider the set of these five occupations.

[34] That includes inverse probability weighting techniques; 1 to 1; many to 1; de Mahalanobis; kernel, local linear regression, inverse probability weighting and spline, considering all possible confounders available (age, sex, level of education, marital status, children in the household, region of residence, difficulties in making ends meet, type of contract, number of employees).

performance indicators[35]. Matching many (NHS-employee) to 1 (control) was the best PSM technique for matching, as it resulted in the lowest mean per cent standardised bias (1.5), as well as the lowest Rubin's B (9.4) (see Table B3). Confirming this result, in Figure B2, we appreciate a significant reduction in standardised percentage bias before and after M (NHS-employee) to 1 (control group).

The final sample consists of 5,330 observations for NHS-employee (9.06% managers; 14.32% physicians; 40.96% nurses; 35.67% other personal care professionals) and 741 observations for control group (27.67% protective service officers; 14.30% librarians; 31.85% legal associate professionals; 13.23% conservation associate professionals; 12.96% animal care services) (see Table B4 for a description of the final sample in all waves).

3.5 *Descriptive statistics*

Figure 1 displays the evolution of the four dependent variables over the period 2009-2019 for the NHS-employee and the control group. In all cases, four events have been reported: (I) January 2013, when Prime Minister Cameron promises a referendum if the Conservative party wins 2015 general elections; (2) May 2015, when the referendum was officially announced; (3) 23rd June 2016, when Brexit referendum took place; (4) March 2017, when Article 50 was triggered[36]. For both the NHS-employee and the control group, no sustained changes in trend over time were observed for the first two

[35] We have evaluated the performance of each PSM technique on the mean and median percent standardized bias, as well as Rubin's B[35] and Rubin's R[35]. Following Rubin's (2001) recommendation, we considered that B less than 25 and R between 0.5 and 2 indicated sufficient balance.

[36] Article 50 of the Treaty on European Union (TEU) is the only legal mechanism by which a member state can withdraw from the European Union. The main parts of the Treaty say as follows: Paragraph 1: "*Any Member State may decide to withdraw from the Union in accordance with its own constitutional requirements*." Paragraph 2: "*A Member State which decides to withdraw shall notify the European Council of its intention [. . .] the Union shall negotiate and conclude an agreement with that State, setting out the arrangements for its withdrawal, taking account of the framework for its future relationship with the Union." Paragraph 3: "The Treaties shall cease to apply to the State in question from the date of entry into force of the withdrawal agreement or, failing that, two years after the notification referred to in paragraph 2, unless the European Council, in agreement with the Member State concerned, unanimously decides to extend this period*." Consolidated version of the Treaty on European Union

events noted (when Prime Minister David Cameron promised a referendum if the Conservative party won the election and when the referendum was announced). However, since the referendum, we have seen substantial differences in the evolution of both groups.

First, we find that as expected, the job satisfaction of the control group reveals a steady behaviour both before and after the Brexit (displaying an average rate of 5.25 in Q1 2009; 5.28 at the referendum; 5.33 at the end of 2019), whilst the job satisfaction of the treatment group decreases sharply after the Brexit (5.30 rating at the referendum time; 4.67 at the end of 2019) [37].

Second, following Brexit, the total number of paid working hours shows a non-significant increase in the control group, rising from 33.35 hours per week in Q1 2009 to 33.69 hours at the time of the referendum and 34.19 hours by the end of 2019. In contrast, our treatment group, consistently with expectations, experienced a pronounced rise in working hours, continuing a trend that began before Brexit, increasing from 35.72 hours per week in Q1 2009 to 36.24 at the referendum and reaching 37.11 by the end of 2019. A notable divergence also emerges when we look at unpaid extra hours. While the percentage of workers performing unpaid overtime slightly declined in the control group (reaching 45% in Q1 2019), it rose sharply among NHS employees, peaking at 76% in Q3 2018. The average number of unpaid extra hours also grew significantly in the NHS-employee group, from 8.65 hours per week in Q2 2016 to a peak of 12.25 hours in Q1

[37] Although we would like to compare the job satisfaction variable in Understanding Society and the NHS Staff Survey, unfortunately, in the NHS Staff Survey, there is no single question that is intended to measure job satisfaction, and consequently, a combination of indicators is needed. In an attempt to use proxies for job satisfaction, we find that 2018 NHS Staff Surveyreports two interesting facts: (i) overall staff engagement has fallen to a score of 3.78 (2016: 3.80) and (ii) motivation at work has fallen to 3.90. And the 2019 NHS Staff Surveystated that 40% of employees have felt unwell from work-related stress in the past year, compared to 1.8% of the entire UK workforce, the highest result over the past five years, and 28.5% of staff reported experiencing bullying in the last 12 months, with 12.3% of staff experiencing bullying and/or harassment at work from managers and 19% from other colleagues. See: 2017-nhs-staff-survey-results-briefing-march-2018.pdf and Statistics » 2019 National NHS Staff Survey

2018, whereas it remained stable between 5 and 6 hours per week in the control group. Finally, before Article 40 was triggered, we identify a small increase in NHS-employee job satisfaction, but after tit tailed-off thereafter. Consistently, we identify an increase in the percentage of NHS staff working unpaid extra hours (and the number of unpaid extra hours).

[Insert Figure 1 about here]

Table B4 displays the descriptive statistics for treatment (labelled as "NHS") and control group for the matched sample, and Table B5 displays the distribution of both groups according to nationality, before and after Brexit. We distinguish three groups: 'UK' referring to employees with British nationality, 'NoUK-EU' referring to those without British nationality from EU countries and 'Overseas' for those with neither British nationality nor EU citizenship. Although the average effects do not suggest a large change in EU workers overall. That is, overall, we find that the percentage of 'UK' workers decreased from 78% to 72.3%, and a sharp rise in workers from 'Overseas' workers (from 17.92% to 23.34%). However, these average figures mask important differences between occupations, as the share of 'NoUK-EU' decreases 0.76pp for 'Managers' and 4.26pp for 'Physicians and healthcare providers. In the control group, the percentage of 'UK' employees decreases from 88.91% to 82.19%, the share of 'NoUK-EU' increases slightly from 0.34% to 0.48% and 'Overseas' increases from 10.76% to 17.32%. Table B6 differentiates the 'Overseas' group by nationality. We observe a strong increase of Asian workers: from 58.1% to 63% for NHS employees and from 74.6% to 84.6% for the control group.

Finally, Table B7 reports the mean value of the 4 dependent variables, differentiating by treatment vs. control group, nationality and pre and the post-Brexit period. We find that workers (i) born UK (from NHS-employee and control) show higher job satisfaction and lower number of (paid) hours worked in the pre-Brexit period with respect to EU and Overseas; (ii) the propensity to perform unpaid overtime in the NHS-employee group is much higher for Non UK workers (although differences are not as wide in the control group); (iii) after Brexit, UK job satisfaction decreases in NHS-employee, but increases in the control group; (iv) this decrease in satisfaction in UK healthcare workers may be related to the increase in the number of hours worked (5.76%), the propensity to perform unpaid overtime (58.74%) and the number of such hours (24.69%); (v) on the contrary, in the Overseas healthcare workers group, job satisfaction increases, although there is also an increase in the three variables outlined above[38].

3.6. Empirical strategy

To estimate the impact of Brexit on job satisfaction and working hours, we use an event-study comparing exposed NHS employees with the control group (as defined in section 3.4). The event study design to test for the Brexit referendum effect over job satisfaction and the number of weekly working hours is as follows:

$$Y_{it} = \sum_{j=-89}^{j=25} \nu_{0j} NHS\ employee_{ij} PostBrexit_{ij} + \nu_1 X_{it} + \lambda_i + \Gamma_r + \Psi_t + \varsigma_{it} \quad (1)$$

where Y_{it} denote the four outcome variables mentioned above for individual i living in year t; $NHS\ employee_{ij}$ is a binary variable that takes the value one for NHS-employee (0 otherwise); $Post - Brexit_j$ (after-referendum) is a binary variable that takes

[38] Although in absolute terms, the increase in the number of (paid) hours is 2.1 among the UK employees versus 1.7 among Overseas, Overseas workers were already working a higher number of hours at the time of the referendum (40.1 vs. 38.5), the percentage change is higher for the UK (5.77%) than for Overseas (4.43%).

the value 1 in the months prior to the referendum (from January 2008 to May 2016: 89 months) and the value 1 after the referendum until December 2018 (25 months); X_{it} includes a vector of explanatory variables, $\lambda_i + \Gamma_r + \Psi_t$ denotes individual, regional and time fixed effects and ς_{it} is an error term. The referendum effect is captured by the coefficients ν_{0j} of the interaction term $NHS\ employee_{ij} Post - Brexit_{ij}$.

Next, we estimate a specification of the DiD type, considering the joint effect of belonging to NHS-employee after the referendum over the same outcomes as before, including several covariates to better control for characteristics that might be systematically different between the treatment and control group:

$$Y_{it} = X'_{it}\alpha_0 + \alpha_1 PostBrexit_t + \alpha_2 NHS\ employee_i + \alpha_3 NHS\ employee_i PostBrexit_t + \lambda_i + \Gamma_r + \Psi_t + \upsilon_{it} \quad (2)$$

The coefficient α_3 identifies the average treatment effect and measures the impact of Brexit referendum on job satisfaction on NHS workers. We consider a series of controls including age, gender, UK citizenship, education, marital status, household size, number of adults, number of children, difficulties for paying bills/mortgage/council tax, number of employees, type of contract) to account for the effects of economic confounding factors. We cluster standard errors at the individual level[39]. A negative (positive) estimate of α_3 would imply that the Brexit referendum decreased (increased) job satisfaction (working hours). The DID strategy allows comparison of NHS workers' satisfaction, while controlling for concurrent time trends by using non-NHS workers as a control group. Another advantage is that it effectively eliminates bias when selection for

[39] We have re-estimated our baseline specification clustering the standard errors at the region level and at individual & regional level, finding that these alternative specifications to consider dependence of the error terms lead to very similar results to clustering only at the individual level.

treatment is based on time-invariant unobservable characteristics (which are also correlated with the outcome measures)[40].

Finally, we examine the triple difference effect by interacting the effects of UK, EU and non-UK non-EU nationality at the time of the Brexit referendum. The model identification relies on the assumption that immigration policies after Brexit changed for EU -migrant workers alone, comparing NHS-employees with the control group, and UK and Overseas workers to EU workers (as the omitted category). Furthermore, some evidence suggests that the Brexit referendum made EU nationals reconsider leaving the UK. This was not the case for non-EU nationals, whose labour market conditions, before Brexit, compared with those of EU nationals, were more restrictive (Rienzo et al., 2020; Luthra, 2020). This corresponds to a difference-in-difference-in-differences (DiDiD) setup that exploits more variation in data, considering a *triple interaction effect by nationality* as follows:

$$Y_{it} = X'_{it}\beta_0 + \beta_1 PostBrexit_t + \beta_2 NHSemployee_i$$

$$+\beta_3 PostBrexit_t NHSemployee_i + \beta_4 UK_i + \beta_5 Overseas_i$$

$$+ \beta_6 UK_i PostBrexit_t + \beta_7 Overseas_i PostBrexit_t$$

$$+ \beta_8 UK_i NHSemployee_i$$

$$+ \beta_9 Overseas_i NHS_i + \beta_{10} UK_i PostBrexit_t NHSemployee_i$$

$$+ \beta_{11} Overseas_i PostBrexit_t NHS\ employee_i + \lambda_i + \Gamma_r + \Psi_t + \in_i \qquad (3)$$

[40] For example, if European NHS workers were, as we argue, an intrinsically more motivated group with a greater desire to stay in the UK, any potentially adverse effects associated with Brexit on migration intentions would be biased downwards. By calculating differences twice, such time-invariant individual heterogeneity (i.e., motivation) will disappear.

where 'UK' refers to workers holding British nationality, and 'Overseas' workers without British nationality and coming from non-EU countries (being the omitted category, 'NoUK-EU', i.e., workers without British nationality and coming from EU countries). An additional advantage of the triple difference strategy is that it accounts for selection bias for time-invariant unobservable characteristics that could affect selection into treatment[41] as well as potential omitted variable bias. Finally, it requires a weaker identification assumption than that of parallel trends. That is, it only requires the absence of contemporaneous shocks that disproportionately influence UK workers and Overseas workers between the pre- and post-Brexit period.

An important identification assumption is that workers cannot self-select into the treatment or comparison group, since they cannot manipulate their nationality or the date of participation in the survey. It is plausible to assume that they cannot change their nationality (at will), nor can they choose the timing of survey participation based on political announcements. Another important identifying assumption is that employees do not self-select into the treatment. In our model, treatment exposure is determined by three variables: employment status (being an NHS employee), nationality, and date of survey. Our "plausible" assumption is that individuals cannot immediately change their citizenship[42] nor can they choose the date of the interview due to the Brexit referendum.

[41] For example, if UK workers were an intrinsically more motivated group than NoUK-NoEU workers, then any potentially adverse treatment effects of the Brexit referendum on job satisfaction would be downward biased. By calculating this triple difference (β_{10} and β_{11}), this time-invariant heterogeneity (i.e., motivation) cancels out.

[42] The process of obtaining British citizenship shows that it cannot be done unexpectedly or without sufficient notice. Eligibility requirements for British nationality: (i) be over 18; (ii) prove being in the UK exactly 5 years before the day the Home Office received application; (iii) prove knowledge of English, Welsh or Scottish Gaelic; (iv) intend to continue living in the UK; (v) be of good character; (vi) not having spent more than 450 days outside the UK during the 5 years before application; (vii) not having spent more than 90 days outside the UK in the last 12 months; (viii) not having broken any UK immigration laws (for example living illegally in the UK). Apply for citizenship if you have indefinite leave to remain or 'settled status': Eligibility and fees - GOV.UK (www.gov.uk)

4. Results

4.1 Event-study estimates

Figure 2 shows the event study estimates for the four outcomes analysed. They corroborate our observations made in Figure 1. That is, job satisfaction experiences a sharp decline just after the referendum and becomes even sharper after Article 4 was triggered. The number of paid working hours increases significantly for NHS employees after Article 50 was activated. Finally, both the percentage of NHS-workers performing unpaid working hours and the average number of unpaid extra working hours also increase. For these last two variables, we find that the coefficients of the event-study increase somewhat after the referendum and spike after the implementation of Article 50.

[Insert Figure 2 about here]

4.2 Difference-in-difference specification

For each of the outcomes, we estimate our main DID specification and we disentangle the effect by NHS occupational group as displayed in Table 1. Estimates suggest that relative to the control group, job satisfaction was not significantly different for NHS employees except for physicians (0.22 points higher)[43]. The coefficient of the variable 'Brexit' is not significant in any model, but its interaction with NHS is significant with a negative sign: -0.072 points for NHS-employee, with a maximum reduction of 0.24 points for physicians and a minimum of 0.10 for managers. For a better interpretation of the results, we compared the effect with the average job satisfaction of each group. Outr estimates suggest that after Brexit, job satisfaction decreased by 1.39% for NHS-

[43] Although the variable 'job satisfaction' is an ordered variable, we estimate equations (1) and (2) using OLS, following Ferrer-i-Carbonell and Frijters (2004) [results with an ordered probit do not yield statistically significant differences; results are available upon request].

employee, 2.02% (managers), 2.66% (physicians), 2.42% (nurses) and 2.41% (other personal care).

Next, we estimate the effect on the total number of paid working hours, which suggests a significantly higher number of working hours in the physician's group (4.17 hours/week). After Brexit, such increase extends to all NHS-employee occupations (1.75 hours/week; 4.8% increase in working hours). When we disentangle the effect by occupation, we then find that the increase in hours worked per week amounts to 2.08 (physicians), 1.88 (nurses), 1.53 (other personal care) and 0.77 (managers), representing an increase in working hours by 6.01%, 4.62%, 4.26% and 2.13%, respectively. Furthermore, the probability of working unpaid extra hours is significant and positive for all occupations included in the NHS-employee except managers. The interaction of this variable with the Brexit referendum shows an increase by 0.19 pp. for NHS-employee as a whole, rising to 0.24 pp for physicians and 0.38 pp. for nurses.

Finally, we find that the number of unpaid extra working hours is significantly higher for NHS employees (with a maximum of 4.24 hours/week for nurses). The interaction with the Brexit referendum shows an increase of 8.31 unpaid hours/week for NHS employees (an increase of 28.06% compared to the average). By occupation, we find evidence of an increase in 10.9 hours/week (among nurses), 9.4 hours/week (among physicians), 8.6 hours/week (among other personal care) and 6.56 hours/week (among managers), which entails an increase over the average number of unpaid working hours of 76.48%, 29.45%, 53.38% and 8.48%, respectively.

