WAGE GROWTH IN PAY REVIEW BODY OCCUPATIONS

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The use of the ASHE and QLFS data does not imply the endorsement of the Secure Data Service in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

The syntax used in our analyses are available on request from the authors.

ABBREVIATIONS

APS	Annual Population Survey
ASHE	Annual Survey of Hours and Earnings
BSD	Business Structure Database
CPI	Consumer Prices Index
IDBR	Inter Departmental Business Register
NHSPRB	National Health Service Pay Review Body
OLS	Ordinary Least Squares
OME	Office of Manpower Economics
ONS	Office for National Statistics
PRB	Pay Review Body
PSM	Propensity Score Matching
QLFS	Quarterly Labour Force Survey
SIC	Standard Industrial Classification
SOC	Standard Occupational Classification
STRB	School Teachers' Review Body
UG	Unit Group

1. EXECUTIVE SUMMARY

1.1. Aims

Individuals' incentives to enter or leave a profession – and their incentives to work productively – are partly driven by what they can earn in that occupation, compared to what they might earn in an alternative profession for which they are qualified. This study aims to arrive at a better understanding of how earnings growth for employees in occupations covered by the PRBs compares with the earnings growth of employees in other, similar occupations. The study:

- describes earnings growth among Pay Review Body (PRB) occupations;
- compares that growth to earnings growth in comparable non-PRB occupations;
- accounts for differences in earnings trajectories between PRB occupations and comparable non-PRB occupations that come from compositional change in the workforces.

1.2. Key Findings

Averaging across all 353 occupations in the UK's Standard Occupational Classification, there was a decline of 5.8% in median real gross hourly occupational earnings between 2005 and 2015.[1] The decline was steeper among non-PRB occupations than PRB occupations (6.1% compared to 3.1%).

Among the 10 largest PRB remit occupations, median real gross hourly occupational earnings fell 10.1%, on average, between 2005 and 2015. However, wage growth varied considerably across PRB occupations, even among occupations whose pay was set by the same PRB.

Relative to their nearest non-PRB comparators, earnings growth was higher for the PRB group in five cases and lower in five cases. However, differences were only statistically significant in three instances, with PRB Nurses and PRB Nursing Auxiliaries experiencing higher earnings growth than their non-PRB comparators, while PRB Radiographers experienced significantly lower growth than their non-PRB comparator occupation (Table ES1). Wage growth in a specific occupation may arise for a variety of reasons, including changes in the composition of the occupation (e.g. an influx of highly-qualified recruits). After accounting for compositional differences in the workers entering different occupations between 2005 and 2015, relative to their nearest non-PRB comparators, earnings growth was higher for the PRB group in seven cases and lower in three cases (Table ES2).

The degree to which earnings growth varies across occupations even within the PRB sector, and after accounting for workforce changes, is, perhaps, the biggest finding from the study. This is despite a fairly uniform public sector pay policy being applied to these groups over the latter half of the period.

[1] Median rather than mean earnings growth was chosen to minimise the impact of changes in within occupation earnings dispersion over time.

1.3. Methodology

Using data from the Annual Survey of Hours and Earnings (ASHE), together with the Quarterly Labour Force Survey (QLFS) we construct a panel of nearly 400 occupations. These data are used to examine growth in median real gross hourly occupational earnings in the PRB and non-PRB sectors over the period 2005-2015 before comparing wage growth in the ten largest PRB occupations with wage growth in "matched" non-PRB occupations. PRB occupations are "matched" to non-PRB occupations based on their characteristics in 2005. We identify the role played by workforce compositional change in the divergence in earnings paths between PRB and non-PRB comparable occupations.

1.4. Findings in Detail

Table ES1 presents growth in median real gross hourly earnings for the 10 largest PRB occupations and their non-PRB comparator occupations between 2005 and 2015. Table ES2 presents earnings growth in the same way, having netted out the effects of workforce compositional change in the PRB and non-PRB comparator occupations.

The chief findings are as follows:

- PRB Nursing Auxiliaries experienced the highest absolute earnings growth, and the highest earnings growth relative to their non-PRB comparator. Their earnings gains were apparent having accounted for changes in occupational workforce composition.
- PRB Nurses experienced very low earnings growth, but it was significantly higher than the earnings growth experienced by their non-PRB comparator. However, the gap closes when accounting for changes in occupational workforce composition. Relative to their non-PRB comparator PRB Nurses experienced relative growth in the proportion working in London and the South East, increasing tenure and they were ageing more rapidly, all of which are conducive to relative improvements in earnings.
- PRB Midwives experienced a small decline in earnings, one that was a little smaller than that of their non-PRB comparator, although not significantly so. Accounting for changes in occupational workforce composition, they experienced earnings growth which was very similar to that of their non-PRB comparator.
- PRB Doctors have seen the biggest fall in median real gross hourly earnings out of the 10 PRB occupations, but the fall was not as large as that experienced by their non-PRB comparator. Furthermore, the decline is largely accounted for by compositional change among PRB Doctors, including a decline in their relative age and tenure. Having accounted for this the earnings growth PRB Doctors experience relative to their non-PRB comparator increases quite considerably.
- PRB Radiographers experienced a big decline in median real gross hourly earnings which is statistically significantly larger than the decline experienced by their non-PRB comparator occupation. The deficit remains large having accounted for changes in occupational workforce composition.
- PRB Physiotherapists' median real gross hourly earnings fell at nearly twice the rate of their non-PRB comparator occupation, though the difference is not statistically significant. The rate of earnings decline

doubled relative to its non-PRB comparator occupation having accounted for changes in occupational workforce composition.

- PRB Occupational Therapists' earnings performed poorly relative to their non-PRB comparator occupation but this was wholly accounted for by changes in occupational workforce composition.
- PRB Teachers experienced real earnings decline which was slightly smaller than that experienced by its comparator occupation, non-PRB Teachers, but the difference is not statistically significant. For both occupations earnings decline is largely accounted for by changes in workforce composition.
- Police Officers and Prison Officers experienced moderate earnings decline that was similar to that for their non-PRB comparator occupation. Accounting for compositional changes in their workforces reduced the rate of earnings decline a little for both PRB occupations, whereas it doubled the rate of decline for their non-PRB comparator occupation, improving the relative position of the two PRB occupations.

Table ES1: Growth in Median Real Gross Hourly Earnings, 2005-2015

PRB occupation	% growth	Nearest non-PRB comparator	% growth	Percentage point difference	Significant?
Nurses	1.4	Non-PRB nurses	-7.4	+8.8	Yes
Radiographers	-19.4	Non-PRB nurses	-7.4	-12.0	Yes
Physios	-13.3	Non-PRB nurses	-7.4	-5.9	No
Midwives	-3.5	Non-PRB nurses	-7.4	+3.9	No
Occupational Therapists	-8.0	Sports Coach/instructor	-0.6	-7.4	No
Doctors	-22.5	CEOs/Senior Officials	-31.7	+9.2	No
Nursing Auxiliaries	7.5	Telephone Sales People	-5.8	+13.3	Yes
Teachers	-10.1	Non-PRB teachers	-13.5	+3.5	No
Police Officers	-7.5	Fire Service Officers	-6.8	-0.8	No
Prison Officers	-9.1	Fire Service Officers	-6.8	-2.3	No

Note: rounding means percentage point differences in column 5 may not be exactly the difference between column 2 and column 4

Table ES2: Growth in Median Real Gross Hourly Earnings Having Netted Out Changes in Workforce Composition, 2005-2015

PRB occupation	% growth	Nearest non-PRB comparator	% growth	Percentage point difference
Nurses	8.6	Non-PRB nurses	6.4	+2.2
Radiographers	-13.9	Non-PRB nurses	6.4	-20.3
Physios	-7.4	Non-PRB nurses	6.4	-13.8
Midwives	6.1	Non-PRB nurses	6.4	-0.3
Occupational Therapists	1.1	Sports Coach/instructor	-0.9	+2.0
Doctors	-3.5	CEOs/Senior Officials	-28.3	+24.8
Nursing Auxiliaries	13.4	Telephone Sales People	-1.7	+15.1
Teachers	0.8	Non-PRB teachers	-2.9	+3.7
Police Officers	-6.3	Fire Service Officers	-13.4	+7.1
Prison Officers	-4.9	Fire Service Officers	-13.4	+8.5

1.5. Implications

Earnings growth varies markedly across PRB occupations, even those whose pay is set by the same PRB. So it is important to understand earnings growth at the level of individual occupations. Comparing those movements to "like" non-PRB occupations is one way to assess whether PRB earnings growth is similar or different to what might have been anticipated given the position of PRB occupations in the earnings distribution and the nature of the workers undertaking the occupation. It is also possible to quantify earnings growth in PRB occupations relative to "like" non-PRB occupations having netted out the effects of compositional change in the individuals in those occupations.

There are various ways of identifying non-PRB comparator occupations. Previous studies use regression techniques to compare earnings in PRB occupations with other occupations, such as those in the rest of the public sector, or else they rely on "benchmarking" techniques based on case studies or qualitative assessments of occupational similarity. In this paper we have used propensity score matching to identify "nearest neighbours". It has a number of strengths and weaknesses compared to methodologies used to date.

Its chief strengths are:

- It permits comparison between specific occupations with similar characteristics, as opposed to broader comparisons made across groups of occupations.
- It quantifies the "closeness" of comparators in a transparent fashion which other analysts can replicate and, potentially, improve upon.
- In contrast to standard regression techniques it assists the analyst in avoiding comparisons with occupations that may not constitute good comparators to PRB occupations.
- The methodology is simple to implement.