[Insert Table 1 about here]

Table 2 displays the differing impacts of Brexit on NHS job satisfaction and working hours by nationality. Post-Brexit, job satisfaction declined by 2.62% among UK workers but increased by 3.07% for Overseas workers, with the largest divergence observed

among managers (-3.47% vs. +5.48%), nurses (-4.44% vs. +2.19%), and physicians (-4.76% vs. +1.19%).

This improvement in the satisfaction of NHS overseas can be explained by alternative explanations. Consistent with Rienzo (2024), the effect of Brexit was perceived by workers from Overseas as the beginning of a more equal access system, ending the pre-existing discrimination. However, Brexit opened the door to a wave of criticism, accusing the UK of succumbing to xenophobia and racism. These criticisms, rather than giving rise to a rise of such attitudes, may have sparked what is "*Prejudice Control Motivation Theory*" predicts, namely that individuals might have become more reluctant to break norms against prejudice and deliberately try to control actions and attitudes that are perceived to violate these norms (Blinder et al., 2013). Therefore, UK citizens, regardless of their referendum vote appear instead to have softened their attitudes towards migrants (Harteveld and Ivarsflaten, 2018)[44].

The trend observed in job satisfaction aligns with changes in working hours, as total paid hours rose by 5.63% (2.13 hours/week) for UK workers compared to just 1.47% (0.58 hours/week) for their Overseas counterparts. Physicians, nurses, and personal care workers experienced a greater increase in paid hours than their Overseas peers. The proportion of workers doing unpaid extra hours grew similarly (0.15pp-0.16pp), with nurses experiencing the largest rise. Unpaid extra hours increased by 4 hours/week for both groups, though the percentage increase was higher for UK workers (47.24%) than for Overseas workers (43.10%). Among nurses, the increase was 2.36 hours/week for UK workers and 2.47 hours/week for Overseas workers, but in percentage terms, the rise was more significant for UK workers (+36.85% vs. +29.58%).

[44] Consistently, Schwartz et al. (2021) found that anti-immigrant attitudes actually softened after the Brexit referendum among both Leave and Remain supporters, and these effects persisted for several months and was also confirmed by the British Election Study panel, which identified a positive shift in perceptions of the benefits of immigration (Ford, 2018).

[Insert Table 2 about here]

To assess the plausibility of the parallel trend hypothesis, we test for the differences in trends prior to treatment. Although these tests are intuitive, recent research has shown that they can have low power (Freyaldenhoven et al., 2019). Hence, Rambachan and Roth (2024) formalised the intuition motivating pre-trends testing, by imposing restrictions on the possible differences in post-treatment trends given the identified pre-trends. Such restrictions suggest that pre-trends are informative about post-treatment counterfactual differences in trends. Hence, we evaluate whether the effects in the post-Brexit period are of "considerable magnitude" relative to those observed in the pre-Brexit period, it follows that there is a true treatment effect. To formalise this idea, Rambachan and Roth (2024) provide a means to adjust confidence intervals by taking the largest difference in the pre-period between treated and controls and deriving adjusted confidence intervals for multiples of them[45]. To do so, we compare the original 95% confidence interval (valid under the assumption of no violation in the common trend) and the adjusted confidence intervals that allow for violations of the common trend equal to 0.1, 0.25, 0.5, 1, 1.5 and 2 times the magnitude observed during the post-Brexit period. Figure B4 displays evidence consistent that our estimations are robust to violations of the parallel trend assumption, up to twice the magnitude observed during the post-Brexit period. percent deviation. While the event study results suggest that the pre-trend was similar between NHS-employee and control groups, we find that this additional check add confidence that

[45] For example, the adjusted confidence interval Mbar=1 (using the terminology proposed by Rambachan and Roth) zero would be interpreted as meaning which effect would survive a violation of the common trend equal to the largest difference observed before treatment. If we were to observe that the adjusted confidence interval Mbar=2 includes zero, it would imply that the effect would survive a violation of the common trend equal to twice the largest difference observed before treatment.

Brexit decreased job satisfaction, but increased paid working hours, probability of working unpaid extra hours and number of unpaid extra hours.

4.3 Heterogeneity

Next, we have re-estimated our DiD estimates by different sociodemographic groups: gender, age, type of contract, number of employees in the company, number of children, region of residence according to the outcome of the vote (exit vs. remain) and political ideology. The tables of the estimates are shown in the appendix (C1 and C2) and Figures 3 and 4 show the percentage variations from the average.

Gender. We document a 5.6% (3.3%) reduction in the job satisfaction of male UK (EU) nationals compared to 3.3% (1.1%) among female UK (EU) nationals. In contrast, we find an increase in job satisfaction among both men and women from Overseas (0.2% for men and 0.6% for women). However, for all groups we find an increase in working hours, especially among UK nationals (4.0% for men and 2.4% for women).

Age. Job satisfaction declines for all age cohorts and UK nationals (more intensely for 50-59 year cohort: -6.6%), but increases among Overseas (especially for 20-29 years and 40-49 years). Consistently, the working hours of UK (EU) workers increase for all groups, and more specifically, by 5.7% (4.5$) for 20-29 years and 5.5% (3.3%) for 30-39 years. Yet these estimates were significantly lower for Overseas, especially those aged 20-29 (2.2%), although on average they work one hour more per week than UK nationals (40.9 vs. 39.8).

Region of residence. We find evidence of a 4.5% (4.6%) reduction in the job satisfaction among UK (EU) workers living in Leave EU regions compared to only 1.7% (-1.1%) for UK (EU) workers living in Remain EU regions. However, job satisfaction of Overseas workers increased by 0.7% in Remain EU regions compared to 0.1% in Leave

EU regions. As for working hours, they show an increase by 4.5% (2.6%) for UK (Overseas) workers in 'Leave EU' regions compared to only 1.2% (1.1%), respectively, in 'Remain EU' regions.

Type of contract. UK (Overseas) workers with fix-term contracts experienced the largest decrease (increase) in their job satisfaction whilst working hours increased especially among UK nationals with permanent contracts.

Size of the workforce. For UK and EU workers, job satisfaction declined irrespective of the size of the workforce, corresponding to the largest effect to organisations with 25-99 and 500+ employees. Consistently, working hours of UK workers increased by 2.1% and 4.3% in these organisations.

Number of children. Job satisfaction of UK workers decreased exponentially with the number of children (-1.84% for no children; -3.52% for one child; -7.22% for more than one child), although the percentage increase in the number of hours has followed an inverse effect (-1.6% for no children; -3.3% for one child; -6.1% for more than one child). These results are coherent with our hypothesis, namely increased overwork which adds strain to work and family balance. Consistently, we find that Overseas workers without children have experienced the greatest increase in job satisfaction (0.7%), despite the greatest increase in working hours (3.4%).

Political orientation. Finally, we examine whether job satisfaction declined depending on the political orientation of UK workers. However, we find a deeper decline among right-wing voters (-5.5%) than among left-wing voters (-4.8%). Conversely, among Overseas workers, the largest increase in job satisfaction (0.5%) is concentrated among left-wing party voters. For EU employees, the highest reduction in job satisfaction corresponds to those who did not vote (-6.2%). Finally, it's worth noting no differences in the number of hours worked depending on an individual's political orientation (in

absolute terms), although, in relative terms, the highest increase corresponds to UK (above 3%) followed by EU and Overseas workers.

[Insert Figures 3 and 4 about here]

4.4. Robustness checks

In this section, we propose three exercises to test the robustness of our results. In the first one, we repeat the estimations using NHS-employee and control group without matching. In the second, we consider two alternative samples by extending the threshold of the entropy index that determines the occupations that are part of the control group. in the third, we consider two alternative samples with the entropy index threshold that determines the occupations that are part of the control group.

4.4.1. Unmatched sample

We have re-estimated our DiD specification using an unmatched sample. Results are consistent with the previous estimates (see Table C3) and suggest a higher reduction (increase) in job satisfaction (working hours) for NHS workers after Brexit as compared to results of the matched sample (Table 1). Therefore, our baseline estimates seem to be a realistic lower bound of the impact of Brexit referendum on workforce job satisfaction and working time.

4.4.2. Different control groups using the entropy index

We have repeated the entire process using two different samples, expanding the number of professional occupations included in the control group. In the first alternative sample, we incorporate occupations until pre-Brexit Simpson index is twice the Simpson index for the occupation with the highest pre-Brexit Simpson index in the original control

group[46]. In the second alternative sample, we include occupations until pre-Brexit Simpson index is 2.5 times the Simpson index for occupation with the highest pre-Brexit Simpson index in the original control group[47].

The size of these alternative samples is 1,055 and 1,112 observations and after matching, the alternative control groups contain 916 and 994 observations, respectively (see Table D1). We have re-estimated equation (2) and Figure D1 shows the comparison of the estimated coefficient α_3. The results are significant, supporting the evidence of the original sample. The magnitude of the estimated coefficients for the alternative samples is slightly higher than that of the original sample, so our results can be considered as a lower bound of the impact of Brexit on the outcomes analysed.

4.4.3. Balanced panel

Given that our estimates are retrieved from an unbalanced panel, unobserved individual fixed effects could lead to biased estimates. In order to check this, we have constructed a new panel selected from individuals who were interviewed before and after Brexit. The process of constructing the panel is detailed in Figure D2, and Figure D3 compares the estimated coefficients with the unbalanced and balanced panel for the 4 outcomes analysed and differentiating by professional categories of NHS workers. We observe that: (i) the balanced panel estimates confirm the previous results, (ii) and the magnitude of the estimated coefficients is higher with the balanced panel (7% for job

[46] In this case, the control group is composed of the initial occupations (codes 613, 355, 352, 117 and 245) and additionally "541. Textiles and garments trades", "121. Managers in farming, horticulture, forestry and services" and "549. Skilled trades, not specifically defined".

47 In this case, the control group is composed of the initial occupations (codes 613, 355, 352, 117, 245, 541, 121, and 549) and additionally, "542. Printing trades", "911. Elementary agricultural occupations", "2532. Building trades", "2341. Artistic and literary occupations" and "2414. Administrative occupations: communications".

satisfaction, 2% for total paid working hours per week; 5% for the probability of unpaid extra working hours and 2% for number of unpaid extra hours).

5. Spillover effects on self-reported job performance

In this section, we examine whether the change in job satisfaction resulting from Brexit has had any spillover effects on job performance, and whether such a change in the number of hours worked has influenced job performance. Despite obvious quantitative limitations, we explain the productivity puzzle.

For this purpose, we use six dependent variables:

(i) *having accomplished less during last week takes the value 1 if the respondent reports 'all of the time', 'most of the time', 'frequently', 0 otherwise;*

(ii) *working less carefully during last week if the respondent answers 'all of the time', 'most of the time', 'frequently', 0 otherwise;*

(iii) *being satisfied with leisure time takes the value 1 if answers 'completely satisfied', 2 'mostly satisfied', 'somewhat satisfied', 0 otherwise;*

(iv) *intentions to move next year (to change job) takes the value 1 if respondent answers 'yes', 0 otherwise;*

(v) *considering that job is attractive due to career prospects takes the value 1 if respondent answers 'yes', 0 otherwise;*

(vi) *considering that job matches experience and training takes the value 1 if respondent answers 'yes', 0 otherwise.*

Figures A6 and A7 show the estimated coefficient for the NHS-employee and Brexit interaction, for different worker profiles: (i) as a function of the number of employees

(<25, 25-99, 100-499, 500+) and (ii) as a function of the type of contract (permanent or temporary).

The likelihood of feeling that you have accomplished less tasks increases for all NHS-employee employees after Brexit, and the estimated coefficient is increasing with organisational size as you move from <25 employees to 500+ employees: 26.8% for managers, 17.3% for physicians; 25.3% for nurses and 20.2% for other personal care. It is also higher for permanent than temporary workers (56.8% higher for physicians and 65.5% higher for nurses). However, although workers perceive that they are not able to cover as much of their workload as they would like, there is no evidence that they have performed their tasks with less care, for any occupation, contract type or size of organisation. The fact that the increased sense of work overload and inability to cover all tasks increases with the size of the organisation is in line with the inverse relationship between Trust size and productivity pointed out by The Health Foundation (2015 and Aragón et al. (2017), so that the diseconomies of scale faced by larger Trusts, due to their more complex organisational structure, dominate the economies of scale from which they could benefit due to reduced procurement costs.

The increase in the number of hours worked is clearly mirrored by an increase in dissatisfaction with leisure time. The probability of considering that leisure time is not enough increases 156.1% for managers, 109.4% for physicians, 196.4% for nurses and 213.3% for other personal care). The decrease in satisfaction with leisure time is also higher for permanent than for temporary workers.

Figure A8 reveals that as expected, the Brexit referendum lead to a reduction in the individual satisfaction with leisure as a function of occupation, whether one has children, and if one has children, their age. We find that: (i) among those without children, satisfaction with leisure decreased by 7.14pp among managers and 14.16pp among

nurses; (ii) and among those with children, the reduction in leisure satisfaction is even higher and such reduction is steeper as the age of the children decreases, (iii) especially among doctors and nurses with children aged 6-10 years (-30.31pp and -50.63pp) and 0-5 years (-49.47pp and -61.21pp).

Although we do not know whether these intentions to seek a job elsewhere have been realised or not, we find that, except for the smallest centres, in the rest there is a significant increase in the intention to look for work elsewhere. Such probability increases by 11pp among managers, physicians and other personal care, and reaches an increase of 15pp for nurses.

In terms of the attributes of the current job, we observe a deterioration in perceived good career prospects and the match of its current job corresponds to their qualifications and experience. It is important to note that these effects do not occur in smaller centres. In larger centres, the probability of having good career prospects decreases by 18.6pp for physicians and 22.5pp for nurses and the probability of considering that the current job does not correspond to the worker's qualifications decreases by 17.5pp for managers and 31.4pp for nurses.

Finally, as an extension, in order to explore the issue of the difficulty in carrying out the tasks of the occupation (which is intrinsically related to the decrease in the worker's productivity, i.e., productivity puzzle) we have examined the effect of the total number of hours worked on the probability of feeling that one cannot cope with all the tasks that one has to carry out. To do so, we propose a model in which the dependent variable whether the worker considers that he/she feels that has accomplished less (always/almost always/frequently) as a function of the total number of hours worked (normal and extra; paid and unpaid) interacted with post-Brexit and the same explanatory variables as in the job satisfaction model. This model has been estimated for the four NHS-employee

occupations. Figure 5 depicts the probability of feeling accomplished less as a function of the number of hours for each occupation. The dashed-dot line represents the average total number of hours worked before Brexit, and the solid red line represents the average total number of hours worked after Brexit. Based on the average number of hours worked, before Brexit, the group of managers and nurses were most likely to feel that they could not perform all the tasks required in their job. These results suggest that this effect might have led to additional spillovers on the individual performance of the NHS, to be examined with a dataset that allows identifying the specific units (NHS Trusts) .

6. Conclusion

This paper studies the impact of Brexit, an institutional shock, on the working conditions and job satisfaction of NHS employees. We document evidence of a 1.39% decline in job satisfaction among NHS workers after the Brexit referendum, driven by increased working hours (2.13%-6.01%), a higher likelihood of unpaid overtime (0.18pp), and an increase in unpaid hours (6.56-10.90 hours/week). Nurses and doctors experienced the greatest rise in working hours, with UK workers seeing the largest decline in job satisfaction and the highest percentage increase in hours worked. Such an effect is partly due to pre-Brexit working conditions, where UK workers had fewer hours but experienced a steeper increase post-Brexit. Our results are robust to the choice of different control groups (the consideration of different thresholds for the entropy indices used) and that estimates with unbalanced panel data (original sample) are consistent with those obtained using balanced panel data (restricting to individuals participating in UKLS before and after Brexit).

Nonetheless, we find that Brexit reduced the perceived "relative discrimination" for non-UK, Non-EU workers, as EU workers lost preferential treatment before Brexit. The

economic impact of Brexit on NHS staffing aligns with studies linking lower EU nurse integration to declining hospital quality. Increased working hours and lower job satisfaction raise concerns about NHS workforce sustainability and healthcare quality, necessitating policy intervention.

We find that the increase in overtime among NHS employees reduced employment quality by disrupting work-life balance, increasing exit from NHS employment, as well as turnover strains efforts to replace staff, causing further delays and unpaid overtime. These are consistent with the idea that Brexit might have exacerbated the so-called NHS "productivity puzzle" (Freedman and Wolf , 2023), and suggest that Brexit-type shocks require a substantial additional investment in human resources to maintain the NHS as a "family-friendly" employer, prioritising work-life balance, and employment quality, which is central to patient safety and quality of care.