- It can be replicated over time to inform policy with up-to-date information.
- By "balancing" PRB and comparator non-PRB occupational traits at the outset, one can argue that differences in subsequent earnings trajectories are independent of those observed traits at the outset.

Its chief weaknesses are:

- It is reliant on data capturing occupational features that are liable to affect the outcome of interest, in this case earnings growth.
- It can be sensitive to the methods used to estimate the metric for "closeness" and, having done so, the choices made as to which potential comparators to use.

Of course, the second of these weaknesses might also be perceived as a strength in the sense that it provides the basis for sensitivity analyses.

Regarding the first weakness, the data used in this paper do not contain information on job tasks: these may vary both within and across occupations and may drive some of the differences in earnings trajectories across PRB and comparator non-PRB occupations.

Future work should investigate the sensitivity of the results presented in this paper to alternative methods. It may be possible to incorporate occupational data on job tasks, for instance. Future work should also explore the advantage of alternative "matching" approaches, some of which are not reliant on estimating a propensity score at all.

2. INTRODUCTION

2.1. Background to the research

Government and its agencies are reliant on recruiting and retaining high calibre staff to provide good quality public services, such as those offered by Pay Review Body (PRB) remit groups. In a market setting it is common for firms to pay efficiency wages or offer performance-related pay to attract the most-able employees in the labour market. The public purse places limitations on the public sector's ability to do this. Traditionally it has compensated by offering a good remuneration package including excellent occupational pensions, but this too is increasingly difficult given strictures on public finances and deferred payments such as pensions may not have a sizeable impact on employee recruitment. It is therefore timely to assess how earnings growth in PRB occupations compares with that in other "like" occupations and what the implications might be for rewarding PRB remit groups in future.

Individuals' incentives to enter or leave a profession – and their incentives to work productively – are partly driven by what they can earn in that occupation, compared to what they might earn in an alternative profession for which they are qualified. The motivation for the proposed research is then to arrive at a better understanding of how earnings growth for employees in occupations covered by the PRBs compares with the earnings growth of employees in other, similar occupations.

Recent PRB annual reports include assessments of how pay in their remit occupations compares with trends in other occupations. In most cases, there is some reference to national patterns of earnings growth (e.g. the ONS' measure of Average Weekly Earnings). In some instances, reference is made to broad public/private sector pay differentials: for instance, the NHSPRB (2016) makes reference to the estimates produced by Jenkins (2014). Other PRB reports go further by making comparisons with particular groups of occupations: the STRB (2016) draws a comparison between the pay of schoolteachers and that of all other employees in SOC Major Group 2 (Professionals). Others make reference to one-off case studies (e.g. PA Consulting, 2008; Incomes Data Services, 2015) or the outcomes of job evaluation exercises (PWC, 2015).

We see limitations to each of these approaches and judge that statistical matching techniques could be profitably used to obtain a better understanding of the comparative experience of PRB employees in respect of earnings and earnings growth. Regression-based studies which seek to identify broad public/private sector pay differentials (e.g. Jenkins, 2014; Cribb et al, 2014) take too little account of the large dissimilarity in occupations between the two sectors and between occupations within each sector. There is a vast degree of heterogeneity within the private sector, and the public sector is also very heterogeneous in itself, comprising occupations covered by different PRBs (e.g. doctors, teachers, prison officers) and occupations that sit entirely outside of the PRB system. This leads to a lack of commonality between the employees entering the regression (known in the econometrics literature as a lack of 'common support'). Equally, the benchmarking exercises referred to in the previous paragraph, which seek to compare a PRB occupation with all other occupations that sit within the same broad position in the occupational hierarchy (say the same SOC Major Group) or which match occupations solely on the basis of task requirements, fail to take

proper account of differences in workforce characteristics and attributes, and differences in the labour market context surrounding employees in those occupations. The approach adopted in this study takes the issue of common support seriously, and also recognises that other things affect pay beyond the task content of occupations.

2.2. The purpose and structure of this paper

The paper outlines the methodology used to compare wage growth in PRB occupations with wage growth in "like" occupations between 2005 and 2015 and then, using that methodology, presents estimates of differences in wage growth between PRB occupations and their matched comparator occupations. Specifically, we:

- Compile a panel of occupations covering the period 2005-2015 containing occupation-level average wages and average employee characteristics
- Identify those occupations that are covered by PRBs and sets of matched comparator occupations that are not covered by PRBs
- Chart the growth in median earnings in each of these occupations over the period 2005-2015, in order to examine how the earnings of the PRB groups have fared relative to the earnings in occupations that are observationally similar
- Identify how much of the differential movement in average earnings between the PRB groups and their matched comparators is due to changes in their observed characteristics.

We use propensity score matching (PSM) to identify comparator occupations. Section Three provides an introduction to the PSM methodology and its merits and limitations as a basis for making wage growth comparisons between PRB and other occupations. Section Four describes the data used to undertake this exercise, drawing specific attention to decisions that need to be made when undertaking the matching and considering the potential sensitivity of results to the choices made. Section Five describes the methods we adopt to compare wage growth in PRB and non-PRB occupations with other occupations. Section Six presents our results. The first part of Section Six provides a descriptive overview of trends in occupational wage growth over the period 2005 to 2015. The second part presents estimates based on PSM and regression estimates based on the matched occupations. Section Seven concludes with discussion of the substantive results and reflections on the benefits and limitations of the methodology deployed and how it might usefully be deployed in future.

3. AN OVERVIEW OF PROPENSITY SCORE MATCHING

In this section we briefly review the existing literature on earnings and earnings progression for PRB occupations before turning to the value of propensity score matching (PSM) as a means of comparing earnings in PRB occupations with those for matched comparator occupations.

To date the literature used to shed light on earnings and earnings growth in PRB occupations has tended to estimate pay differentials between public and private sector employees as a whole (e.g. Jenkins, 2014; Cribb et al., 2014) or else compared PRB occupations with others in the public sector (Dolton et al., 2015). Regression-adjustments are made to account for the fact that differences in the demographic profile of employees in those occupations may also influence earnings growth. The difficulty with this standard approach is the occupational heterogeneity within both the private and public sectors, which means that earnings growth in specific PRB occupations, or groups of PRB occupations, is being compared with that in occupations which may have very different attributes. For instance, PRB employees remit groups are largely confined to SOC Major Groups 1, 2, 3 and 6, whereas the regression approaches cited above typically also include employees from SOC Major Unit Groups 4, 5, 7, 8 and 9.

"Matching" PRB occupations with non-PRB occupations according to their observed traits offers greater prospects of comparing wage trajectories for PRB occupations with "like" non-PRB occupations. "Likeness" is determined by characteristics of the occupations measured in 2005 which is the start of the period under investigation (2005-2015). It involves identifying occupations that are observationally similar to the PRB occupation, in terms of the sorts of individuals who work in them, where they sit in the earnings rankings, and their earnings trajectory in the years prior to 2005. Having done so one can argue that differences in earnings trajectories between the PRB and "like" non-PRB occupation subsequent to 2005 are independent of their observed characteristics at the outset.

We match non-PRB occupations to PRB occupations using a single index, the propensity score, which captures the degree of likeness between occupations based on their observed traits. The procedure allows us to establish how close particular occupations are to PRB occupations and to use this information to identify similar occupations, or sets of occupations, against which to judge the earnings growth of the PRB occupations. Those occupations deemed too far distant from the PRB occupation on the propensity score are excluded from the analysis since they are deemed insufficiently similar to the PRB occupation to constitute a credible comparator. The method avoids comparisons between earnings trajectories for PRB occupations and dissimilar non-PRB occupations, as occurs when all occupations or all workers are entered into a regression analysis.

Applying the method is straightforward. For each PRB occupation, or group of PRB occupations, a matching occupation (or set of occupations) is found from among the non-PRB occupations. The choice of match is dictated by observed characteristics, such that one seeks to match each PRB occupation or set of occupations with an occupation sharing similar characteristics. Earnings growth for the PRB occupation(s) can then be evaluated by comparing with the earnings trajectory of the comparator group.

Rosenbaum and Rubin (1983) showed that matching on a single index reflecting the probability of participation could achieve consistent estimates of the treatment effect in the same way as matching on all covariates. This index is the propensity score and this variant of matching is termed "propensity score matching". The advantage is that it replaces high-dimensional matches with single index matches.

It is possible that occupational matches may not be found for one or more PRB occupations where the estimated propensity scores for non-PRB occupations are deemed insufficiently similar to those of the PRB occupations. In the literature these PRB occupations would be described as being "off common support", common support being that part of the propensity distribution for which comparator occupations are available. In this scenario it is not possible to recover a comparator for the PRB occupation. The analyst is able to set tolerances regarding the "nearness" of matching occupations, testing the sensitivity of results to the chosen bandwidth.

The explicit acknowledgement of the common support problem is one of the main features distinguishing PSM from regression analyses since regression results can be used to extrapolate to unsupported cases, something which may or may not be deemed appropriate. The other main distinguishing feature is that matching is non-parametric. Consequently, it avoids the restrictions involved in models that require the relationship between characteristics and outcomes to be specified. If one is willing to impose a linear functional form, the matching estimator and the regression-based approach share the same identifying assumptions.

The mechanics of this exercise are described in Section Four.