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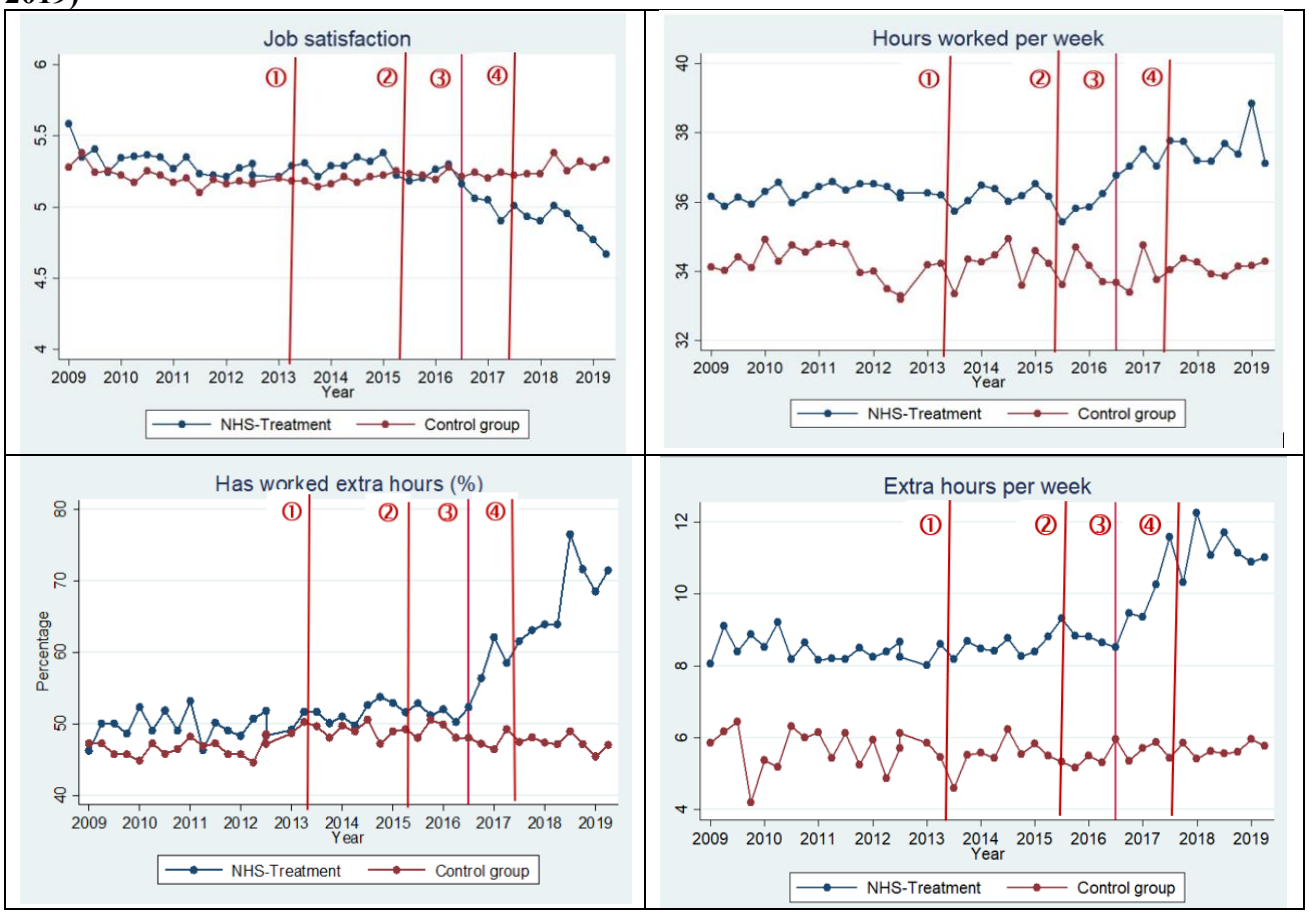
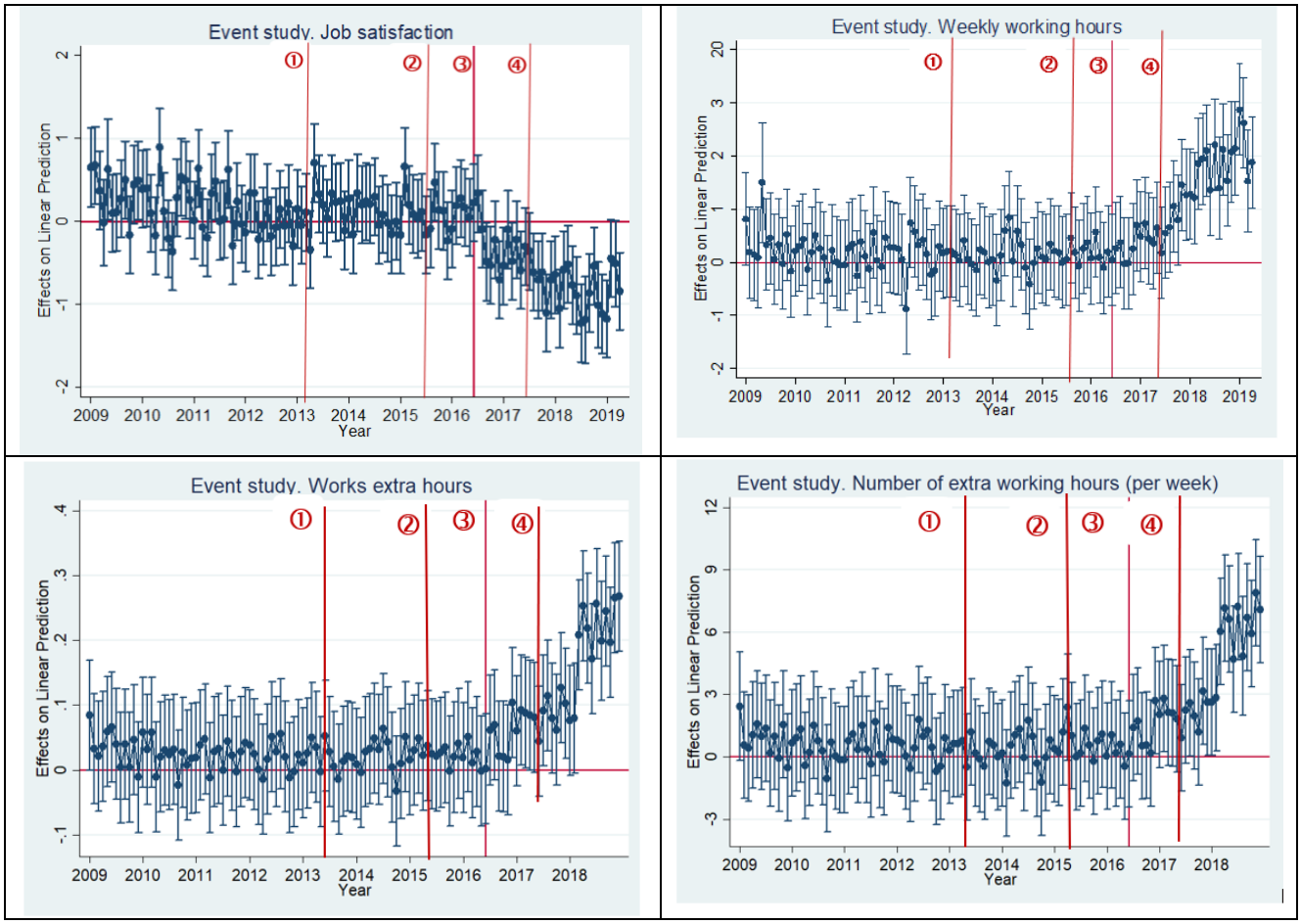
Tables and Figures

Figure 1. Trends in health care employment quality and working times (2008-2019)



Note: The four figures the trends in different in health care employment across four key periods between treatment and control groups. The upper left figure displays of satisfaction, while the upper right figure illustrates average total paid working hours, including both regular and extra hours. The lower left figure shows the percentage of workers doing unpaid extra hours, and the lower right figure depicts the average number of unpaid extra working hours. The data is sourced from Understanding Society. Key Brexit-related milestones include: (1) Prime Minister David Cameron's referendum promise (January 2013), (2) Referendum announcement (May 2015), (3) Brexit Referendum (June 23, 2016), and (4) Article 50 activation (March 2017), marking the formal process of the UK's departure from the EU.

Figure 2. Event study of Brexit events on health care employment quality and working time 2008-2019

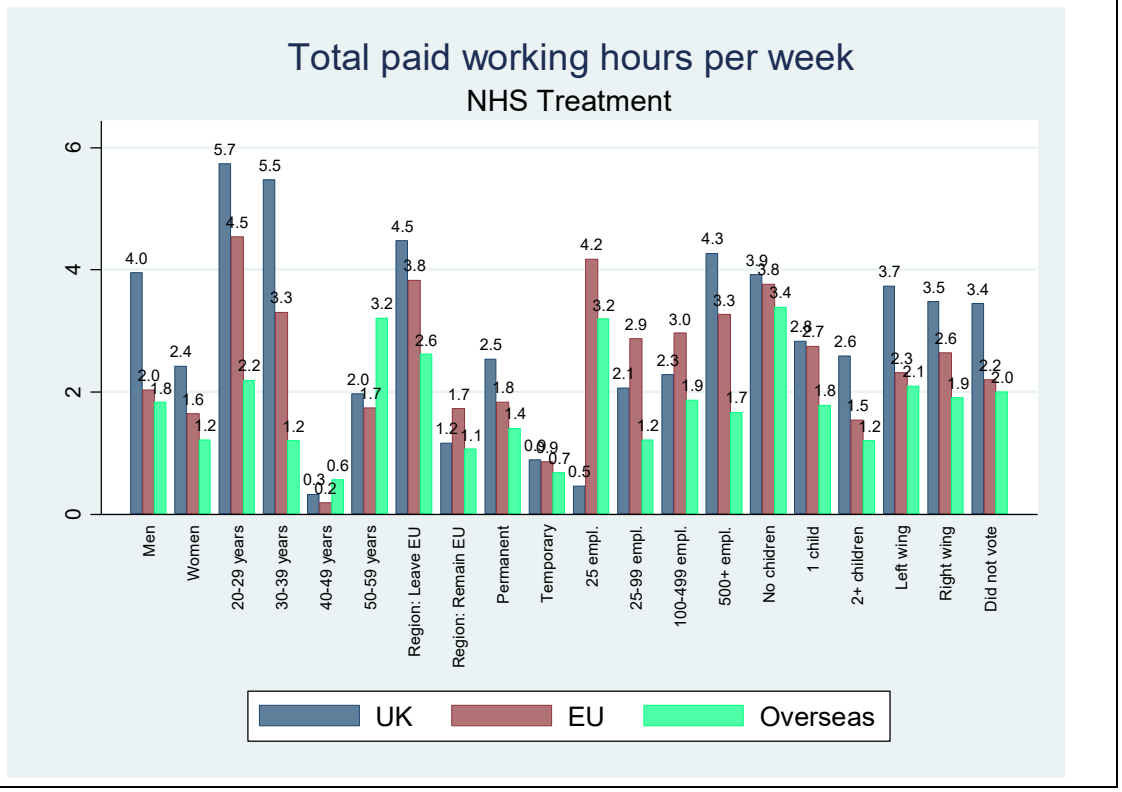


Note: The four figures depict the event study results of four key periods between treatment and control groups on relevant employment outcomes. The upper left figure displays of satisfaction, while the upper right figure illustrates average total paid working hours, including both regular and extra hours. The lower left figure shows the percentage of workers doing unpaid extra hours, and the lower right figure depicts the average number of unpaid extra working hours. The data is sourced from Understanding Society. Key Brexit-related milestones include: (1) Prime Minister David Cameron's referendum promise (January 2013), (2) Referendum announcement (May 2015), (3) Brexit Referendum (June 23, 2016), and (4) Article 50 activation (March 2017), marking the formal process of the UK's departure from the EU.

Figure 3. Heterogeneous Effect of Brexit on Job Satisfaction

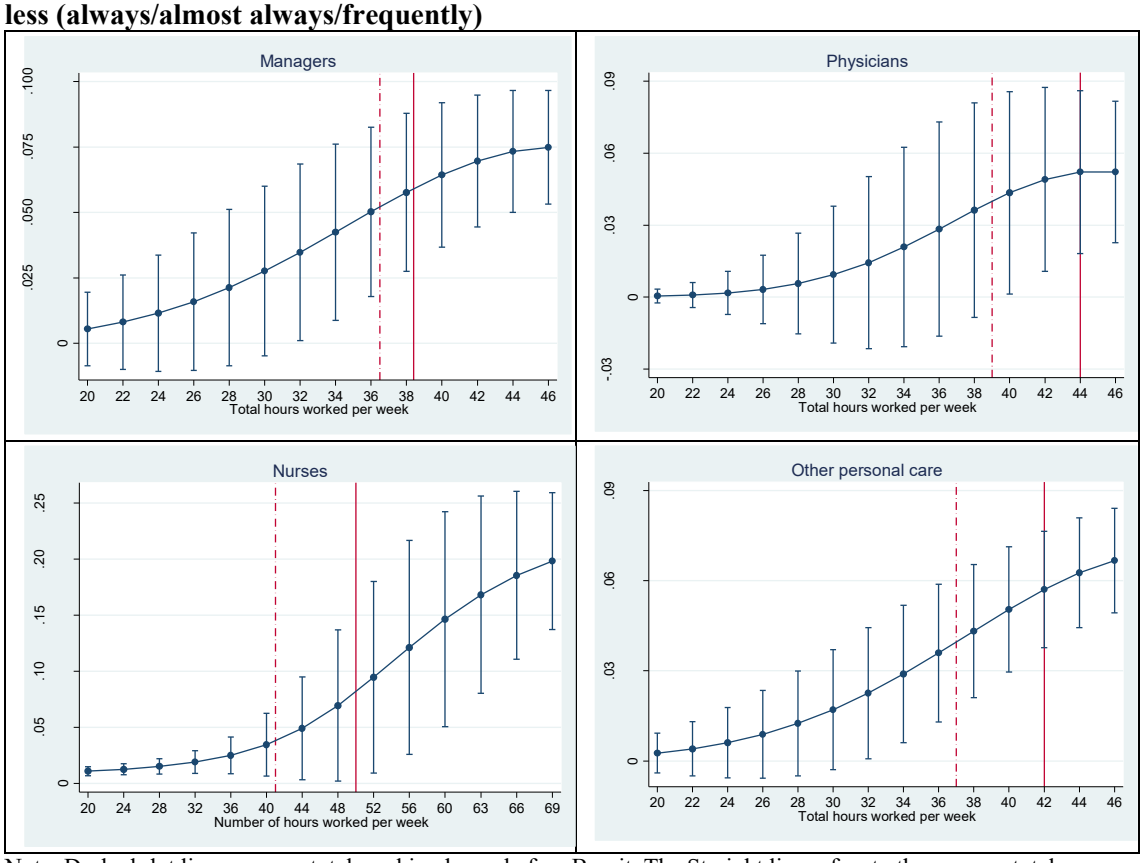
Source: Estimation results on Table C1. This figure shows the effect of the NHS_Employee*Post-Brexit interaction as a function of the worker's nationality (UK, European Union, Overseas) on job satisfaction. For a better visualization of the results, we show the percentage that the estimated coefficient represents with respect to average satisfaction for each of the groups considered.

Figure 4. Heterogeneity Effect of `Brexit on total paid working hours



Source: Estimation results on Table C2. This figure shows the effect of the NHS_Employee*Post-Brexit interaction as a function of the worker's nationality (UK, European Union, Overseas) on total paid working hours. For a better visualization of the results, we show the percentage that the estimated coefficient represents with respect to average paid working hours for each of the groups considered.

Figure 5. Effect of total working hours on the probability of feeling that has accomplished less (always/almost always/frequently)



Note: Dashed-dot line: average total working hours before Brexit. The Straight line refers to the average total working hours after Brexit. The estimated probability is obtained from a regression of has accomplished less (always/almost always/frequently) on the total number of hours interacted with Brexit and a vector of sociodemofigureic characteristics.

Table 1. Difference-in-difference model.

	NHS employee_Treat. vs. Control group	Managers vs. Control group	Physicians vs. Control group	Nurses vs. control group	Other personal care prof. vs control group
Job satisfaction					
NHS employee	0.0810	0.026	0.221**	0.089	0.010
	(0.081)	(0.123)	(0.099)	(0.091)	(0.095)
Post-Brexit	0.145	0.016	0.050	0.147	0.100
	(0.379)	(0.351)	(0.311)	(0.376)	(0.394)
NHS employee*Post-Brexit	-0.072***	-0.107***	-0.244***	-0.128***	-0.121***
	(0.016)	(0.048)	(0.082)	(0.045)	(0.046)
Average satisfaction	**5.175**	**5.321**	**5.397**	**5.301**	**5.050**
% with respect to average	**-1.393**	**-2.020**	**-2.661**	**-2.424**	**-2.405**
N	6,071	1,224	1,504	2,924	2,642
R2	0.3184	0.3427	0.3436	0.3129	0.3504
F	39.911	38.753	20.901	33.272	49.343
p	0.000	0.000	0.000	0.000	0.000
Total paid working hours per week					
NHS employee	0.827*	1.321*	4.174***	0.174	-0.247
	(0.475)	(0.786)	(0.734)	(0.475)	(0.590)
Post-Brexit	-1.729	-2.009	-1.213	-1.783	-1.837
	(0.464)	0.641)	(0.295)	(0.170)	(0.689)
NHS employee*Post-Brexit	1.750***	0.774***	2.076***	1.884***	1.530***
	(0.595)	(0.125)	(0.210)	(0.410)	(0.125)
Average working hours	**36.378**	**36.267**	**34.524**	**40.747**	**35.942**
% with respect to average	**4.811**	**2.134**	**6.012**	**4.623**	**4.258**
N	6,071	1,224	1,504	2,924	2,642
R2	0.418	0.455	0.407	0.420	0.497
F	58.272	50.757	20.267	28.743	20.720
p	0.000	0.000	0.000	0.000	0.000
Works unpaid extra hours					
NHS employee	0.056***	0.013	0.055***	0.095***	0.082***
	(0.012)	(0.271)	(0.015)	(0.011)	(0.017)
Post-Brexit	0.048	0.073	0.041	0.049	0.065
	(0.170)	(0.152)	(0.167)	(0.168)	(0.167)
NHS employee*Post-Brexit	**0.260*** **	**0.136*** **	**0.355*** **	**0.666*** **	**0.240*** **
	(0.042)	**(0.047)**	**(0.057)**	**(0.061)**	**(0.048)**
N	6,071	1,224	1,504	2,924	2,642
R2	0.339	0.239	0.309	0.361	0.364
F	56.503	124.314	78.695	90.034	106.216
p	0.000	0.000	0.000	0.000	0.000
Number of extra unpaid working hours (per week)					
NHS employee	2.525***	0.265***	1.381***	5.142***	1.395***
	(0.561)	(0.134)	(0.593)	(1.772)	(0.374)
Post-Brexit	0.441	0.350	0.877	0.638	0.583
	(3.949)	(6.394)	(2.357)	(2.594)	(2.904)
NHS employee*Post-Brexit	**2.468*** **	**0.590*** **	**2.956*** **	**9.202*** **	**4.881*** **
	(1.039)	**(0.162)**	**(0.817)**	**(2.390)**	**(0.924)**
Average extra working hours	8.311	6.859	9.389	10.898	8.581
% with respect to average	29.695	8.609	31.485	84.439	56.879
N	6,071	1,224	1,504	2,924	2,642
R2	0.349	0.316	0.360	0.346	0.390
F	64.479	114.009	146.039	123.321	97.932
p	0.000	0.007	0.000	0.069	0.000

Note: All regressions include age, sex, citizenship, education, marital status, household size, number of adults, number of children and difficulties for paying bills/mortgage/council tax, number of employees, temporary worker, individual, month, year and region fixed effects. Standard deviation between parenthesis. Robust standard errors. ***, ** and * denote statistical significance at the 1%, 5% and 10% level.

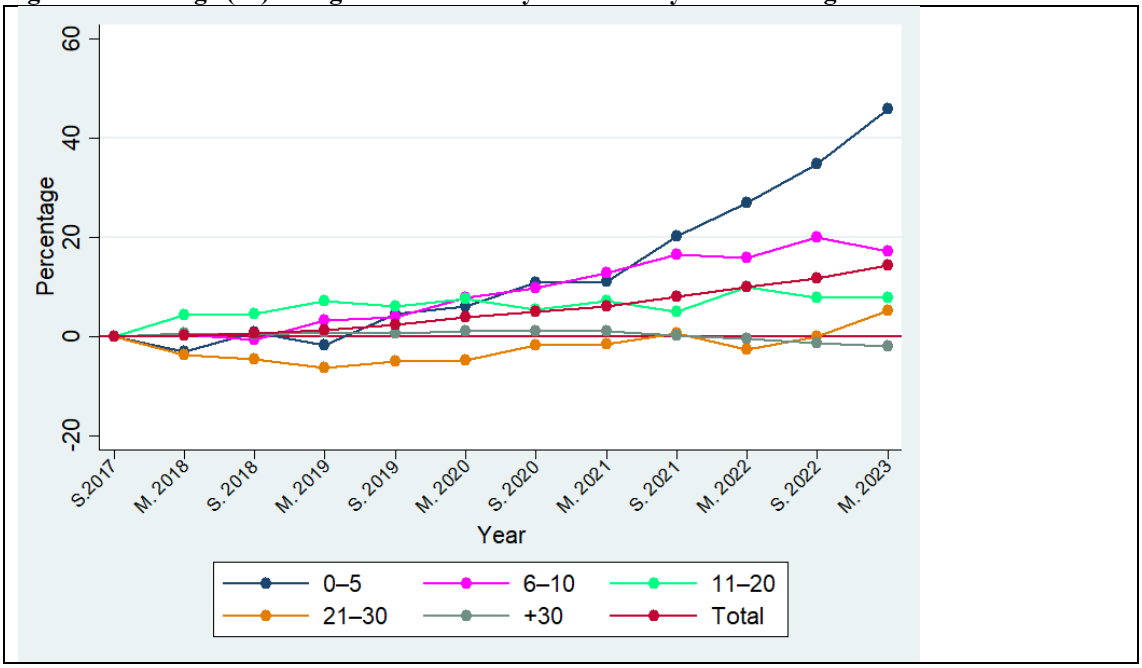
Table 2. Difference-in-difference-in difference model.

	NHS employee_Treatment vs. Control group	Managers vs. Control group	Physicians vs. Control group	Nurses vs. control group	Other personal care prof. vs control group
Job satisfaction					
Post-Brexit	0.31	0.30	0.30	0.32	-0.34
	(0.69)	(0.70)	(0.69)	(0.63)	(0.52)
NHS employee	2.44*	0.84*	2.44*	-0.31	0.61**
	(1.37)	(0.43)	(1.37)	(0.38)	(0.25)
UK*NHS employee*Post-Brexit	-0.13***	-0.17***	-0.24***	-0.22***	-0.10***
	(0.04)	(0.061)	(0.07)	(0.04)	(0.02)
% with respect to mean	**-2.62**	**-3.47**	**-4.76**	**-4.44**	**-1.94**
Overseas*NHS employee*Post-Brexit	0.162***	0.27***	0.06***	0.12***	0.003***
	(0.55)	(0.59)	(0.013)	(0.052)	(0.001)
% with respect to mean	**3.07**	**5.48**	**1.19**	**2.19**	**0.07**
N	6,071	1,224	1,504	2,924	2,642
R2	0.320	0.314	0.316	0.318	0.321
F	33.76	23.30	23.55	23.34	25.33
p	0.000	0.000	0.000	0.000	0.000
Weekly normal working hours					
Post-Brexit	0.23	0.22	0.21	-0.82	-4.37
	(4.43)	(4.45)	(4.44)	(4.01)	(3.49)
NHS employee	2.63	-1.87	2.58	-3.38	0.44
	(8.75)	(2.77)	(8.76)	(2.41)	(1.69)
UK*NHS employee*Post-Brexit	2.125***	1.762**	3.382***	1.884***	0.676***
	(0.581)	(0.862)	(0.984)	(0.456)	(0.281)
% with respect to mean	**5.626**	**4.718**	**7.934**	**5.328**	**1.856**
Overseas*NHS employee*Post-Brexit	0.583***	1.976***	0.381***	0.993***	0.592***
	(0.201)	(0.889)	(0.144)	(0.404)	(0.260)
% with respect to mean	**1.474**	**5.010**	**0.886**	**2.477**	**1.497**
N	6,071	1,224	1,504	2,924	2,642
R2	0.430	0.424	0.433	0.437	0.481
F	33.84	34.80	34.66	36.38	28.26
p	0.000	0.000	0.000	0.000	0.000
Works extra hours					
Post-Brexit	0.01	0.00	0.01	0.00	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)
NHS employee	0.07*	0.01	0.07*	0.08**	0.07**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
UK*NHS employee*Post-Brexit	**0.16*****	**0.07*****	**0.15*****	**0.22*****	**0.18*****
	(0.06)	(0.02)	(0.04)	(0.04)	(0.02)
Overseas*NHS employee*Post-Brexit	**0.15****	**0.05****	**0.11*****	**0.17*****	**0.08****
	(0.07)	(0.01)	(0.04)	(0.05)	(0.03)
N	6,071	1,224	1,504	2,924	2,642
R2	0.01	0.00	0.01	0.00	0.01
F	76.48	84.83	98.13	1055.28	112.78
p	0.000	0.000	0.000	0.000	0.000
Extra working hours (per week)					
Post-Brexit	0.67**	0.56	0.67**	0.55*	0.56*
	(0.34)	(0.35)	(0.33)	(0.32)	(0.30)
NHS employee	2.16***	1.12***	2.10***	1.99***	0.41
	(0.82)	(0.53)	(0.79)	(0.76)	(0.75)
UK*NHS employee*Post-Brexit	3.96***	2.76***	2.73**	2.36***	1.84***
	(1.44)	(1.06)	(1.09)	(0.83)	(0.56)
% with respect to mean	**47.24**	**25.04**	**34.71**	**36.85**	**19.90**
Overseas*NHS employee*Post-Brexit	4.01**	2.80**	2.86**	2.47**	1.89*
	(1.63)	(1.42)	(1.33)	(1.12)	(0.96)
% with respect to mean	**43.10**	**28.21**	**32.78**	**29.58**	**18.26**
N	5.157	690	970	2.390	2.108
R2	0.01	0.00	0.01	0.00	0.01
F	106.28	114.83	138.63	1065.28	112.78
p	0.000	0.000	0.000	0.000	0.000

Note: All regressions include age, sex, citizenship, education, marital status, household size, number of adults, number of children and difficulties for paying bills/mortgage/council tax, number of employees, temporary worker, individual, month, year and region fixed effects. Standard deviation between parenthesis. Robust standard errors. ***, ** and * denote statistical significance at the 1%, 5% and 10% level.

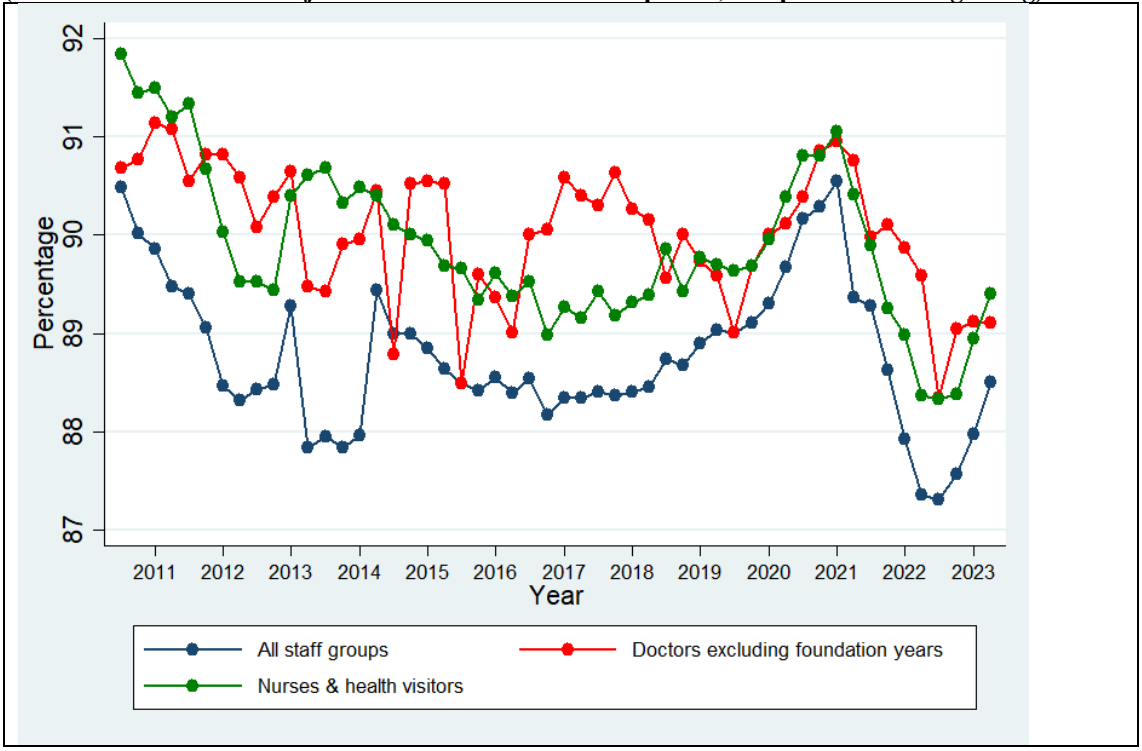
Appendix A

Figure A1. Change (%) in registered nurses by number of years since registration



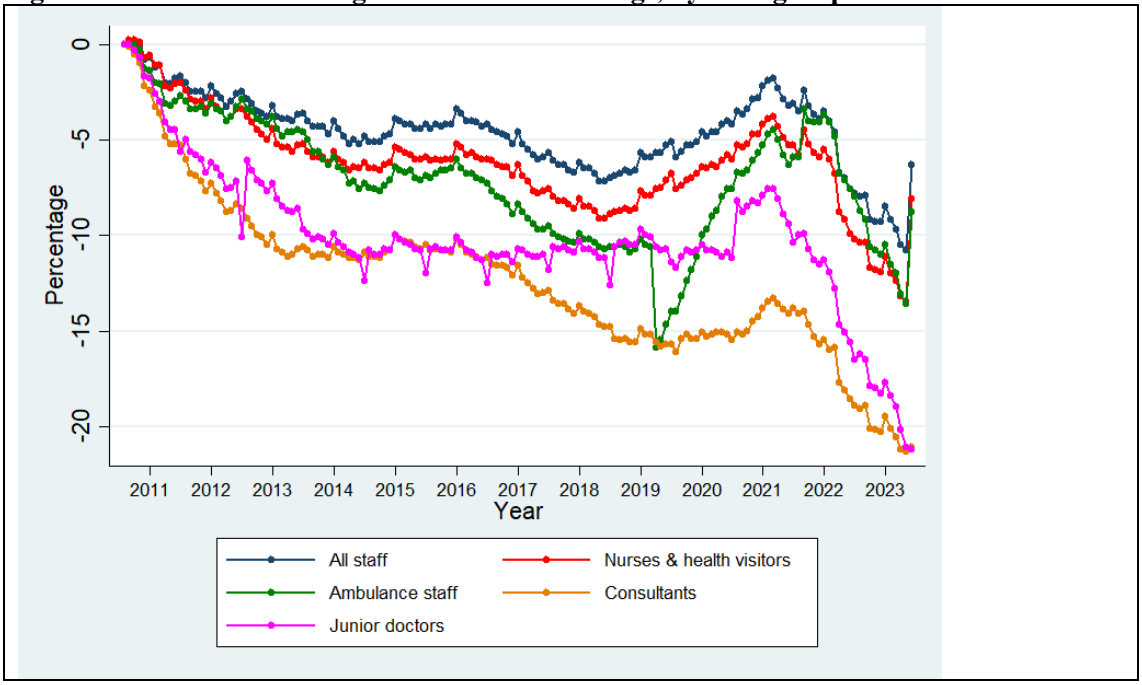
Source: own work using data from Performance Tracker 2023: Hospitals | Institute for Government

Figure A2. Rolling average of NHS staff staying in post over the previous 12 months, by staff group (% who remained in their jobs at the end of a 12-month period, compared to the beginning)



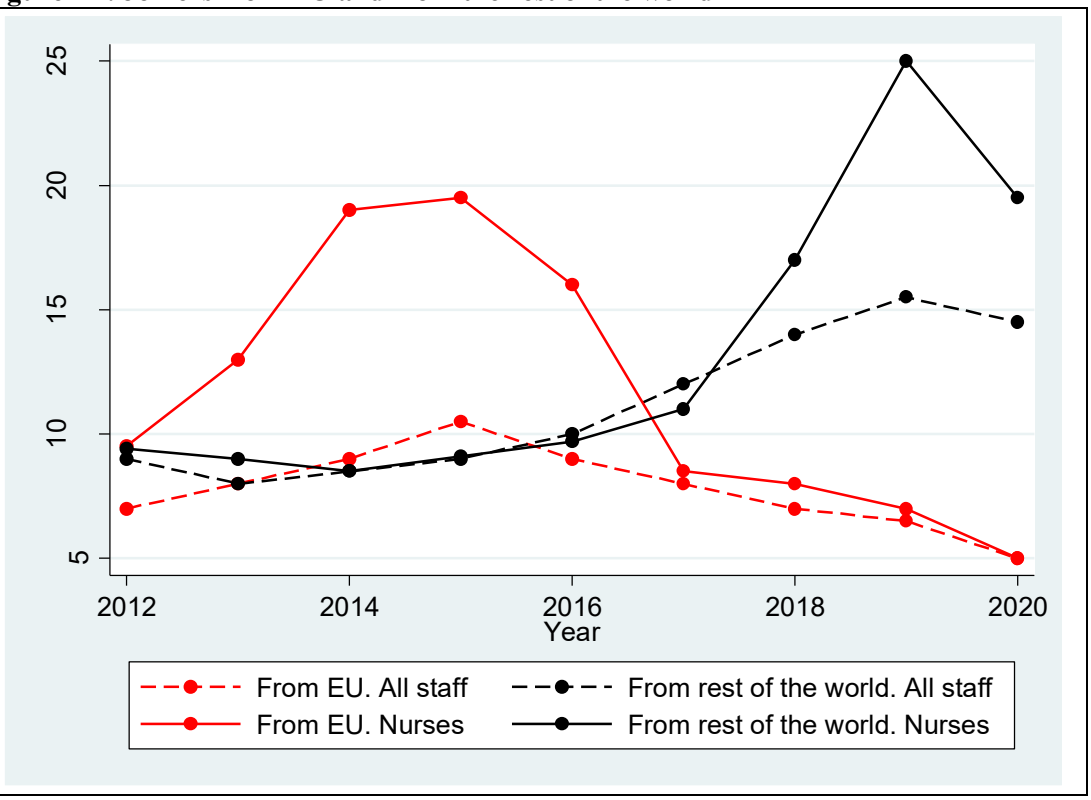
Source: own work using data from Performance Tracker 2023: Hospitals | Institute for Government

Figure A3. Real-terms change in NHS staff earnings, by staff group



Source: own work using data from Performance Tracker 2023: Hospitals | Institute for Government

Figure A4. Joiners from EU and from the rest of the world



Note: This figure reports the share of individuals joining the NHS from the EU and the rest of the world.
Source: Own work using NHS Digital, NHS Workforce Statistics (Turnover tables).