4. DATA CONSIDERATIONS WHEN IMPLEMENTING PSM TO COMPARE WAGE GROWTH IN PRB AND 'LIKE' OCCUPATIONS

In this section, we describe the data sets used in the analysis, and how we approach the data issues that arise in identifying PRB occupations and their comparators.

4.1. Introduction to ASHE and QLFS

The Annual Survey of Hours and Earnings (ASHE) is a panel data set constructed from a survey of 1% of all employees in employment. Their employers are surveyed each April and asked to provide a wide range of information about the employee. Employees can be followed from year to year within the data, and job mobility can be identified through changes in the unique employer identifier. The survey is carried out by the UK's Office for National Statistics (ONS) and is mandatory.

At the time the analysis was conducted, the ASHE data were available via the Secure Data Service for the period 1997-2015, however we confine our attention to the decade from 2005-15. This allows us to focus our analyses and findings on a relatively recent period – encompassing some years prior to the recession, when public sector employment was expanding, as well as more recent years when it has been contracting. There is also a practical aspect to our chosen observation period, as our prior work with ASHE indicates that changes to the design and wording of the questions on performance-related payments in 2005 mean that the incidence and extent of performance-related pay was understated in the years leading up to this change, thereby compromising any measure of total earnings.

Although it is common to use QLFS data to examine earnings and public/private sector differentials, ASHE has a number of benefits including a large sample size compared to QLFS, a long individual-level panel component, very high response rates, and accurate employer-provided data on both earnings and public versus private sector status.[2] The main disadvantages of ASHE compared with QLFS are its limited information on demographic characteristics and its hours measure, which is confined to paid hours.

4.2. Defining a PRB occupation

OME estimates suggest that the PRB system covers around 2.5 million workers, accounting for around 45% of all public sector employees (Office of Manpower Economics, 2015). All of these PRB workers have the potential to appear in ASHE, with the exception of: (i) the self-employed[3] (ASHE covers employees only); (ii)

[2] One important drawback with QLFS is that many respondents lack information on these key data items when answering the survey, leading to measurement error. This problem is particularly acute with proxy respondents. For an example using information on trade union membership see http://www.wiserd.ac.uk/research/civil-society/economic-austerity-social-enterprise-equality/trade-union-membership-associational-life-and-wellbeing1/research-findings/research-briefs/

[3] Some General Medical Practitioners and General Dental Practitioners covered by the Doctors' and Dentists' Review Body are self-employed.

the Armed Forces; (iii) any employees working in Northern Ireland (the ASHE dataset available in the Secure Data Service only includes workplaces in Great Britain).

We focus our attention on occupations within the PRBs with the largest ASHE coverage, namely: NHS staff; School teachers; Doctors and Dentists; Police Officers; and Prison Service Staff. The Data Appendix lists all of the occupations within the remit of these five PRBs and specifies the means by which we identify PRB jobs within ASHE. We identify 33 separate occupational groups under these PRBs (see Appendix Table A1). They are variously identified using their four-digit occupational coding, their public sector status[4], their location and, in some cases, their SIC code.

For occupations, such as teachers, where there are practitioners both within the PRB system (those in state schools) and those outside it (private schools), we use the SOC2010 unit group in combination with the IDBR legal status to identify those working in the public sector. Where an occupation code covers a group of jobs across different industrial activities (e.g. SOC2010=1173, which covers fire, ambulance and prisons) we use SIC(2007) in addition to identify the remit group (in this case, senior operational managers in the prison service). We also have regard to region, as some PRBs only cover England and Wales while others extend to Scotland.

Table 1: ASHE Employee Observations, By Year

YEAR	OBSERVATIONS
2002	161,000
2003	163,000
2004	163,000
2005	165,000
2006	166,000
2007	139,000
2008	140,000
2009	171,000
2010	173,000
2011	183,000
2012	177,000
2013	180,000
2014	183,000
2015	180,000

In some cases, we cannot say with certainty whether an employee in ASHE is within the PRB's remit. Schoolteachers are one example, as it is not possible in ASHE to identify teachers in state-maintained schools (who are covered by the

[4] The public sector identifier in ASHE is taken from the Inter-Departmental Business Register and follows ONS's official definition (Millard and Machin, 2007).

STRB) from those in Academy schools (who, strictly speaking, are not).[5] In the case of medical practitioners and dentists, we have included those working in the private sector so as to capture those supplying services to the NHS under independent contracts.[6]

For the most part occupations within PRBs' remit have been so throughout the period of observation. However, there are occupations that have moved into or out of their remit, most notably the police whose pay has been set following PRB recommendations since 2014. We have chosen to set occupations as "PRB" or "not PRB" according to their status at the end of our period, namely 2015, such that changes in PRB status prior to that point are ignored. The reason for this is that the purpose of the study is to compare earnings growth in occupations that are currently within the PRBs' remit relative to comparator occupations. Our aim is not to establish whether PRBs have a causal effect on wage growth (an exercise which would rely on tracking occupational "switchers" over time).

Over the period of our analyses (2002 to 2015) ASHE provides around 2.3 million employee job observations, including 1.9 million for the main period of analysis between 2005 and 2015,[7] with the sample size ranging between 139,000 and 183,000 employee job observations per year (Table 1). Of these, we identify around 18,000 jobs per year as PRB jobs using the definitions set out in the Data Appendix.

Our sample of PRB jobs in ASHE is slightly larger than anticipated when grossed up to population totals. If one grosses up our sample of jobs in 2015 using the ASHE population weights (CALWGHT), one arrives at an estimated total of 2.7 million jobs, accounting for 44% of the 6.1 million public sector jobs covered by ASHE (compared with the OME's estimate of 2.5 million jobs cited earlier).[8] Table 2 compares our 2015 ASHE estimates for PRB jobs with the headcounts cited in Figure 1 of the OME's 2015-16 Business Plan (Office of Manpower Economics, 2016). The largest discrepancies arise in respect of the Police (where we estimate a total of 211,000 jobs rather than 137,000)[9] and the NHS (with a

[5] Under the ONS public sector definition academy schools are identified as being in the public sector so they are indistinguishable from teachers in local authority controlled schools, despite the fact that academy school teachers are not within the PRB's remit.

[6] In practice, this may include some private practitioners who perform no NHS work and who are therefore not covered by the PRB. We do not have the information to estimate the size of this private practitioner group.

[7] The 2002 to 2005 period was used for estimating earnings trajectories prior to the main analysis period.

[8] The share of public sector jobs that are PRB jobs has risen sharply in recent years, from a stable 35% over the period 2005-2011. This is chiefly due to a decline in the numbers of non-PRB jobs in the public sector over the period since 2011. The rise is not an artefact of the switch to SOC(2010) coding because the increase does not occur until after 2011.

[9] It is difficult to explain the discrepancy. There are single SOC codes for senior police officers and police officers respectively and they are the same in SOC(2000) and SOC(2010). We confine our PRB group to those employed in England and Wales by local authorities. Although we cannot separate out the small number of superintendents who are not covered by the Police PRB those numbers will be small.

300,000 discrepancy). A comparison with the APS reveals that its occupational totals are closer to those published by OME for these two PRBs, but that its estimates are further away for the remaining three PRBs. It is then clear that there is no firm consensus on the size of the various remit groups.

Table 2: ASHE PRB Totals Relative to the OME Business Plan

PRB totals	ASHE 2015	OME Business Plan 2015-16
Doctors and dentists	197,000	212,000
NHS	1,708,000	1,408,000
Police	211,000	137,000
Prisons	29,000	27,000
School teachers	512,000	540,000

Some measurement error in designating certain employees as within the PRBs' remit is unavoidable, as in the case of Academy school teachers noted above. One issue that bedevils research relying on the designation of employees as either public or private sector workers is measurement error in the recording of public sector status. This occurs because workers are often not well informed about the public sector status of their employer. However, ASHE relies on quality-assured administrative data from the IDBR to identify the status of the workplace, thus minimising this measurement error problem (Millard and Machin, 2007; Dolton et al., 2015). Similarly, as shown in the Data Appendix, some PRBs cover England and Wales, while others also cover Scotland, yet employer location is coded without error in ASHE by the employer who provides the full postcode for the workplace where the sampled employee works. Some PRBs also cover Northern Ireland, but the ASHE data in the Secure Data Service does not.

There are therefore disagreements between different sources as to the total number of jobs that fall under the remit of these five PRBs. However, the causes of the discrepancies between the different sources are difficult to identify without further information on the totals published by OME.

4.3. Discontinuities in occupational coding over time

Occupations are relatively static over time, in the sense that the bundle of tasks performed within an occupation, coupled with the socio-economic status that is also accounted for in the coding of occupational hierarchies, is quite stable. That said, the range of job tasks in the economy – and how these are bundled into jobs - do change over time, leading to new occupational classifications. (Some occupations are born, some die, while others grow or shrink in importance).

There is a technical difficulty in that ASHE changed its method of occupational coding in 2011 from SOC(2000) to SOC(2010), creating a discontinuity. Occupations are coded to SOC(2000) from 1997-2010 and to SOC(2010) thereafter. However, many of the SOC(2010) Unit Groups for PRB occupations have a one-to-one correspondence in SOC(2000) (see Data Appendix) allowing us to bridge the change in classification for those specific occupations without any difficulty. Indeed, only one of the 33 occupational groups (Health Professionals n.e.c.) cannot be traced over time across the change in occupational classification.