A5. Requirements for Working in the NHS After Brexit

Although the United Kingdom officially left the EU on January 31, 2020, it remained part of the European Common Market during the transition period. The free movement of workers, as established in the 1992 Maastricht Treaty, ended on January 1, 2021. From that date, all individuals seeking employment in the UK—including EU citizens—must obtain a visa and comply with the same immigration rules as non-EU nationals. However, EU citizens already residing in the UK before Brexit retained their pre-Brexit immigration rights under the EU Settlement Scheme (House of Commons Library, 2020).

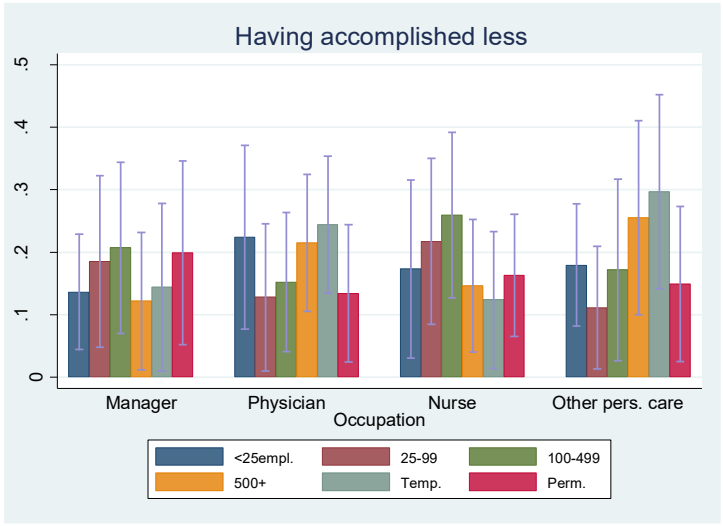
To work in the NHS as a doctor or nurse, candidates must:

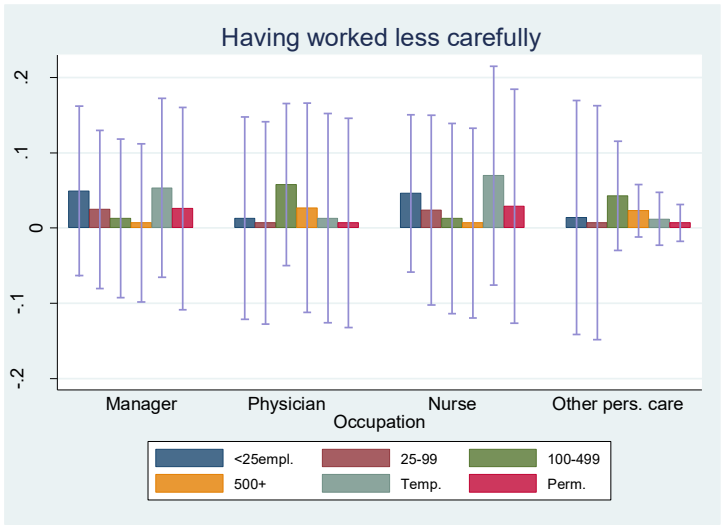
- Hold a recognized qualification from an accredited institution. Demonstrate English proficiency through either the IELTS or Occupational English Test (OET).
- Pass additional exams (for doctors and nurses):
- Doctors must pass the Professional and Linguistic Assessments Board (PLAB) exams: a multiple-choice test (PLAB1) and a structured clinical examination (OSCE). They must also register with the General Medical Council (GMC) and complete a specialist training program lasting 7–10 years.
- Nurses must pass a computer-based test (CBT) and a practical competency test (OSCE) before registering with the Nursing and Midwifery Council (NMC).

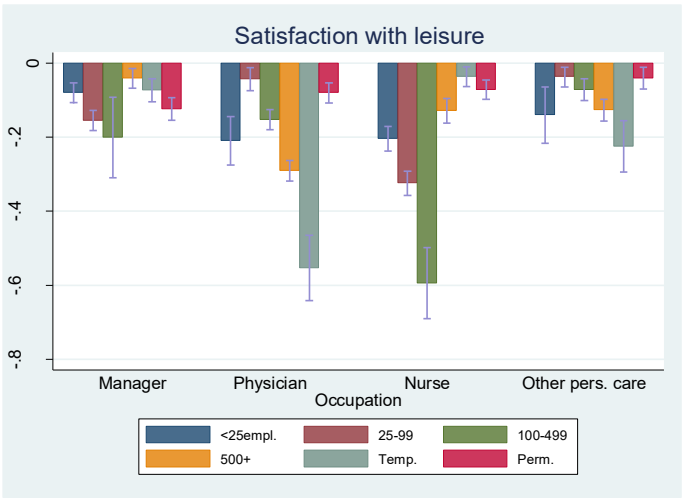
Brexit significantly impacted EU and EEA healthcare professionals, as they were previously exempt from passing the PLAB, CBT, and OSCE exams. Before January 2021, they only needed to submit an English language certificate (effective from January 2016 for EU-EEA nurses and June 2014 for EU-EEA doctors). Now, these exams are mandatory for all healthcare professionals, regardless of nationality.

Additionally, the European Working Time Directive (EWTD), which limits the average workweek to 48 hours and guarantees rest periods and paid leave, has applied to NHS staff since 1998 and doctors in training since 2004. However, NHS doctors can voluntarily opt out and receive additional compensation. Since Brexit, changes have been introduced regarding vacation pay calculations, accrual, and carryover. Nevertheless, the Brexit deal includes commitments to maintaining worker protections (Moberly, 2022).

Figure A5. Impact of post-Brexit over probability of having accomplished less work, having worked less carefully and being satisfied with leisure time

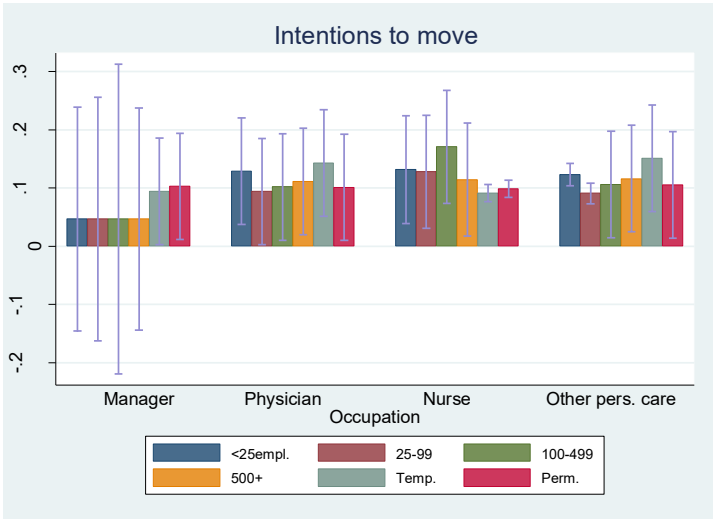


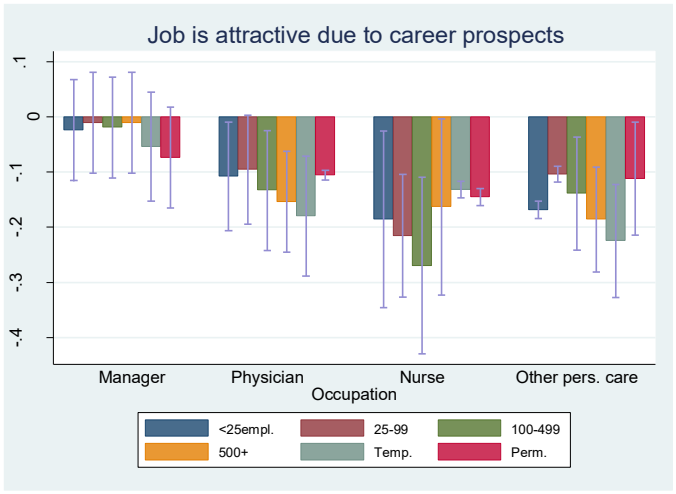


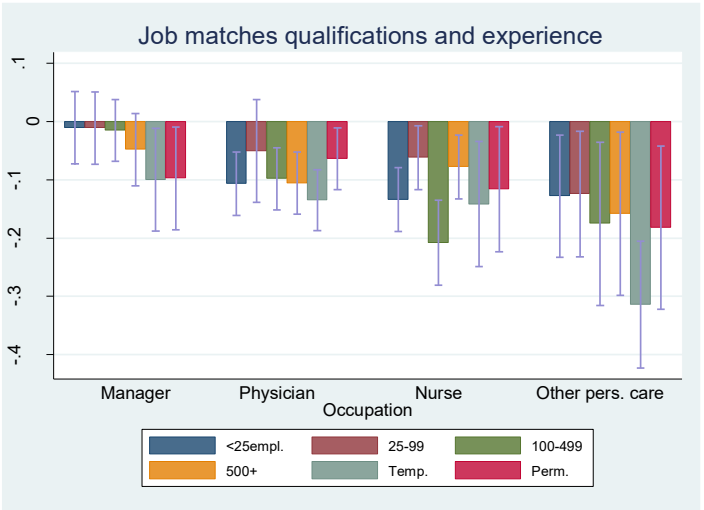


Note: Each figure shows the effect of the NHS-Employee*Post-Brexit interaction on the probability of having accomplished less at work, having worked less carefully and the probability of being satisfied with leisure time. For the three probabilities the effect is shown as a function of professional occupation, organization size and contract type. The vertical lines represent the 95% confidence interval.

Figure A7. Impact of post-Brexit over intentions to move, considering that job is attractive due to career prospects and considering that job matches employee's qualification and training

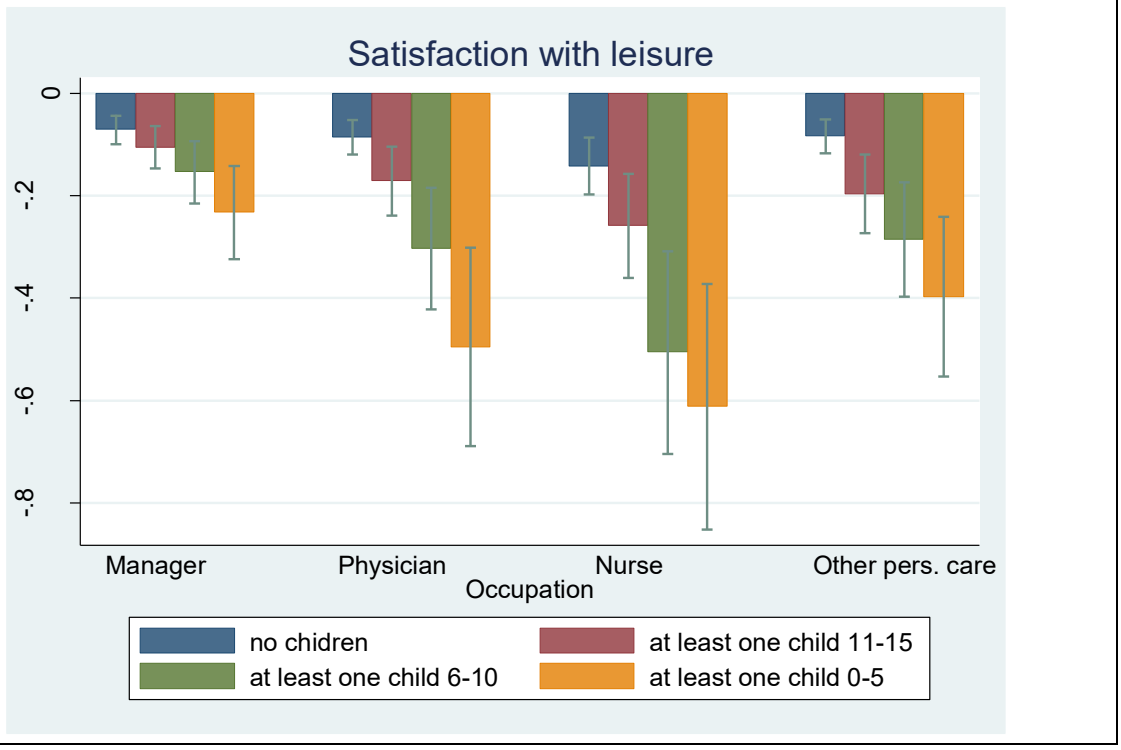






Note: Each figure shows the effect of the NHS-Employee*Post-Brexit interaction on the probability of wanting to move elsewhere in the UK, the probability of considering that the job is attractive due to career prospects and the probability of considering that the job matches qualifications and experience. For the three probabilities the effect is shown as a function of professional occupation, organization size and contract type. The vertical lines represent the 95% confidence interval.

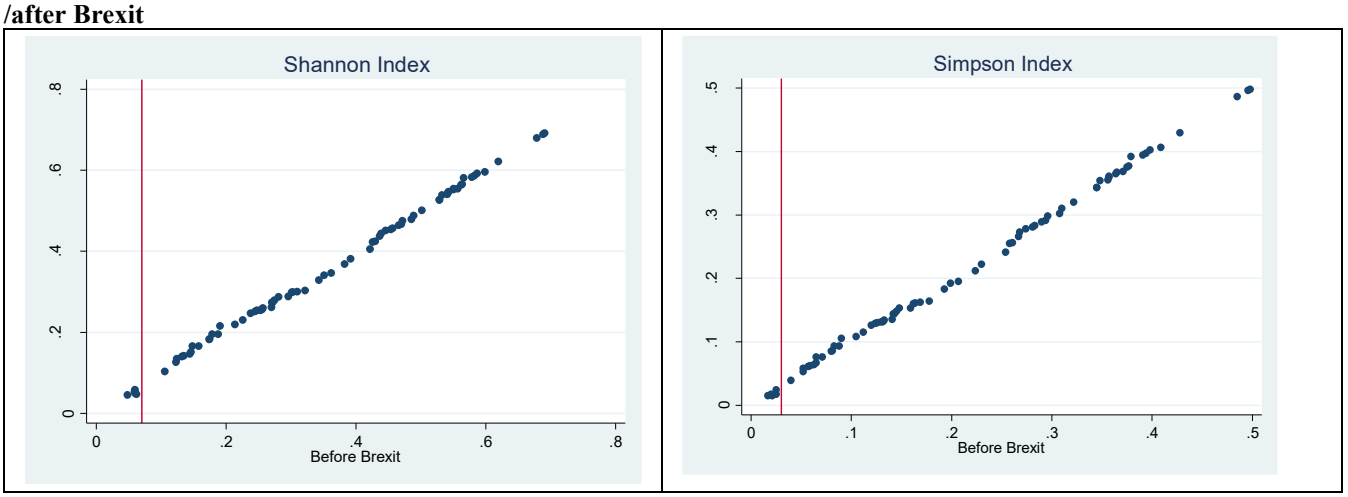
Figure A8. Leisure satisfaction by occupational group and age of children in the household



Nota: Each figure shows the effect of the NHS-Employee*Post-Brexit interaction on the probability of being satisfied with leisure time as a function of occupational occupation, whether or not one has children, and the age of one's children. The vertical lines represent the 95% confidence interval.

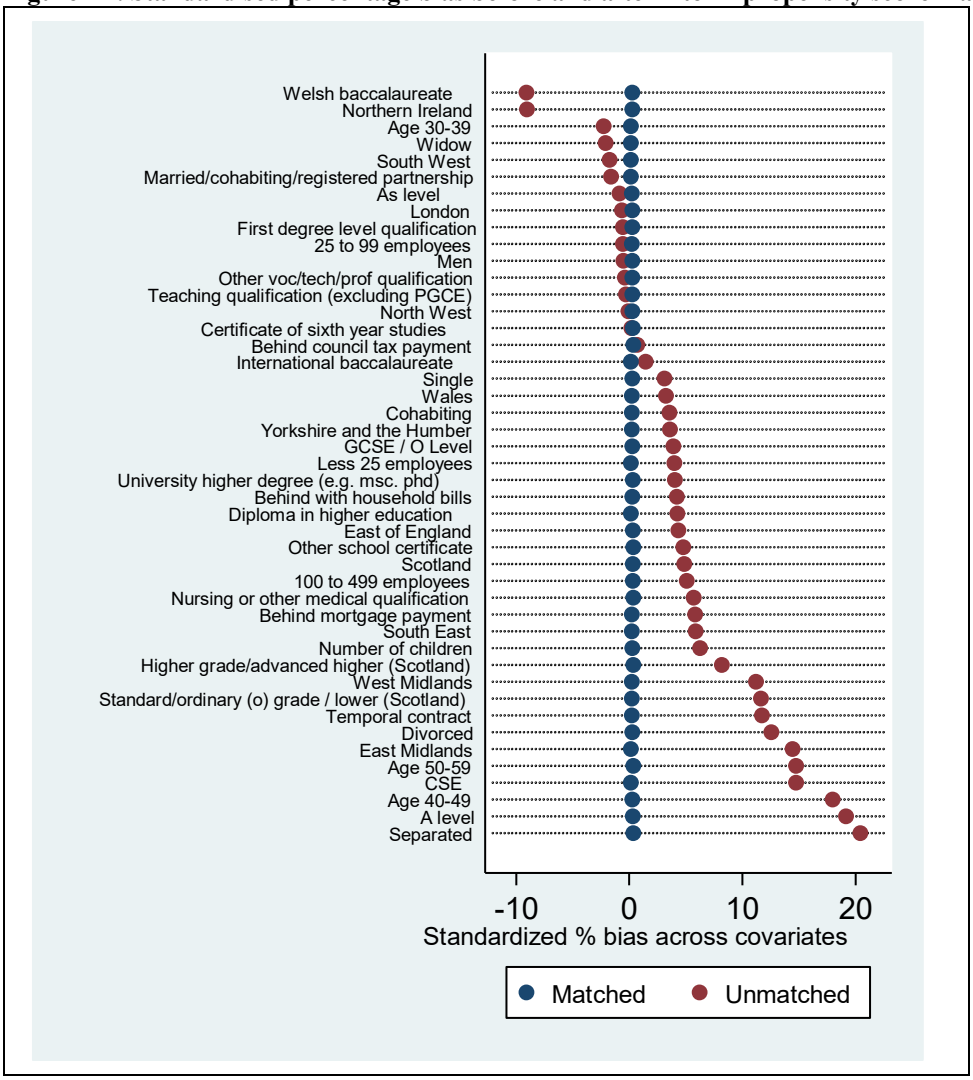
Appendix B

Figure B1. Scatter plot of Simpson index and Shannon Index for professional occupations, before /after Brexit



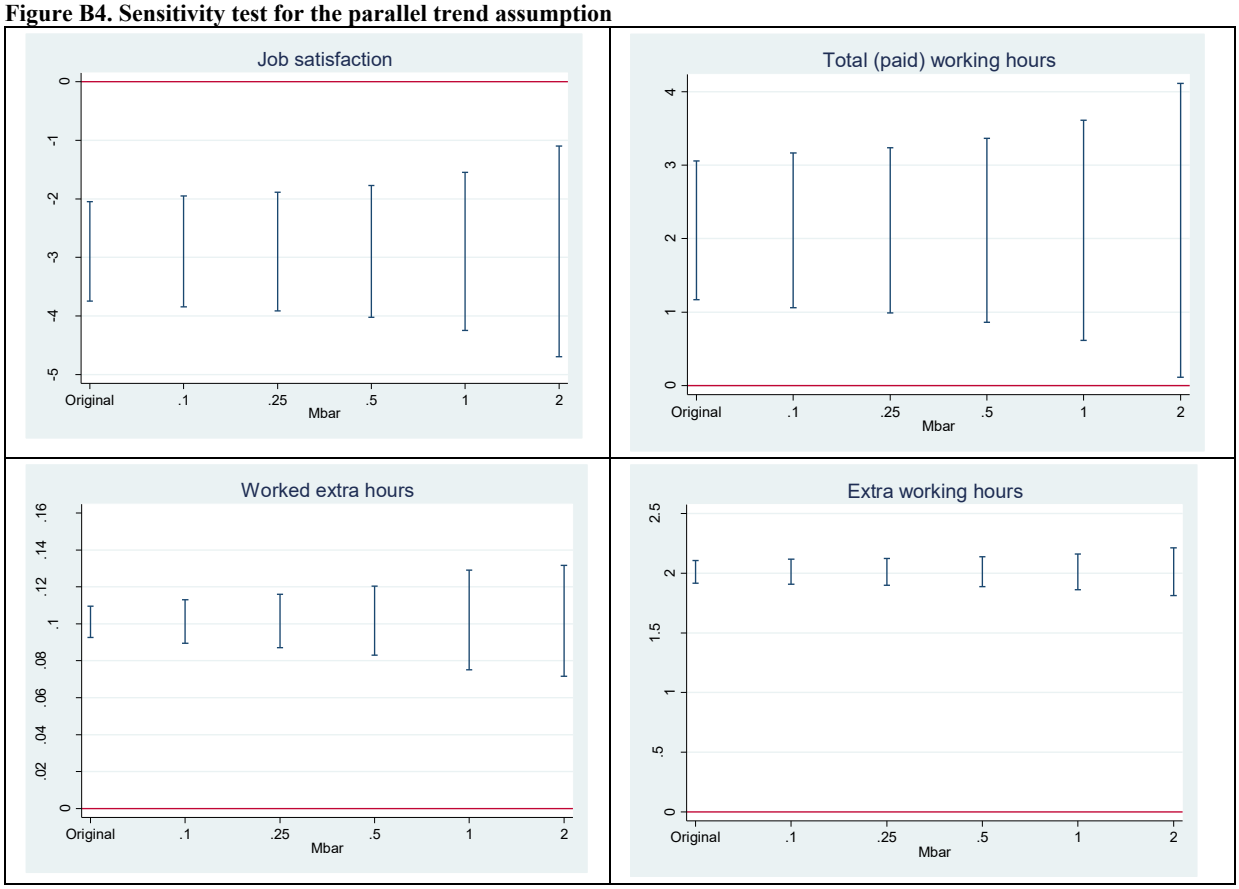
Note: The left figure presents a scatter plot of the Shannon Index, and the right figure displays a scatter plot of the Simpson Index for professional occupations before and after Brexit. Both indices measure occupational diversity, classified according to SOC2000 | HESA standards. A red vertical line marks the division between occupations included in the control group—comprising Animal Care Services, Conservation Associate Professionals, Legal Associate Professionals, Protective Service Officers, and Librarians—and all other occupations. Explicit values corresponding to these figures can be found in Table B1.

Figure B2. Standardised percentage bias before and after 1 to M propensity score matching



Comparison of control variables between NHS employee-treatment and control group before/after PSM (many (NHS-treatment) to 1 (control group).

Figure B4. Sensitivity test for the parallel trend assumption



Sensitivity analysis of the parallel trend assumption based on Rambachan and Roth (2023). The figure shows the original estimate and estimates sensitive to violations of the common post-Brexit trend equal to 01. 0.25, 0.5, 1, 1.5 and 2 times the maximum deviation observed in the pre-Brexit period

Table B1. Description of occupations in the treatment and control group

Treatment

118 **Health And Social Services Managers ➔ Managers**
1181 Hospital and health service managers
1182 Pharmacy managers
1183 Healthcare practice managers
1184 Social services managers
1185 Residential and day care managers

221 **Health Professionals ➔ Physicians and health care providers**
2211 Medical practitioners
2212 Psychologists
2213 Pharmacists/pharmacologists
2214 Ophthalmic opticians
2215 Dental practitioners

321 **Health Associate Professionals ➔ Nurses and related professionals**
3211 Nurses
3212 Midwives
3213 Paramedics
3214 Medical radiofigureers
3215 Chiropodists
3216 Dispensing opticians
3217 Pharmaceutical dispensers
3218 Medical and dental technicians

611 **Healthcare And Related Personal Services ➔ Other personal care professionals**
6111 Nursing auxiliaries and assistants
6112 Ambulance staff (excluding paramedics)
6113 Dental nurses
6114 Houseparents and residential wardens
6115 Care assistants and home carers

Control group: less than 1,5% of EU workers

117 **Protective Service Officers**
1171 Officers in armed forces
1172 Police officers (inspectors and above)
1173 Senior officers in fire, ambulance, prison and related services
1174 Security managers

245 **Librarians And Related Professionals**
2451 Librarians
2452 Archivists and curators

352 **Legal Associate Professionals**
3520 Legal associate professionals

355 **Conservation Associate Professionals**
3551 Conservation and environmental protection officers
3552 Countryside and park rangers

613 **Animal Care Services**
6131 Veterinary nurses and assistants
6139 Animal care occupations n.e.c.

Source: own work using Standard Occupational Classification: SOC2000 | HESA)

Table B2. Shannon index and Simpson index pre/post Brexit

		Pre-Brexit		Post-Brexit	
Code	**Description**	**Shannon**	**Simpson**	**Shannon**	**Simpson**
	Control group				
613	Animal care services	0.048	0.017	0.045	0.015
355	Conservation associate professionals	0.059	0.020	0.054	0.017
352	Legal associate professionals	0.060	0.021	0.050	0.015
117	Protective service officers	0.060	0.025	0.058	0.024
245	Librarians and related professionals	0.062	0.025	0.047	0.017
	Rest of occupations in ascending order of index value				
541	Textiles and garments trades	0.106	0.040	0.103	0.039
121	Managers in farming, horticulture, forestry and services	0.123	0.052	0.126	0,053
549	Skilled trades nec.	0.124	0.052	0.134	0,058
542	Printing trades	0.132	0.057	0.140	0,061
911	Elementary agricultural occupations	0.135	0.059	0.142	0,062
532	Building trades	0.144	0.063	0.146	0,064
341	Artistic and literary occupations	0.146	0.065	0.151	0,067
414	Administrative occupations: communications	0.148	0.065	0.166	0,076
312	Draughtspersons and building inspectors	0.158	0.071	0.166	0,076
344	Sports and fitness occupations	0.174	0.080	0.182	0,085
629	Personal services occupations nec	0.175	0.081	0.183	0,086
351	Transport associate professionals	0.179	0.083	0.195	0,093
521	Metal forming, welding and related trades	0.188	0.088	0.195	0,093
622	Hairdressers and related occupations	0.191	0.090	0.215	0,105
111	Corporate managers and senior officials	0.214	0.105	0.219	0,108
623	Housekeeping occupations	0.226	0.112	0.230	0,115
511	Agricultural trades	0.238	0.120	0.247	0,126
342	Design associate professionals	0.245	0.124	0.251	0,129
211	Science professionals	0.248	0.126	0.254	0,130
912	Elementary construction occupations	0.253	0.130	0.254	0,131
822	Mobile machine drivers and operatives	0.255	0.131	0.256	0,132
814	Construction operatives	0.256	0.132	0.257	0,132
925	Elementary sales occupations	0.257	0.133	0.260	0,134
322	Therapists	0.270	0.141	0.261	0,135
621	Leisure and travel service occupations	0.271	0.142	0.273	0,144
343	Media associate professionals	0.272	0.143	0.273	0,144
241	Legal professionals	0.275	0.145	0.279	0,148
712	Sales related occupations	0.281	0.148	0.287	0,153
243	Architects, town planners, surveyors	0.296	0.159	0.288	0,153
913	Elementary process plant occupations	0.301	0.162	0.298	0,160
114	Quality and customer care managers	0.303	0.164	0.299	0,161
232	Research professionals	0.310	0.169	0.300	0,162
523	Vehicle trades	0.322	0.178	0.303	0,164
244	Public service professionals	0.343	0.193	0.329	0,183
812	Plant and machine operatives	0.351	0.199	0.341	0,192
921	Elementary administration occupations	0.362	0.207	0.346	0,195
313	It service delivery occupations	0.383	0.224	0.368	0,212
122	Managers and proprietors in hospitality and leisure services	0.392	0.230	0.381	0,222
924	Elementary security occupations	0.422	0.254	0.405	0,241
311	Science and engineering technicians	0.426	0.258	0.423	0,255
543	Food preparation trades	0.430	0.261	0.424	0,256
531	Construction trades	0.437	0.267	0.437	0,266
811	Process operatives	0.439	0.268	0.444	0,273
813	Assemblers and routine operatives	0.446	0.274	0.451	0,278
522	Metal machining, fitting and instrument making trades	0.454	0.281	0.454	0,281
242	Business and statistical professionals	0.457	0.283	0.457	0,283
914	Elementary goods storage occupations	0.466	0.290	0.464	0,289
212	Engineering professionals	0.470	0.294	0.467	0,291
323	Social welfare associate professionals	0.472	0.296	0.475	0,298
331	Protective service occupations	0.486	0.308	0.479	0,302
524	Electrical trades	0.489	0.310	0.488	0,310
123	Managers and proprietors in other service industries	0.502	0.322	0.501	0,320
115	Financial institution and office managers	0.529	0.345	0.527	0,343
721	Customer service occupations	0.529	0.345	0.527	0,343
411	Administrative occupations: government and related organisations	0.533	0.348	0.539	0,354
923	Elementary cleaning occupations	0.541	0.356	0.540	0,355
356	Public service and other associate professionals	0.542	0.357	0.545	0,359
354	Sales and related associate professionals	0.543	0.357	0.547	0,361
116	Managers in distribution, storage and retailing	0.551	0.365	0.554	0,367
413	Administrative occupations: records	0.551	0.364	0.552	0,365
922	Elementary personal services occupations	0.557	0.371	0.554	0,368
421	Secretarial and related occupations	0.562	0.375	0.563	0,375

213	Information and communication technology professionals	0.564	0.377	0.565	0,377
353	Business and finance associate professionals	0.566	0.379	0.581	0,392
112	Production managers	0.579	0.391	0.583	0,394
821	Transport drivers and operatives	0.583	0.394	0.586	0,397
415	Administrative occupations: general	0.587	0.398	0.592	0,402
612	Childcare and related personal services	0.599	0.409	0.596	0,406
412	Administrative occupations: finance	0.620	0.428	0.621	0,429
711	Sales assistants and retail cashiers	0.679	0.485	0.679	0,486
113	Functional managers	0.689	0.496	0.689	0,496
231	Teaching professionals	0.691	0.498	0.691	0,498

Source: own work using Understanding Society and Standard Occupational Classification: SOC2000 | HESA)

Table B3. Results of different PSM techniques

	Mean bias	Median bias	Rubin's R	Rubin's B
1 to 1	2.939	2.838	14.290	0.912
1 to many	1.520	1.216	9.526	0.902
Mahalanobis	2.838	2.027	16.722	0.953
Kernel	1.622	1.115	9.932	0.983
Inverse probability weighting	2.736	2.736	14.796	1.034
Local linear regression	3.952	2.331	26.046	1.115
Spline	3.243	2.331	21.283	1.084

Note: This table presents Rubin's B and Rubin's R as measures of balance in propensity score matching. Rubin's B calculates the absolute standardized difference of the means of the linear index of the propensity score between the treated and (matched) non-treated groups, while Rubin's R shows the ratio of the variances of the propensity score index between these groups. A sample is considered sufficiently balanced if Rubin's B is less than 25 and Rubin's R falls between 0.5 and 2.