For non-PRB unit groups, we collapse the ASHE data to SOC(2010) unit group level in those years when SOC(2010) is available and we use the ONS' occupational look-up tables (Office for National Statistics, 2012) to construct SOC(2010) Unit Groups from the SOC(2000) data in the years prior to 2011. This allows us to create a dataset of continuous occupational classes.

The Office for National Statistics (ONS) occupational look-up tables utilise data from three surveys which have been coded to both SOC(2000) and SOC(2010), specifically: the 1996/7 QLFS; the January to March quarter of the 2007 QLFS; and a 1% sample of economically active respondents from the 2001 Census. In each of these dual-coded datasets, ONS have cross-tabulated the SOC(2000) code and the SOC(2010) codes for each individual to arrive at a set of tables which show how the two classifications map onto one another. Separate tables are created from each dataset at Major Group (one-digit), Sub-Major Group (two-digit), Minor Group (three-digit) and Unit Group (four-digit) level, and each tabulation is done separately for men and women. We have used the Unit Group level tables deriving from the 2001 Census sample, as the sample size for the dual-coded data is three times the size of that used in the QLFS dual coding (circa 210,000 observations, compared with ~67,000 for the 2007 QLFS).[10]

We use the male and female Census correspondence tables at Unit Group (UG) level to derive a set of weights for each SOC(2000) UG which show that UG's contribution towards the composition of each specific SOC(2010) unit group. For instance, Table 1a in ONS (2012) shows that, in the 2001 Census sample, some 26.7% of the men in SOC(2000) UG 1111 and 20.8% of the men in SOC(2000) UG 1113 were coded to SOC(2010) UG 1116 (these being the only SOC(2000) UGs with men classified to that SOC(2010) UG). The equivalent figures for women were 11.1% and 21.7% respectively. We are then able to construct SOC(2010) UG 1116 in our ASHE data prior to 2011 by taking 26.7% of the men coded to SOC(2000) UG 1111, 20.8% of the men coded to SOC(2000) UG 1113, 11.1% of the women coded to SOC(2000) UG 1111 and 21.7% of the women coded to SOC(2000) UG 1113, and combining these individuals together as one group.[11]

4.4. Constructing a Panel of Occupations

The procedure outlined above allows us to create a panel of SOC(2010) UGs from ASHE over the period 2005-2015, even though many of those years of ASHE data are coded to SOC(2000). Anyone in a PRB SOC group who is not actually covered by a PRB, such as secondary school teachers in private schools, constitutes an additional occupational group in our data represented by a new row in our occupational panel. That is to say, when a UG contains PRB covered and non-covered employees we create separate rows of data for each (one PRB row and one non-PRB row for teachers, in this case).[12] In principle, among the PRB

[10] The correlation between the unit group weights is nonetheless high across these two sources (0.96 for men and 0.95 for women).

[11] In practice, we do not 'take' 26.7% of the individuals, but give them a weight equal to 0.267 times their ASHE population weight when computing aggregated estimates for the SOC(2010) UG, using a Horwitz-Thompson type estimator.

[12] We had originally intended to separately identify Head Teachers but they are grouped with teachers in SOC(2000) and are only separately identifiable in SOC(2010). We also considered separating primary and secondary school teachers. However, we observe a strong shift in employment across the series

occupations all but police officers may have non-PRB employees in the same occupation. The remaining rows of the panel consist of occupational unit groups where nobody has their pay set via a PRB.

In collapsing the ASHE data to occupation level the data are weighted with ASHE population weights (the variable is called CALWGHT).

Our final balanced panel contains 394 SOC(2010) Unit Group occupations. Of these 32 are PRB occupations (see Appendix Table A1) and 362 are non-PRB occupations. They are observed over 11 years providing us with 5,516 occupation-by-year observations.

Table 3: The Distribution of PRB Occupations By SOC Major Groups

SOC Major Group	Number of non-PRB occupations	Number of PRB occupations	Total	% PRB
1	35	3	38	8%
2	68	15	83	18%
3	62	5	67	7%
4	25	1	26	4%
5	57	1	58	2%
6	26	4	30	13%
7	18	1	19	5%
8	42	1	43	2%
9	29	1	30	3%
All	362	32	394	8%

A cursory glance at the occupational distribution of PRB occupations reveals that they are more heavily concentrated in SOC Major Group 2, 3, 1 and 6 than their non-PRB counterparts (Table 3). In 2015 64% of PRB employees were in SOC(2010) Major Group 2 compared with just 15% of non-PRB employees, bringing us back to our earlier point about the importance of identifying observationally similar comparators.

4.5. Earnings measures

Our analysis of wage growth focuses on changes in median gross hourly earnings among employees in each of our chosen occupations.

Employers of the sampled ASHE employees are asked to provide a wide range of information about the employee's earnings during the preceding year, including the amount of bonus or incentive pay received. The survey also asks about the employee's earnings and hours during the current pay period (that is, the week that includes the survey date, for employees paid weekly, or the month including the survey date for those paid monthly). From these data we are able to derive alternative measures of employees' gross hourly earnings.

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from primary to secondary schools which we cannot explain. Hence we abandoned our plans for separate primary and secondary school teacher occupations, treating all primary and secondary school teachers in maintained schools as a single group.

We focus on the measures of earnings that relate to the preceding year ie. gross annual earnings, rather than merely the current pay period, in order not to miss any bonus payments that are not paid in the pay period covered by ASHE's April survey date. Forth et al. (2016) show that bonuses are highly seasonal. A focus on the April pay period alone thus risks understating the importance of bonus payments, and is likely to do so differentially across occupations and industries.

Our analyses focus on hourly pay rather than annual or weekly earnings for both full-time and part-time employees, so that our comparisons are unaffected by differences between occupations in the average numbers of hours worked per week or per annum. Our measure of hourly pay is constructed from total gross annual earnings[13] but relies on a measure of hours worked from the reference period to convert this to an hourly rate, as ASHE contains no data on annual hours. Our assumption, then, is that hours in the reference period (April) are a good proxy for average annual hours.[14]

Earnings data perform two functions. First, we match PRB occupations with their non-PRB comparators using 2005 gross hourly earnings and changes in gross hourly earnings between 2002 and 2005. Second, earnings growth from 2005-2015 is our dependent variable.[15] Measures used to capture pre-2005 pay trends include some measurement error because they rely on the "old" set of ASHE questions on performance-related pay, as noted earlier.[16]

In tracking earnings growth since 2005 we adjust nominal earnings for price inflation using the Consumer Prices Index (CPI, with 2015=100) so that earnings growth is measured in terms of real wage growth since 2005.

[13] Throughout we use the terms wages and earnings interchangeably but, strictly speaking, we are estimating earnings not wage rates.

[14] We tested this assumption using the Annual Population Survey (APS) to see how hours varied across the year. In fact, March/April hours are typical. The average number of hours worked in March and April 2015 combined was 35.46 a week, compared with an annual average of 35.48 a week. Thus, it appears that using hours in April to characterise hours worked over the course of a year is relatively unproblematic.

[15] To establish whether median occupation-level earnings may have been affected by the construction of occupational groups crossing the change in SOC classification in 2010/11 we investigate the correlation between median occupation-level wages within the "real" and "synthetic" SOC(2010) groups in 2011 when data were dual coded. The correlation is 0.94 for all occupations and 0.97 for PRB occupations and there is no systematic bias upwards or downwards.

[16] The question about annual incentive pay was first introduced into ASHE in 2002. As noted earlier, we focus on the period from 2005 as a change to the design and wording of the question in 2005 indicates that the incidence of incentive pay was understated in the period 2002-2004. In each year from 2005-2012, employers were asked, "For the tax year ending 5 April [year],..how much bonus or incentive payments did the employee receive for the current job?". They are instructed to include "profit sharing, productivity performance and other bonus or incentive pay, piecework and commission", and to exclude "basic, overtime and shift premium pay".

Throughout we analyse growth in median hourly earnings, as opposed to mean earnings, so our estimates are not so sensitive to changes in within occupation earnings dispersion.

4.6. Matching variables

The ability of PSM to identify occupations that are closely matched to PRB occupations at the start of the period relies upon the assumption that, conditional on the observed traits used in the matching algorithm, subsequent earnings growth in the absence of a PRB is independent of whether an occupation has its pay set via a PRB. This conditional independence assumption is not testable but its credibility can be considered in the light of theoretical considerations relating to wages growth. Factors that are likely to affect PRB status and earnings outcomes include the human capital of the workers in that occupation, as indicated by their age, education, and gender, other demographics such as ethnicity, and the location of workers (which will likely reflect wage demands and local cost pressures). These are included in our matching estimator.

We also match on earnings growth in the period 2002-2005 and earnings levels in 2005 to ensure that the baseline earnings of PRB and matched non-PRB occupations are very closely matched. By accounting for variations in pre-2005 earnings trends we minimise the potential for post-2005 earnings growth to reflect the statistical artefact of regression to the mean, that is, a period of low earnings growth is likely to be followed by a catch up and vice versa. These pre-2005 earnings data can also help capture otherwise unobservable occupation-specific factors that might drive occupational earnings growth.

Finally, in order to restrict our comparisons to occupations at a similar point in the occupational hierarchy, we require comparator occupations to be drawn from the same SOC Major Group or a Major Group adjacent to it.

Age, gender, location, earnings in 2005 and earnings change between 2002 and 2005 are derived from ASHE. Although location can be very precisely identified we focus on the key distinction between London and the Rest of the South East and elsewhere.

Other variables on employee demographic traits and qualifications are derived for the relevant SOC unit group using the APS.[17] For instance, as education is not recorded in ASHE we match on estimates of the distribution of employees in each occupation by education (using the levels of the National Qualifications Framework or NQF) from the APS. The education coding distinguishes between NQF Levels 0-4 ("no degree"), NQF Levels 4-6 ("lower degree") and NQF Levels 7-8 ("higher degree"); those with vocational qualifications are coded according to their NVQ level attainment.[18] These data are used in our matching estimators, but we also look at variations in educational attainment over time as one potential explanation for movements in earnings.

[17] The APS suffers from similar problems to the LFS mentioned earlier, including measurement error associated with public sector status.

[18] We use the APS variable HIQUAL11 (and its predecessors), categorising codes 1-7 as NQF Level 7/8, codes 8-29 as NQF Levels 4-6 and codes 30-79 as NQF Levels 0-4.

We experimented with various specifications for the model estimating the probability of being the PRB occupation but, in the end, chose a relatively simple model containing the following occupation-level variables:

- Percent male
- Mean number of children (including zeros)
- Mean age
- Percent married
- Percent white
- Percent with a highest qualification at Masters level or above and percent with a highest qualification at undergraduate degree level (with these coefficients evaluated against a reference group, namely the percent with a highest qualification below degree level)
- Percent working in London or the South East
- Percent working in a large organization (with 10,000 or more employees)
- Median annual hourly earnings in 2005
- Whether median real annual earnings grew between 2002 and 2005

Demographic characteristics often affect occupational choices, as well as earnings, so it makes sense to incorporate them in the model. Investments in human capital through the education system will also influence occupational choices and earnings. Some PRB occupations such as teaching require occupation-specific qualifications. Both size of organization and region are known to be associated with earnings. Although it is less clear what role they have in relation to being a PRB occupation, it seemed sensible to incorporate them in the matching estimator. Finally matching on median occupational earnings in 2005 and trends in median real occupational earnings between 2002 and 2005 ensures that comparators for the PRB occupations are likely to be drawn from the sub-set of occupations resembling the PRB occupation in terms of where the occupation sits in the earnings distribution at the start of our period of analysis (2005), as well as sharing similar earnings' trajectories prior to the analysis period.

Descriptive information on these variables is given in the top half of Appendix Table A2 for all 392 occupations that appeared in the balanced panel. Minimum and maximum values are omitted to avoid disclosure.

The APS sample size for Britain is somewhat smaller than that for ASHE but still relatively large. There are 139,000 APS observations in 2005 falling gradually to 115,000 observations in APS 2015. The APS data are compiled in a similar way to ASHE using SOC(2010) Unit Groups for 2011-2015 and SOC(2000) Unit Groups for 2005-2010. As in ASHE, when the data are collapsed to occupation level they are collapsed using APS population weights (variable name PWTA14) to construct occupational means.

5. METHODS FOR COMPARING WAGE GROWTH IN PRB AND NON-PRB OCCUPATIONS

In this section we describe the methods used to compare wage growth for the median earnings in a PRB occupation to that for median earnings in "like" occupations, using propensity score matching (PSM). We describe how we implement PSM to estimate differences in earnings growth between PRB occupations and their matched comparator occupations, explaining the choices we made in the process, and comment on the assumptions that underpin the approach adopted. We also describe how we use regression techniques to establish the degree to which workforce compositional change can account for differences in occupational earnings growth between PRB occupations and their matched comparators.

5.1. Earnings Growth for PRB Occupations Relative to "Matched" non-PRB Occupations

We compare growth in log hourly median earnings in PRB and comparable non-PRB occupations having matched the PRB to non-PRB occupations using propensity score matching (PSM) (Rosenbaum and Rubin, 1983; Bryson et al, 2002). We match PRB occupations to non-PRB occupations according to their characteristics in 2005 to ensure that we are comparing earnings growth over the period 2005-2015 for occupations that started from a similar point in the earnings distribution and had a similar demographic make-up. If PSM leads to a satisfactory match between a PRB occupation and a comparator non-PRB occupation or occupations this will be apparent from the balance between the values on the matching variables between the PRB and non-PRB occupations. If this is satisfactory according to metrics discussed below, and one believes that the covariates used in the matching capture the main features affecting both the propensity to be a PRB occupation and earnings growth, we can recover the wage growth in the PRB occupation relative to a "like" non-PRB occupation, or occupations, by simply comparing the difference in the log median earnings growth of the PRB occupation and its matched comparator(s).

Our first consideration was which occupations to include in the matching estimates. It is impractical to look at each of the 32 PRB occupations that we can track over time in detail. In any event, some of them contain relatively few observations making estimation imprecise. We therefore adopted the following criteria for the inclusion of PRB occupations in our PSM analysis:

- The occupation needed to be a well-defined group, that is, a single unit group, which meant ignoring some of the NHS occupational groups that were ill-defined in terms of their SOC code. The exception was teachers who, although they spanned four SOC unit groups, are nevertheless a homogeneous set
- The occupation must contain a minimum threshold of 150 employee observations per annum, on average, over the period 2005-2015 to ensure precise estimates (and to avoid problems relating to the inadvertent disclosure of sensitive data)
- Taken together the chosen PRB occupations should account for a substantial proportion of all PRB employees.

This resulted in the identification of the 10 occupations marked in yellow in Appendix Table A1. Together they accounted for 70% of PRB employees in 2005, rising to 75% in 2015.

It seems sensible to ensure that there are a reasonable number of employee observations in each potential non-PRB comparator occupation so we confine our attention to those 222 non-PRB occupations with at least 150 employees in 2005, which is the point in time at which the occupations are matched.

Having identified the sample of occupations for inclusion in the analysis the next stage is to run matching estimates for each of the 10 PRB occupations separately. This involved two steps. First, we chose to "hard match" on SOC Major Group, that is, we decided that matched comparators to the PRB occupations had to be drawn from the same part of the SOC Major Group distribution – either they had to come from the same SOC Major Group or the Major Group adjacent to it. For example, PRB nurses belong to SOC Major Group 2 so matches are only sought in SOC Major Groups 1, 2 and 3.[19] Having done this, matching is run for the 10 PRB occupations separately. This entailed running an OLS regression with covariates measured in 2005 (together with earnings growth over the period 2002-5) on a dummy variable identifying the PRB occupation.[20] We then recover each occupation's probability of being the PRB occupation under the model. This predicted probability is the propensity score which is used to calculate the distance between each non-PRB occupation and the PRB occupation.

The resulting propensity score is fed into the matching estimator to recover a matched comparator or comparators giving greater weight to those Unit Groups that are close to the chosen PRB occupation in terms of observables, and less weight to those that are more distant. In the process, some Unit Groups may be omitted from the matched sample where the estimated propensity score is too distant. In this way, one arrives at a combination of Unit Groups which is observationally equivalent to the chosen PRB occupation at the start of our period of study, and which can then be used as matched comparators for that occupation.

We used the STATA algorithm PSMATCH2 for this process. There are a range of options available to the analyst in deciding which occupations should constitute matched comparators for the PRB occupation. These choices entail trade-offs between estimators that are the least biased and those that use the data more efficiently (Bryson et al., 2002: 26-28). Nearest neighbour matching bases comparisons of PRB earnings growth with that of the occupation that is closest to it in the propensity score distribution, thus delivering the least-biased estimates at the expense of throwing away information related to other occupations closest to the nearest neighbour. However, following Frölich et al. (2015), we also report results using the five nearest neighbour occupations to construct the non-PRB

[19] In practice this means comparators cannot be drawn from a part of the occupational distribution that is far from the PRB's position in the occupational distribution.

[20] Ordinarily estimates of the propensity score are based on a probit or logit estimator. This was infeasible in our case because in each of the ten estimation samples only one occupational observation scored "1" on the (0,1) dependent variable.

counterfactual.[21] Nearest neighbour matching has the additional advantage of identifying a specific occupation whereas using the five nearest neighbours entails comparing PRB earnings growth to a synthetic composite occupation. By using two sets of estimates – the nearest neighbour and the nearest five neighbours – we can establish how sensitive our results are to alternative choices. We compare these estimates to those derived from a simple naïve comparison between wage growth in the PRB occupation and the average among all non-PRB occupations taken together.

We investigate the quality of the occupational matches to ensure that covariates are reasonably balanced across PRB and non-PRB occupations post-matching. We do so using a standard technique which involves computing for each matching covariate the absolute deviation of the comparator occupation(s) from the PRB occupation, standardising this distance by expressing it as a proportion of the value for the PRB occupation. These deviations are then summed across all covariates to obtain an absolute standardised bias measure. We compare this measure of bias for the three cases, namely the naïve comparison between the PRB occupation and all non-PRB occupations, the nearest neighbour estimates and the five nearest neighbour estimates, to establish what effect matching has in reducing the absolute standardised bias.

To establish whether the difference between PRB earnings growth and that of its matched comparator(s) is statistically significant it is necessary to obtain standard errors for those estimates. We recover these standard errors for the nearest neighbour estimates by constructing an employee level data set containing only employees in the PRB occupation and its nearest neighbour for the years 2005 and 2015. We recover the difference in earnings growth for those employees by using quintile regression and interacting the PRB indicator with a year dummy for 2015. This returns the differential wage growth at the median for those in the PRB occupation relative to its nearest neighbour together with a standard error for that coefficient.