Table B4. Description of the sample

	Waves									Total	%
NHS employee-Treatment	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		
Managers	38	65	59	69	57	53	59	45	38	483	**9.06**
Physicians and health care providers	74	80	73	90	94	87	73	98	94	763	**14.32**
Nurses and related professionals	219	278	268	250	250	218	268	223	209	2183	**40.96**
Other personal care professionals	185	258	235	217	208	218	235	182	163	1901	**35.67**
Total	**516**	**681**	**635**	**626**	**609**	**576**	**635**	**548**	**504**	**5330**	**100.00**
Control group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**		%
Protective service officers	21	24	27	31	29	17	27	17	12	205	**27.67**
Librarians and related professionals	10	15	15	14	8	8	15	11	10	106	**14.30**
Legal associate professionals	12	32	26	26	31	23	26	31	29	236	**31.85**
Conservation associate professionals	12	12	8	10	12	9	8	18	9	98	**13.23**
Animal care services	7	16	9	5	11	8	9	13	18	96	**12.96**
Total	**62**	**99**	**85**	**86**	**91**	**65**	**85**	**90**	**78**	**741**	**100,00**

Source: own work using Understanding Society (waves 1 to 9).
Wave 1: 8th January 2009 - 7th March 2011
Wave 2: 12th January 2010 – 27th March 2012
Wave 3: 7th January 2011 – 12th July 2013
Wave 4: 8th January 2012 – 19th June 2013
Wave 5: 8th January 2013 – 5th June 2015
Wave 6: 8th January 2014 – 11th May 2016
Wave 7: 14th January 2015 – 15th May 2017
Wave 8: 5th January 2016 - 10th May 2018
Wave 9: 5th January 2017 – 24th May 2019

Table B4. Descriptive statistics after PSM

	Control group	NHS employee Treatment
N	741	5,330
Men	23.40	21.53
Women	76.60	78.47
Age 20-29	20.84	22.21
Age 30-39	17.58	18.40
Age 40-49	25.50	21.78
Age 50-59	36.09	37.61
Highest level of education		
University higher degree (e.g. msc, phd)	37.31	38.18
First degree level qualification	17.70	20.80
Diploma in higher education	9.03	10.25
Teaching qualification (excluding PGCE)	0.96	0.49
Nursing or other medical qualification	11.55	9.94
A level	0.19	0.43
Welsh baccalaureate	3.84	4.79
International baccalaureate	0.00	0.00
As level	0.12	0.12
Higher grade/advanced higher (Scotland)	0.55	0.61
Certificate of sixth year studies	0.55	0.55
GCSE / O Level	0.31	0.37
CSE	10.53	10.74
Standard/ordinary (o) grade / lower (Scotland)	3.85	3.68
Other school certificate	0.96	0.61
Other voc/tech/prof qualification	0.65	0.12
None of the above	1.90	1.42
Household size	2.67	2.80
	(1.26)	(1.36
Number of adults	2.39	2.41
	(1.01)	(1.04)
Number of children	0.32	0.39
	(0.72)	(0.58)
Marital status		
Married/cohabiting/registered partnership	55.63	53.25
Cohabiting	53.06	50.98
Separated	2.31	1.90
Divorced	10.01	8.47
Single	32.65	36.99
Widow	0.61	0.61
Missing marital status	0.31	0.12
Financial situation		
Behind mortgage payment	8.16	6.20
Behind council tax payment	6.55	5.21
Behind with household bills	4.32	3.99
Type of contract		
Temporal contract	5.30	5.03
Permanent contract	94.70	94.97
Number of employees		
Less 25 employees	30.88	30.18
25 to 99 employees	28.51	26.32
100 to 499 employees	10.93	10.67
500 + employees	28.94	32.32
Missing	0.76	0.49
Region		
North East	4.89	4.72
North West	10.19	11.72
Yorkshire and the Humber	6.75	8.47
East Midlands	7.15	7.18
West Midlands	8.23	9.14
East of England	8.04	7.61
London	11.37	13.74
South East	9.45	9.82
South West	8.49	8.04
Wales	7.39	6.32
Scotland	10.47	8.59
Northern Ireland	7.58	4.66
Supports any political party		
Yes	47.76	43.06
No	52.24	56.94
Political support (if 'yes' to previous question)		
Left-wing	11.18	7.98
Centre-left to left-wing	2.73	5.04
Centre-left	47.59	55.46

Centre to centre-left	13.26	8.82
Centre-right	22.37	17.23
Right-wing	0.91	0.42
Right-wing to far-right	1.69	4.62
Far-right	0.26	0.42

Source: Own work using Understanding Society (waves 1 to 9), with sample weights applied, and standard deviation in parentheses. The pre-Brexit period is defined as 2009 to 23rd June 2016, while the post-Brexit period spans from 24th June 2016 to 2019. Political affiliations are categorized as follows: Left-wing (Green Party); Centre-left to left-wing (Sinn Féin, Plaid Cymru); Centre-left (Labour, Scottish National Party, Social Democratic and Labour Party); Centre to centre-left (Liberal Democrats, Alliance Party); Centre-right (Conservative, Ulster Unionist); Right-wing (Democratic Unionist Party); Right-wing to far-right (UK Independence Party); and Far-right (British National Party).

Table B5. Distribution by citizenship (%)

	PRE-BREXIT			POST-BREXIT		
	UK	**NoUK-EU**	**Overseas**	**UK**	**NoUK-EU**	**Overseas**
NHS employee-Treatment						
Managers	82.35	3.43	14.22	89,33	2,67	8,00
Physicians and health care providers	53.82	7.13	39.05	62,64	2,87	34,48
Nurses and related professionals	81.24	4.75	14.02	69,81	6,47	23,72
Other personal care professionals	82.11	2.37	15.52	76,77	3,03	20,20
Total	78.00	4.08	17.92	72,30	4,36	23,34
	UK	**NoUK-EU**	**Overseas**	**UK**	**NoUK-EU**	**Overseas**
Control group						
Protective service officers	94.41	0.00	5.59	96,15	0,00	3,85
Librarians and related professionals	89.77	0.00	10.23	83,33	0,00	16,67
Legal associate professionals	75.69	1.10	23.20	60,00	1,42	38,58
Conservation associate professionals	96.10	0.00	3.90	100,00	0,00	0,00
Animal care services	100.00	0.00	0.00	100,00	0,00	0,00
Total	88.91	0.34	10.76	82,19	0,48	17,32

Source: Own work using Understanding Society (waves 1 to 9). The groups are defined as follows: **UK** refers to individuals born in the UK; **NoUK_EU** includes immigrants from European Union countries (without UK citizenship); **Overseas** refers to immigrants from countries outside the European Union (without UK citizenship). The **Pre-Brexit period** is defined as from 2009 to 23rd June 2016.

Table B6. Distribution of NoUK-NoEU by country of birth

	PRE-BREXIT	POST-BREXIT
NHS employee-Treatment		
Turkey	0.1	0.0
Australia	0.3	0.0
Canada	0.1	0.0
United States	0.1	0.0
Caribbean	15.2	14.8
South America	0.8	0.0
Asia	58.1	63.0
Africa	26.5	22.6
Total	100.0	100.0
Control group		
Turkey	0.0	0.0
Australia	0.0	0.0
Canada	0.0	0.0
United States	0.0	0.0
Caribbean	14.3	7.7
South America	3.2	0.0
Asia	74.6	84.6
Africa	9.5	7.7
Total	100.0	100.0

Source: own work using Understanding Society (waves 1 to 9).
Pre-Brexit period: from 2009 to 23th June 2016.

Table B7. Job satisfaction before/after Brexit by occupation and citizenship

	PRE-BREXIT				POST-BREXIT				Variation (%)			
	Total	**UK**	**NoUK-EU**	**Overseas**	**Total**	**UK**	**NoUK-EU**	**Overseas**	**Total**	**UK**	**NoUK-EU**	**Overseas**
Job satisfaction												
NHS employee-												
Treatment	5.3	5.3	5.3	5	5.2	5.1	5.2	5.2	-1.33%	-3.59%	-2.61%	4.00%
	(1.46)	(1.49)	(1.40)	(1.33)	(1.36)	(1.35)	(1.39)	(1.32)				
Control group	5.4	5.4	4.5	5.1	5.5	5.6	4.8	4.4	2.24%	2.59%	6.67%	-13.73%
	(1.44)	(1.43)	(1.31)	(1.47)	(1.54)	(1.57)	(1.31)	(1.20)				
Total paid working hours												
NHS employee-												
Treatment	37.1	36.4	36.5	38.4	38.9	38.5	38.1	40.1	4.90%	5.76%	4.38%	4.43%
	(7.14)	(7.01)	(7.41)	(7.84)	(7.63)	(7.70)	(7.48)	(7.87)				
Control group	36.2	36.1	36.6	36.4	36.6	36.5	36.5	36.9	1.10%	-1.37%	1.39%	1.37%
	(7.22)	(7.29)	(7.94)	(7.08)	(6.77)	(6.65)	(7.97)	(8.70)				
Working unpaid extra hours (%)												
NHS employee-												
Treatment	50.3	41.2	55.9	60.3	64.5	65.4	60.2	64.6	28.23%	58.74%	7.69%	7.13%
	(6.18)	(5.19)	(6.79)	(7.15)	(6.09)	(6.61)	(5.96)	(6.10)				
Control group	47.2	46.9	47.2	47.3	46.5	46.3	46.1	47.1	-1.48%	-1.28%	-2.33%	-0.63%
	(4.63)	(4.79)	(4.38)	(4.31)	(5.39)	(5.76)	(5.47)	(5.33)				
Number of unpaid extra working hours												
NHS employee-												
Treatment	8.3	8.1	8.4	8.6	10.8	10.1	10.3	10.8	30.12%	24.69%	22.62%	25.58%
	(3.37)	(4.01)	(3.07)	(2.91)	(3.42)	(3.15)	(3.49)	(3.41)				
Control group	5.2	5	5.5	5.6	4.4	4.1	4.3	4.5	-15.38%	-18.00%	-21.82%	-19.64%
	(1.12)	(1.09)	(1.19)	(1.21)	(1.45)	(1.36)	(1.43)	(1.47)				

Source: Own work using Understanding Society (waves 1 to 9). The groups are defined as follows: **UK** refers to individuals born in the UK; **NoUK_EU** includes immigrants from European Union countries (without UK citizenship); **Overseas** refers to immigrants from countries outside the European Union (without UK citizenship). The **Pre-Brexit period** spans from 2009 to 23rd June 2016.

Appendix C

Table C1. Difference-in-difference model for job satisfaction. Heterogeneity

	Men	**Women**	**20-29 years**	**30-39 years**	**40-49 years**
UK*NHS employee*Post-Brexit	-0.351***	-0.210***	-0.066***	-0.032***	-0.128***
	(0.104)	(0.047)	(0.020)	(0.011)	(0.037)
Mean satisfaction	**5.335**	**5.380**	**5.517**	**5.355**	**5.365**
% variation with respect to mean	**-6.579**	**-3.903**	**-1.196**	**-0.598**	**-2.386**
Overseas*NHS employee*Post-Brexit	0.112***	0.312***	0.520***	0.119***	0.329***
	(0.024)	(0.111)	(0.171)	(0.050)	(0.115)
Mean satisfaction	**5.336**	**5.310**	**5.440**	**5.600**	**5.216**
% variation with respect to mean	**2.099**	**5.876**	**9.558**	**2.125**	**6.307**
N	26531	22072	12135	10329	12203
R2	0.323	0.319	0.320	0.3332	0.326
F	22.837	26.106	22.069	23.737	24.028
p	0.000	0.000	0.000	0.000	0.000
	50-59 years	**Region: Leave EU**	**Region: Remain EU**	**Permanent contract**	**Temporary contract**
UK*NHS employee*Post-Brexit	-0.414***	-0.286***	-0.105***	-0.449***	-0.211***
	(0.127)	(0.082)	(0.037)	(0.103)	(0.069)
Mean satisfaction	**5.318**	**5.384**	**5.369**	**5.690**	**5.357**
% variation with respect to mean	**-7.785**	**-5.312**	**-1.956**	**-7.891**	**-3.939**
Overseas*NHS employee*Post-Brexit	0.067***	0.043***	0.375***	0.320***	0.113***
	(0.028)	(0.017)	(0.083)	(0.140)	(0.037)
Mean satisfaction	**5.056**	**5.271**	**5.327**	**5.086**	**5.347**
% variation with respect to mean	**1.325**	**0.816**	**7.040**	**6.292**	**2.113**
N	13936	1379	47224	2574	46029
R2	0.314	0.378	0.312	0.325	0.311
F	22.929	21.133	24.392	22.686	24.064
p	0.000	0.000	0.000	0.000	0.000
	<25 employees	**25-99 employees**	**100-499 employees**	**>499 employees**	**No children**
UK*NHS employee*Post-Brexit	-0.022***	-0.669***	-0.119***	-0.490***	-0.100***
	(0.009)	(0.144)	(0.051)	(0.136)	(0.038)
Mean satisfaction	**5.381**	**5.365**	**5.227**	**5.310**	**5.367**
% variation with respect to mean	**-0.409**	**-12.470**	**-2.277**	**-9.228**	**-1.863**
Overseas*NHS employee*Post-Brexit	0.115***	0.151***	0.187***	0.494***	0.383***
	(0.08)	(0.078)	(0.085)	(0.162)	(0.086)
Mean satisfaction	**5.266**	**5.301**	**5.260**	**4.798**	**5.293**
% variation with respect to mean	**2.184**	**2.849**	**3.555**	**10.295**	**7.236**
N	14288	12860	11197	3493	46953
R2	0.222	0.233	0.221	0.292	0.213
F	22.045	23.023	21.234	23.266	25.081
p	0.000	0.000	0.000	0.000	0.000
	1 child	**>1 children**	**Left-wing**	**Right-wing**	**Did not vote**
UK*NHS employee*Post-Brexit	-0.211***	-0.389***	-0.300***	-0.543***	-0.479***
	(0.047)	(0.123)	(0.109)	(0.113)	(0.075)
Mean satisfaction	**5.960**	**5.385**	**5.367**	**5.393**	**5.391**
% variation with respect to mean	**-3.523**	**-7.224**	**-5.590**	**-10.069**	**-8.886**
Overseas*NHS employee*Post-Brexit	0.089***	0.042***	0.269***	0.025***	0.097***
	(0.22)	(0.011)	(0.107)	(0.005)	(0.010)
Mean satisfaction	**5.875**	**5.724**	**5.412**	**5.400**	**5.038**
% variation with respect to mean	**1.515**	**0.734**	**4.970**	**0.463**	**1.925**
N	805	845	7660	3065	9923
R2	0.354	0.378	0.344	0.303	0.305
F	21.196	21.427	23.030	21.260	25.653
p	0.000	0.000	0.000	0.000	0.000

Standard deviation between parenthesis. Robust standard errors. ***, ** and * denote statistical significance at the 1%, 5% and 10% level.