5.2. What Accounts for Differential Earnings Growth in PRB and Matched non-PRB Occupations?

Wage growth in a specific occupation may arise for a variety of reasons, including changes in the composition of the occupation. For instance, an increase in the qualification levels of the average employee or a shift in employment to higher-cost areas such as the South East are both likely to increase average wage levels within an occupation. Similarly, recruitment drives which bring in large numbers of inexperienced recruits are likely to lower the average wage level, as these individuals are likely to be on lower pay.

We seek to establish whether such compositional changes can account for any differential occupational earnings growth between PRB and "matched" occupations over the past decade. We do this by using regression methods to estimate the aggregate effects of compositional change on occupational earnings within our panel of 232 occupations. The coefficients from that regression are then used to estimate how compositional change affected earnings growth within each of our PRB occupations.

[21] In their simulations Frölich et al. (2015) found that one-to-many matching was one of the estimators that performed very well in a variety of settings.

The methodology for doing this is as follows. First, we run a regression model estimating log hourly median wage *changes* between 2005 and 2015 for all 232 occupations used in the PSM analysis (10 PRB occupations and 222 non-PRB occupations). The model contains variables capturing changes in the composition of workers in each of these occupations over the period 2005-2015. The variables used are those with the "d" prefix in the bottom half of Appendix Table A2. They are changes in:

- proportion male;
- mean age;
- mean tenure;
- educational qualifications (proportion with Master's degree or above and proportion with an undergraduate degree)
- contractual arrangements (proportion full-time; proportion on temporary contracts; proportion in performance pay jobs);
- receipt of additional payments (overtime; shift premia; performance-related pay; employer pension contributions[22]);
- union pay setting;
- occupational entry and exit rates;
- inter-firm mobility rate;
- average firm size;
- proportion located in London and the South East.

These variables are all known to influence earnings and earnings growth, either because they capture aspects of employees' human capital (male, age, tenure, qualifications), firms' ability to pay (firm size), local labour market conditions (geographical location), job amenities which employees may trade-off against wages (contract type, additional payments), or the operation of internal and occupational labour markets (inter-firm mobility rates and occupational entry and exit rates).

Changes in these variables account for around two-fifths of the change in log median occupational earnings between 2005 and 2015.[23] Occupations experience higher growth in earnings when they experience increases in the proportion male, the age of their workers, their tenure, their qualifications, the proportion on permanent contracts, the proportion in performance pay jobs, and the proportion working in London and the South East, and with a reduction in the proportion in receipt of overtime payments.

[22] Pensions fall largely outside the remit of PRBs. However, as Dolton et al. (2015) make clear, a total reward approach to comparability across occupations would need to take account of pension entitlements. These have traditionally been more generous in the public than the private sector. It is therefore conceivable that PRB occupations that appear to be less well-paid than their non-PRB occupational counterparts are, in fact, relatively much better off once one accounts for differences in pension entitlements. ASHE does not contain pension entitlement data but it does contain information on pension contributions made by employers which are strongly correlated with pension entitlements and used here to partial out changes in occupational pension contributions when comparing residual wages between PRB and non-PRB occupations.

[23] The adjusted r-squared is 0.38.

From this regression we can recover wage growth having netted out the contribution from compositional changes along the dimensions listed above. We call this 'residual wage growth' since it is wage growth that is not accounted for by the variables listed above.[24] We compare these residual wage changes between PRB occupations and their matched comparator occupations using the approach described in Section 5.1. In so doing, we obtain an estimate of the extent to which differential earnings movements between the PRB occupation and its matched comparator can be explained by differential changes in the composition of those occupations (and thus an estimate of the extent to which differential earnings movements remain unexplained).

A comparison of earnings growth and growth in residual earnings between PRB occupations and their matched comparators allows us to estimate the degree to which compositional changes between 2005 and 2015 noted above account for the differences in wage trajectories in PRB and non-PRB occupations. The gap that is unaccounted for by compositional change could be said to approximate the "true" underlying differences in earnings trajectories between PRB and other occupations.

[24] Residual wage growth is highly correlated with unadjusted wage growth: the correlation coefficient is 0.76.

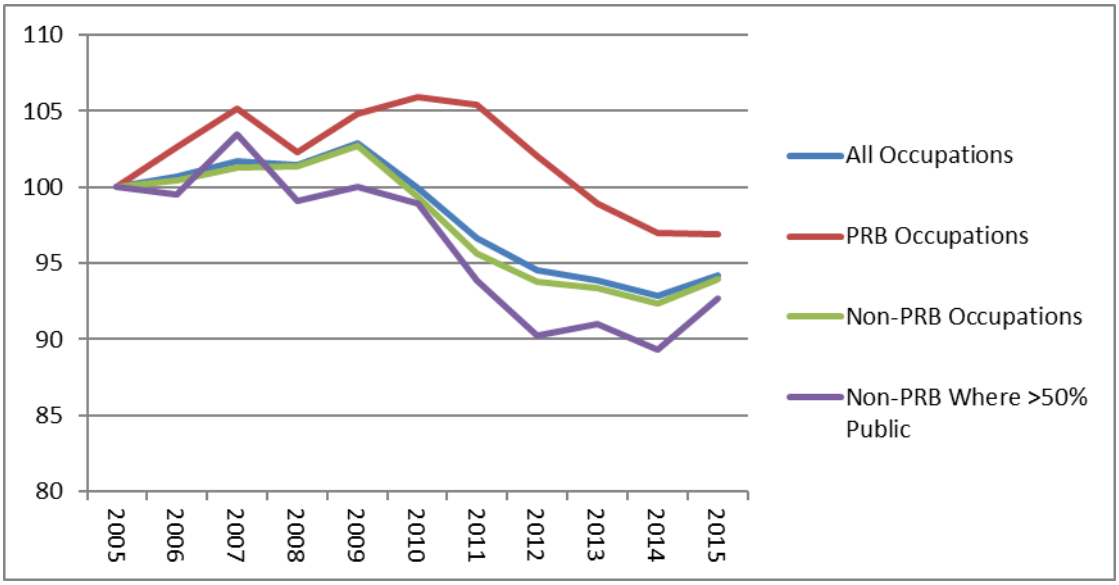
6. RESULTS

In this section, we present our findings on occupational earnings growth for PRB occupations relative to non-PRB occupations. We begin with descriptive analyses of earnings growth and relative earnings between 2005 and 2015 before turning to PSM estimates of earnings growth for 10 PRB occupations relative to matched comparator non-PRB occupations.

6.1. Descriptive Analyses of Earnings Change and Rank Earnings

Figure 1 shows the change in the arithmetic mean of median real gross hourly occupational earnings that occurred between 2005 and 2015 with earnings indexed to 100 in 2005. The graph is run for all 394 occupations appearing in the balanced panel and thus shows the average (mean) value of all 394 occupation-level medians in each year. It is striking that for all occupational groupings real earnings begin falling from 2010 and remain well below their 2005 level by 2015. This is a reminder of just how exceptional this period is in recent British economic history since, throughout most of the post-War period real earnings have risen.[25] PRB occupations experienced lower earnings decline than non-PRB occupations. Those non-PRB occupations with a majority of public sector employees experienced the biggest decline in earnings.

Figure 1: Median Real Hourly Occupational Earnings, 2005-2015



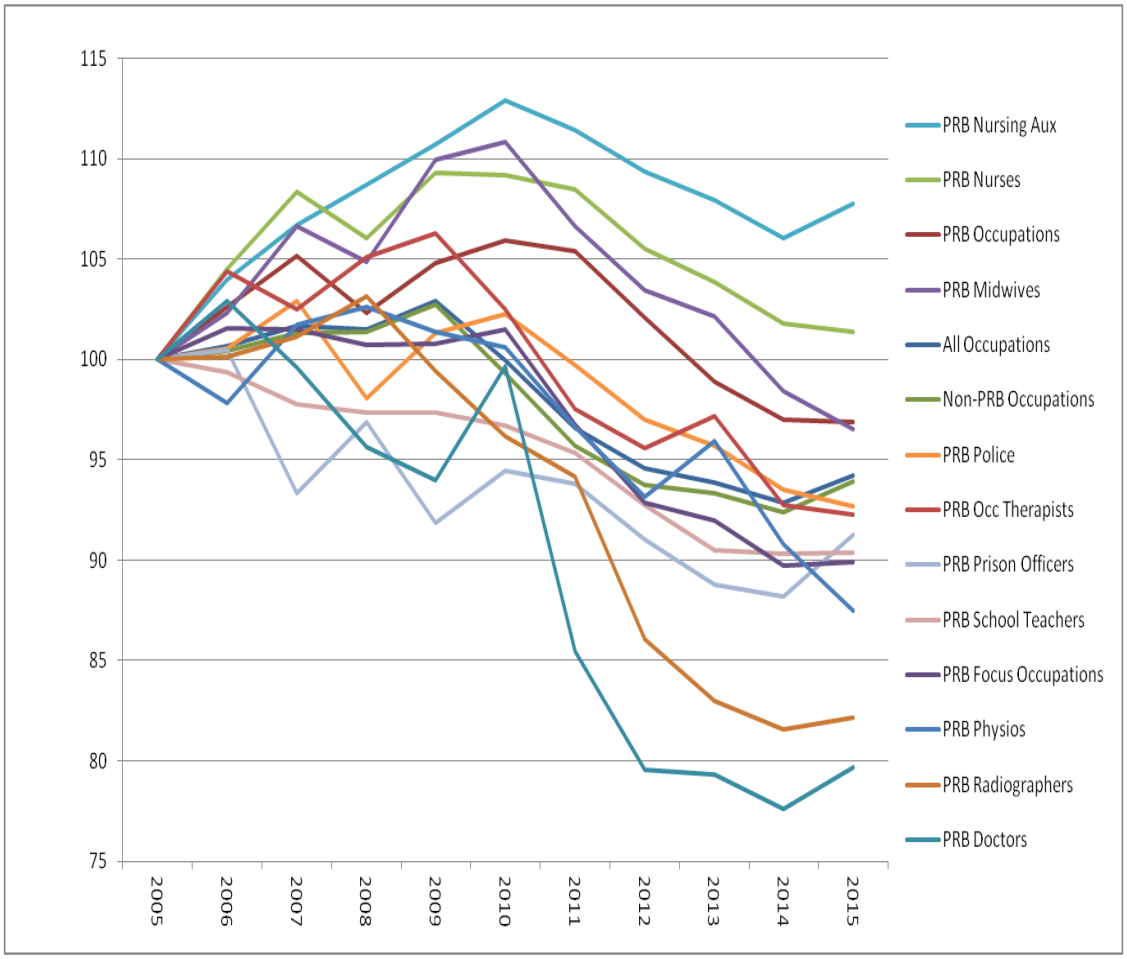
Note: these figures are the arithmetic mean of occupation-level median hourly earnings (calculated using annual earnings) and, as such do not replicate official earnings trends.