Table C2. Difference-in-difference model for working hours. Heterogeneity

	Men	**Women**	**20-29 years**	**30-39 years**	**40-49 years**
UK*NHS employee*Post-Brexit	2.891***	1.557***	6.323***	3.869***	0.213***
	(0.419)	(0.226)	(0.476)	(0.446)	(0.090)
Mean working hours	**40.22**	**35.39**	**39.81**	**38.91**	**36.28**
% variation with respect to mean	**7.185**	**4.400**	**15.884**	**9.943**	**0.587**
Overseas*NHS employee*Post-Brexit	1.421***	0.844***	1.631***	0.895***	0.411***
	(0.422)	(0.205)	(0.259)	(0.277)	(0.135)
Mean working hours	**42.70**	**38.20**	**40.91**	**40.79**	**40.16**
% variation with respect to mean	**3.328**	**2.209**	**3.985**	**2.194**	**1.021**
N	26531	22072	12135	10329	12203
R2	0.311	0.360	0.362	0.359	0.311
F	35.297	176.133	133.476	108.586	253.302
p	0.000	0.000	0.000	0.000	0.000
	50-59 years	**Region: Leave EU**	**Region: Reman EU**	**Permanent contract**	**Temporary contract**
UK*NHS employee*Post-Brexit	1.215***	2.950***	0.770***	0.910***	0.593***
	(0.329)	(1.074)	(0.200)	(0.208)	(0.200)
Mean working hours	**33.95**	**36.26**	**36.42**	**35.66**	**36.43**
% variation with respect to mean	**3.579**	**8.135**	**2.114**	**2.552**	**1.628**
Overseas*NHS employee*Post-Brexit	2.210***	1.900***	0.772***	1.754***	0.496***
	(0.505)	(0.622)	(0.195)	(0.483)	(0.110)
Mean working hours	**37.90**	**39.92**	**39.86**	**37.95**	**40.09**
% variation with respect to mean	**5.831**	**4.759**	**1.937**	**4.622**	**1.237**
N	13936	1379	47224	2574	46029
R2	0.378	0.336	0.317	0.376	0.322
F	499.998	30.850	690.380	23.247	706.448
p	0.000	0.000	0.000	0.000	0.000
	<25 employees	**25-99 employees**	**100-499 employees**	**>499 employees**	**No children**
UK*NHS employee*Post-Brexit	0.302***	1.320***	1.504***	2.869***	2.593***
	(0.064)	(0.408)	(0.499)	(0.662)	(0.201)
Mean working hours	**35.89**	**35.10**	**36.27**	**36.94**	**36.39**
% variation with respect to mean	**0.842**	**3.761**	**4.147**	**7.767**	**7.126**
Overseas*NHS employee*Post-Brexit	2.144***	0.882***	1.340***	1.265***	2.449***
	(0.772)	(0.235)	(0.150)	(0.260)	(0.414)
Mean working hours	**36.92**	**39.82**	**39.42**	**41.72**	**39.77**
% variation with respect to mean	**5.807**	**2.215**	**3.399**	**3.032**	**6.158**
N	14288	12860	11197	3493	46953
R2	0.350	0.338	0.398	0.376	0.318
F	278.721	227.340	150.854	31.915	693.331
p	0.000	0.000	0.000	0.000	0.000
	1 child	**>1 children**	**Left-wing**	**Right-wing**	**Did not vote**
UK*NHS employee*Post-Brexit	1.943***	1.746***	2.489***	2.209***	2.268***
	(0.443)	(0.746)	(0.485)	(0.768)	(0.483)
Mean working hours	**37.80**	**37.04**	**36.68**	**34.91**	**36.22**
% variation with respect to mean	**5.140**	**4.714**	**6.785**	**6.327**	**6.262**
Overseas*NHS employee*Post-Brexit	1.389***	0.889***	1.504***	1.494***	1.443***
	(0.329)	(0.299)	(0.481)	(0.421)	(0.323)
Mean working hours	**42.77**	**40.76**	**39.51**	**43.07**	**39.67**
% variation with respect to mean	3.248	2.181	3.807	3.469	3.638
N	805	845	7660	3065	9923
R2	0.413	0.411	0.398	0.344	0.337
F	114.495	114.766	91.913	64.363	196.659
p	0.000	0.000	0.000	0.000	0.000

Standard deviation between parenthesis. Robust standard errors. ***, ** and * denote statistical significance at the 1%, 5% and 10% level.

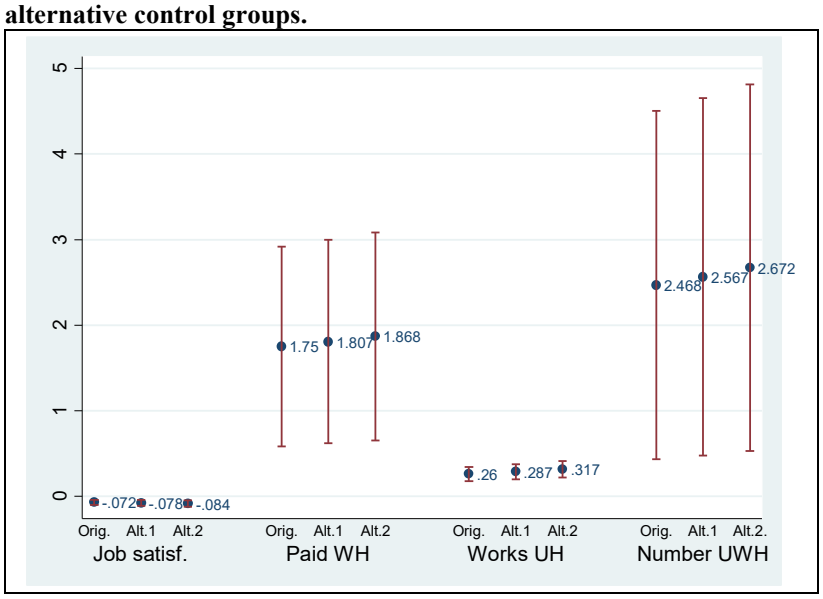
Table C3. Difference-in-difference model using the unmatched sample

	NHS employee_Treat. vs. Control group	Managers vs. Control group	Physicians vs. Control group	Nurses vs. control group	Other personal care prof. vs control group
Job satisfaction					
NHS employee	0.104	0.027	0.319***	0.105	0.010
	(0.094)	(0.153)	(0.119)	(0.108)	(0.113)
Post-Brexit	0.187	0.017	0.055	0.190	0.120
	(0.666)	(0.597)	(0.504)	(0.659)	(0.704)
NHS employee*Post-Brexit	-0.082***	-0.130***	-0.363***	-0.161***	-0.150***
	(0.017)	(0.053)	(0.095)	(0.049)	(0.050)
Average satisfaction	**5.175**	**5.321**	**5.397**	**5.301**	**5.050**
% with respect to average	**-1.592**	**-2.441**	**-6.727**	**-3.033**	**-2.976**
N	6,196	1,282	1,577	2,992	2,697
R2	0.287	0.308	0.309	0.282	0.315
F	35.920	25.878	18.811	29.945	44.409
p	0.000	0.000	0.000	0.000	0.000
Weekly working hours					
NHS employee	0.998	1.757	6.530***	0.182	-0.125
	(0.531)	(0.940)	(0.869)	(0.531)	(1.072)
Post-Brexit	-2.476	-3.018	-1.581	-2.578	2.762
	(0.518)	(0.744)	(0.317)	(0.177)	(4.951)
NHS employee*Post-Brexit	2.516***	0.924***	3.153***	2.771***	5.641***
	(0.684)	(0.129)	(0.221)	(0.452)	(1.830)
Average satisfaction	**36.378**	**36.267**	**34.524**	**40.747**	**35.942**
% with respect to average	**6.915**	**2.547**	**9.134**	**6.801**	**21.258**
N	6,196	1,282	1,577	2,992	2,697
R2	0.376	0.410	0.366	0.378	0.447
F	52.445	45.681	18.240	25.869	18.648
p	0.000	0.000	0.000	0.000	0.000
Works extra hours					
NHS employee	0.104	0.027	0.319***	0.105	0.010
	(0.094)	(0.153)	(0.119)	(0.108)	(0.113)
Post-Brexit	0.187	0.017	0.055	0.190	0.120
	(0.666)	(0.597)	(0.504)	(0.659)	(0.704)
NHS employee*Post-Brexit	-0.082***	-0.130***	-0.363***	-0.161***	-0.150***
	(0.017)	(0.053)	(0.095)	(0.049)	(0.050)
Average satisfaction	**5.175**	**5.321**	**5.397**	**5.301**	**5.050**
% with respect to average	**-1.592**	**-2.441**	**-6.727**	**-3.033**	**-2.976**
N	6,196	1,282	1,577	2,992	2,697
R2	0.287	0.308	0.309	0.282	0.315
F	35.920	25.878	18.811	29.945	44.409
p	0.000	0.000	0.000	0.000	0.000
Extra working hours (per week)					
NHS employee	0.998	1.757	6.530***	0.182	-0.125
	(0.531)	(0.940)	(0.869)	(0.531)	(1.072)
Post-Brexit	-2.476	-3.018	-1.581	-2.578	2.762
	(0.518)	(0.744)	(0.317)	(0.177)	(4.951)
NHS employee*Post-Brexit	2.516***	0.924***	3.153***	2.771***	5.641***
	(0.684)	(0.129)	(0.221)	(0.452)	(1.830)
Average satisfaction	**36.378**	**36.267**	**34.524**	**40.747**	**35.942**
% with respect to average	**6.915**	**2.547**	**9.134**	**6.801**	**21.258**
N	6,196	1,282	1,577	2,992	2,697
R2	0.376	0.410	0.366	0.378	0.447
F	52.445	45.681	18.240	25.869	18.648
p	0.000	0.000	0.000	0.000	0.000

All regressions include age, sex, citizenship, education, marital status, household size, number of adults, number of children and difficulties for paying bills/mortgage/council tax, number of employees, temporary worker, individual, month, year and region fixed effects. Standard deviation between parenthesis. Robust standard errors. ***, ** and * denote statistical significance at the 1%, 5% and 10% level.

Appendix D

Figure D1. Robustness check. Comparison of the original difference-in-difference model using alternative control groups.



This figure shows the estimated coefficient and the confidence interval corresponding to the NHS-Employee*Post-Brexit interaction for the four outcomes analyzed. The original estimate is compared with the estimates obtained using two alternative control groups.Orig: diff-in-diff with original control group.
Alt.1: diff-in-diff with alternative control group 1
Alt.2: diff-in-diff with alternative control group 2
"Paid WH": paid working hours; "Works UH": works unpaid hours; "Number UWH": number of unpaid working hours

Figure D2. Steps for building the balanced panel sample

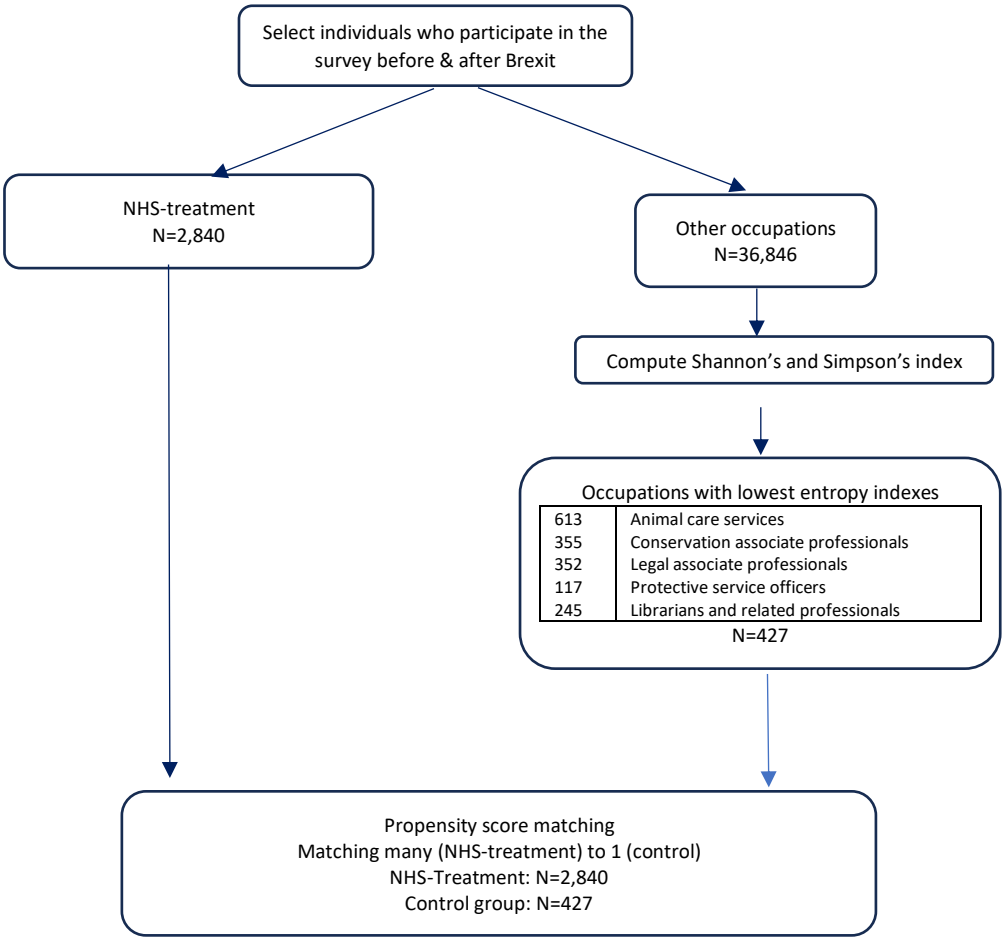
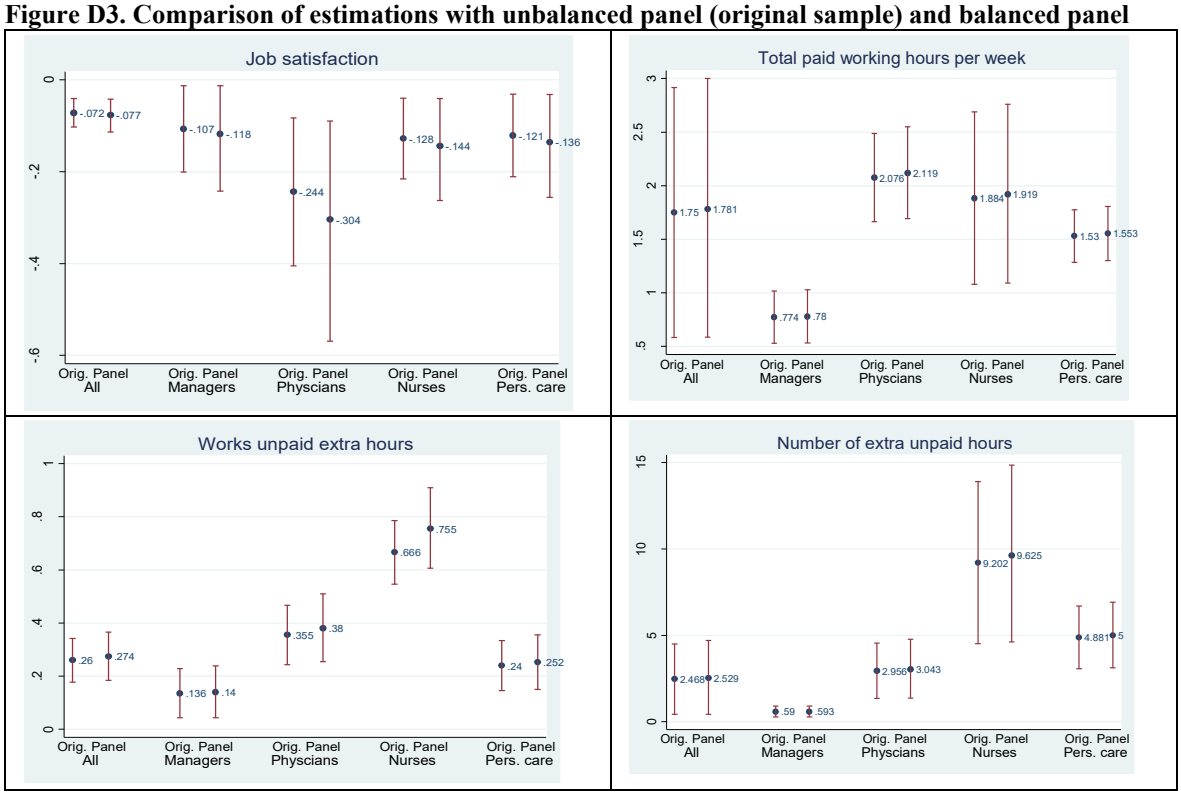


Figure D3. Comparison of estimations with unbalanced panel (original sample) and balanced panel



This figure shows the estimated coefficient and the confidence interval corresponding to the NHS-Employee*Post-Brexit interaction for the four outcomes analyzed. It compares the original estimate with the estimate obtained using a balanced panel (i.e., selecting those individuals appearing before and after Brexit).Unbalance panel (original sample): NHS-treatment (N=5,330) and control group (N=741).
Balanced panel: NHS-treatment (N=2,744) and control group (N=401).

Table D1. Comparison of the original control group with two alternative control groups

	Control group		Treatment group
	Number of observations (before matching)	Number of observations (after matching)	Number of observations (after matching)
Original control group	784	741	5,300
Alternative control group 1	1055	916	5,359
Alternative control group 2	1112	994	5,377

<u>Alternative control group 1</u>: including occupations until pre-Brexit Simpson index is twice the Simpson index for occupation with the highest pre-Brexit Simpson index in the original control group.

Initial occupations	613	Animal care services
	355	Conservation associate professionals
	352	Legal associate professionals
	117	Protective service officers
	245	Librarians and related professionals
New occupations	541	Textiles and garments trades
	121	Managers in farming, horticulture, forestry and services
	549	Skilled trades nec.

<u>Alternative control group 2</u>: including occupations until pre-Brexit Simpson index is 2.5 times the Simpson index for occupation with the highest pre-Brexit Simpson index in the original control group.

Initial occupations	613	Animal care services
	355	Conservation associate professionals
	352	Legal associate professionals
	117	Protective service officers
	245	Librarians and related professionals
New occupations	541	Textiles and garments trades
	121	Managers in farming, horticulture, forestry and services
	549	Skilled trades nec.
	542	Printing trades
	911	Elementary agricultural occupations
	532	Building trades
	341	Artistic and literary occupations
	414	Administrative occupations: communications