Figure 2 shows the same trends for all occupations, PRB occupations and non-PRB occupations but also adds in the earnings trends for the 10 PRB occupations we focus on. What is striking is just how much earnings trajectories differ across PRB occupations over the period, even when they belong to the same PRB. This can happen for a number of reasons, including changes in the composition of the

[25] For more discussion of the impact of recession on earnings and other aspects of the labour market see Bryson and Forth (2016).

workforce in that occupation, but also because earnings can depart quite substantially from basic wage increases due to changes in grading structures, additional payments such as bonuses and overtime, and other factors. Two PRB occupations – PRB Nursing Auxiliaries (the light blue line at the top) and PRB Nurses (the lime green line just below it) – experienced positive wage growth throughout the period and had median real earnings in 2015 that were in excess of their median earnings in 2005. At the other end of the spectrum are PRB doctors (the bottom line) who experienced a real earnings decline of about 20 percentage points between 2005 and 2015, with most of that decline occurring from 2010 onwards.

Figure 2: Growth in Median Real Occupational Earnings, 2005-2015 (2005=100)



Note: these figures are the mean of occupation-level median hourly earnings (calculated using annual earnings) and, as such do not replicate official earnings trends.

The dark purple line which falls to 90% by the end of the period is the arithmetic mean of the median real earnings for the 10 PRB occupations we focus on (*PRB Focus Occupations* in the figure). Their earnings fall 10 percentage points over the period, thus performing a little more poorly than all PRB occupations taken together.

Table 4 examines the earnings levels and trends in earnings for the 10 PRB occupations we focus on. PRB doctors earn well in excess of other PRB occupations throughout the period – three times as much as the lowest paid of the 10 occupations (Nursing Auxiliaries). Their earnings are roughly stable between 2005 and 2010 but fall by 4.4% per annum between 2010 and 2015. Some PRB occupations experience wage growth in 2005-2010 but, with the exception of PRB Nurses and PRB Nursing Auxiliaries, these gains are more than eradicated in 2010-2015. The decline in earnings from 2010 coincides with the wage freeze imposed on public sector pay settlements by government in 2011-2013 for all but the lowest paid workers and the average 1% rise in 2014-2015 (Cribb et al., 2014).

Table 4: Median Real Hourly Earnings (ASHE) for 10 PRB Occupations

	£ per hour			*Average annual growth (%)*		
	2005	*2010*	*2015*	*2005-2010*	*2010-2015*	*2005-2015*
Doctors	38	38	30	-0.1	-4.4	-2.2
Radiographers	22	21	18	-0.8	-3.1	-1.9
Physios	18	18	15	0.1	-2.8	-1.3
Occupational therapists	17	18	16	0.5	-2.1	-0.8
Nurses	16	17	16	1.8	-1.5	0.1
Midwives	19	21	18	2.1	-2.7	-0.4
Nursing auxiliaries	9	11	10	2.5	-0.9	0.8
Police officers	20	20	18	0.4	-1.9	-0.8
Prison officers	16	15	15	-1.1	-0.7	-0.9
School teachers	25	24	22	-0.7	-1.3	-1.0

Note: earnings are in constant (2015) prices (deflated using the CPI) and rounded to the nearest pound to prevent disclosure of individual earnings values.

A very simple and intuitive way to think of changes over time in occupations' relative earnings is to consider their position in the rank order of occupational earnings. Table 5 shows changes in the rank of PRB occupations from the highest (rank number 1) to the lowest (rank number 394 in our balanced panel) occupation according to their median hourly earnings and how this changed between 2005 and 2015. It is possible for an occupation to experience a relatively large change in median earnings but for their rank position to change relatively little, if they are located towards the extremes of the earnings distribution where there are few other occupations with similar earnings levels. Similarly, an occupation in the densely-populated centre of the distribution can see large changes in rank from relatively small changes in median earnings.

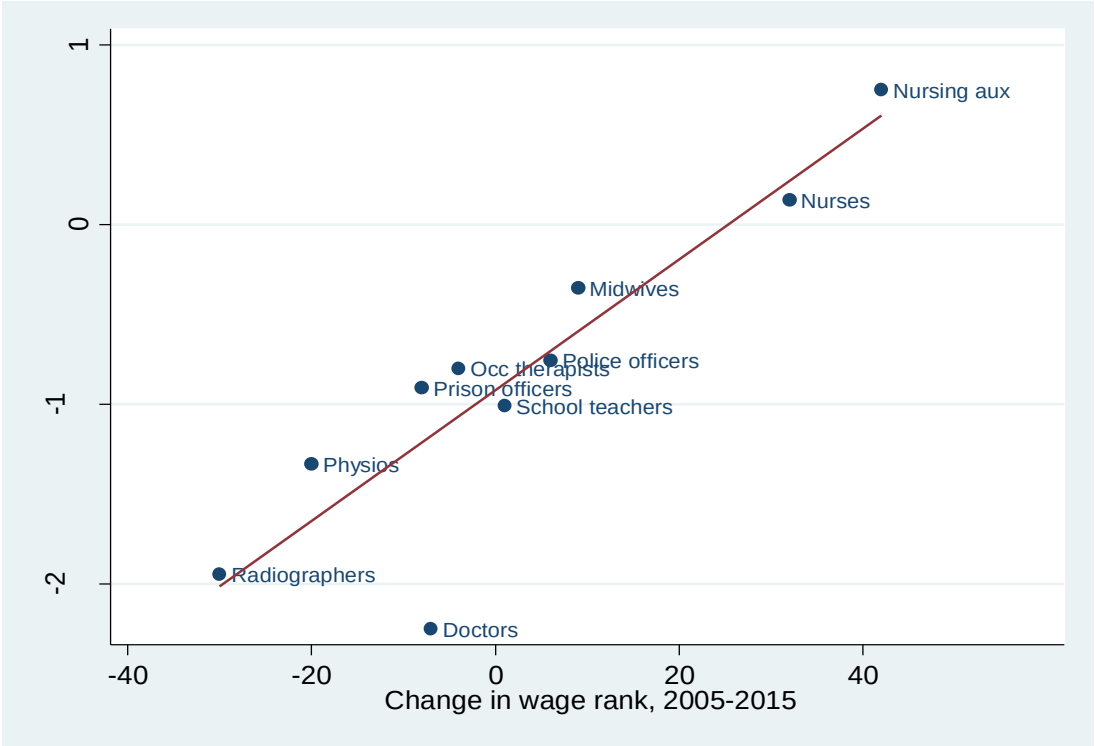
PRB doctors were the fourth highest paid occupation out of the 394 occupations in our panel in 2005. They had moved up to third by 2010, only to fall to eleventh by 2015. So, despite a precipitous decline in earnings, they only fell seven places in the occupational rankings. PRB radiographers also experienced a substantial decline in earnings over the period, with median real earnings falling at a rate of 1.9% per annum between 2005 and 2015. But in their case, this was enough to see them plummet thirty places in the occupational rankings from 57th to 87th. The small gains made by PRB Nurses and PRB Nursing Auxiliaries were enough to move them up the occupational earnings rankings – 32 and 42 places respectively.

Table 5: Occupational Rankings on Median Hourly Earnings

	Rank position					
	Rank (1=highest)			Change in rank		
	2005	2010	2015	2005-2010	2010-2015	2005-2015
Doctors	4	3	11	1	-8	-7
Radiographers	57	65	87	-8	-22	-30
Physios	103	102	123	1	-21	-20
Occupational therapists	106	104	110	2	-6	-4
Nurses	141	109	109	32	0	32
Midwives	89	66	80	23	-14	9
Nursing auxiliaries	318	286	276	32	10	42
Police officers	80	68	74	12	-6	6
Prison officers	125	143	133	-18	10	-8
School teachers	31	37	30	-6	7	1

Figure 3 shows the correlation between changes in wage growth and changes in wage rank for the 10 PRB occupations. Five PRB occupations (Midwives, Police Officers, Occupational Therapists, Prison Officers and School Teachers) experienced small annual reductions in their real earnings, with relatively small adjustments in their occupational earnings rankings. For PRB Nurses and PRB Nursing Auxiliaries their earnings growth translated into a marked improvement in their occupational earnings ranking. Similarly, the decline in real earnings for PRB Radiographers and PRB Physios resulted in a decline in their occupational earnings rankings. Doctors are the outlier, experiencing the biggest decline in real earnings but a modest shift in their rank position in the occupational earnings distribution. As we shall see later, this decline in Doctors' earnings is largely accounted for by compositional change in those in the profession.

Figure 3: Change in Hourly Wage Rank and Annual Wage Growth



6.2. PSM Estimates of Median Hourly Earnings Growth

In this section, we present estimates of growth in earnings and residual earnings for 10 PRB occupations relative to their matched comparators following the procedures described earlier. Results are presented for each of the 10 PRB occupations in turn and follow a similar format.

6.2.1. PRB Nurses

Table 6 presents estimates for earnings growth and residual earnings growth for PRB Nurses. Median earnings rose by 0.14% per annum, on average, among PRB Nurses over the period 2005-2015 (column 1). This rises to 0.86% if one nets out compositional changes (column 4). How does this compare to those in non-PRB occupations? In the first row comparisons are made with the 101 non-PRB occupations in our data set for occupations in the same or adjacent SOC Major Group categories to nurses, namely those in SOC(2010) 1, 2, and 3. This broad group experienced declining real wage growth of -0.86% per annum on average. Nearly four-fifths of this decline was due to compositional change so that, having netted that out, their residual wage growth was -0.19% per annum. If we compare wage growth for PRB Nurses with that for non-PRB occupations in SOC Major Groups 1 to 3, PRB Nurses experienced wage growth that was about 1 percentage point per annum higher than those in non-PRB occupations. This is the case whether one accounts for compositional change or not (compare columns 3 and 6 in row 1 of the data).

This naïve comparison does not account for the differences between PRB Nurses and those in non-PRB occupations so we use PSM to identify comparator occupations that resemble PRB Nurses more closely on observed traits in 2005.

To do this we use PSM to identify the occupations nearest to PRB Nurses based on their propensity score.[26] We make comparisons with the "nearest neighbour" (denoted 'NN' in the table) and the nearest five neighbours ('5NN'). The nearest neighbour is non-PRB nurses and the five nearest neighbours are identified in note (2) below Table 6.[27]

Matching allows us to "balance" the PRB and non-PRB comparator samples so that we are comparing earnings growth in the PRB occupation with comparators that appear observationally equivalent at the start of the period. To assess the quality of the match we compare how well matched the groups are using an overall measure, the absolute standardised bias (see Section 5.1 for a description of how it is calculated) and inspect the way the mean characteristics for the comparator occupation(s) shift pre- and post-matching. Comparing the figures in the two final columns of Table 6 it is apparent that matching substantially reduces the bias but does not eliminate it. The bias is substantially smaller for the nearest neighbour matching than it is for the five nearest neighbours. Details are provided for each covariate used in the matching in Table 7. If one considers column 1 it is apparent that 11% of PRB Nurses are men, whereas an average of 62% of those in non-PRB occupations are men. However, the "match" on this covariate is much closer if we compare the PRB figure to the nearest neighbour: 9% of non-PRB Nurses are men. The match is not always so successful. For example, matching does nothing to reduce the gap between PRB Nurses and their comparators when it comes to the percentage working in London and the South East.[28]

Table 6: Growth in Median Real Wages, PRB Nurses

	Average wage growth per year 2005-2015(%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	0.14	-0.86	1.00	0.86	-0.19	1.05	8.77	
NN	0.14	-0.74	0.88	0.86	0.64	0.22	2.56	70.82
5NN	0.14	-0.81	0.94	0.86	0.37	0.49	7.12	18.89

Notes:
(1) Nearest neighbour is SOC(2010) 2231, non-PRB Nurses
(2) Five Nearest Neighbours are: non-PRB nurses; Dancers/Choreographers; chartered/certified accountants; solicitors; legal professionals n.e.c.

[26] As discussed in Section 5, 'nearness' is measured in terms of occupations' nearness to the PRB occupation in terms of its predicted probability of being the PRB occupation based on occupational traits measured in 2005. Those predicted probabilities come from a probit model for the (0,1) outcome of being the PRB occupation, in this case PRB Nurses.
[27] To give some idea as to how close these occupations are under the model their propensity scores were as follows: non-PRB Nurses 0.20; Dancers/Choreographers 0.08; Chartered/Certified Accountants 0.08; Solicitors 0.07; Legal Professionals n.e.c. 0.07. PRB Nurses had a propensity score of 0.25.
[28] Even if we achieved a perfect match on these observed traits, it is possible that earnings growth differentials are being driven by unobserved factors that have not been accounted for in the regression generating the propensity score.

Row 2 in Table 6 compares PRB Nurses' earnings growth to that of their nearest neighbour, non-PRB Nurses. PRB Nurses experience wage growth that is 0.88 percentage points per annum above that of their nearest neighbour.[29] Around three-quarters of the differential is due to compositional change in the PRB Nurses workforce when compared to the non-PRB Nurses workforce. (This is because non-PRB Nurses experience compositional changes in their workforce that drag down their wage growth, notably in relation to their age, tenure and percentage located in London and the South East). Once this is accounted for PRB Nurses experience wage growth that is 0.22 percentage points per annum above their non-PRB counterparts.

Making the comparison with average earnings growth among the five nearest neighbours produces similar results, although PRB Nurses experience greater growth in residual earnings based on this comparison (0.49% per annum compared to 0.22% in the case of the nearest neighbour). In this case, however, we prefer the nearest neighbour estimate because it strongly outperforms the five nearest neighbour method in reducing bias.

Table 7: PSM Variable Means for PRB Nurses and their Comparators

	% male	Mean N kids	Mean age	% married	% white	% above degree	% degree	% in Lon/SE	% in large org	2005 wage	Wage Δ 02-05
PRB nurses	0.11	0.90	40.98	0.64	0.86	0.05	0.86	0.22	0	15.70	0
All non-PRB	0.62	0.68	40.32	0.58	0.93	0.13	0.43	0.36	0.38	19.60	0.28
NN	0.09	0.83	44.62	0.59	0.76	0.03	0.82	0.36	0	15.92	1
5NN	0.35	0.71	39.51	0.56	0.86	0.19	0.64	0.42	0	21.65	0.2

6.2.2. PRB Radiographers

PRB Radiographers experienced negative median real wage decline averaging 1.94% per annum between 2005 and 2015. This is low relative to most occupations in the full balanced panel of 232 occupations: they sat at the 10th percentile in the distribution of all wage growth rates observed. Their earnings growth rate was 1.08 percentage points lower than the average experienced by the 101 non-PRB occupations in the same and adjacent SOC Major Groups 1, 2 and 3 (Table 8, row 1). The gap widens a little to -1.20 percentage points per annum when accounting for compositional change (row 1, column 6).

PRB Radiographers' nearest neighbour comparator is non-PRB Nurses. The matching reduces the absolute standardised bias by almost one-third. Since non-PRB Nurses experienced slightly lower real wage decline than non-PRB occupations in general in SOC Major Groups 1 to 3, the gap in earnings growth

[29] Wage growth for PRB nurses sits at the 81st percentile in the distribution of all wage growth rates observed in the balanced panel of 232 occupations. Non-PRB Nurses sit at the 43rd percentile so, measured in this way, PRB Nurses have done rather well compared to their matched nearest neighbour.

between PRB Radiographers and their nearest matched neighbour is slightly larger at -1.20 percentage points per annum (Table 8, row 2 column 3). The gap is still larger (-2.03 percentage points per annum) having accounted for changes in occupational composition among PRB Radiographers and Non-PRB Nurses. Earnings growth is -1.36 percentage points per annum lower for PRB Radiographers compared with average annual earnings growth among their five nearest neighbours, a differential that only falls a little when accounting for compositional changes between 2005 and 2015. Table 8 shows that the comparison with the five nearest neighbours is to be preferred over other comparisons because the absolute standardised bias is lowest in this case. On this basis, we can judge that PRB radiographers did relatively poorly in wage terms over the period 2005-2015, although this was due in part to the adverse effects of compositional change within the occupation.

Table 8: Growth in Median Real Wages, PRB Radiographers

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-1.94	-0.86	-1.08	-1.39	-0.19	-1.20	5.57	
NN	-1.94	-0.74	-1.20	-1.39	0.64	-2.03	3.80	31.68
5NN	-1.94	-0.58	-1.36	-1.39	-0.28	-1.11	2.36	57.61

Notes:
(1) Nearest neighbour is SOC(2010) 2231, non-PRB Nurses
(2) Five Nearest Neighbours are: non-PRB nurses; Welfare Professionals n.e.c.; Secondary Education Teaching Professionals; Police Officers; Social Workers.

6.2.3. PRB Physios

PRB Physios had also experienced quite substantial negative wage growth between 2005 and 2015, putting them at the 21st percentile in the distribution of all wage growth rates observed in the sample of 232 occupations in the balanced panel. At -1.33% per annum their growth rate was 0.47 percentage points per annum lower than the average for the 101 non-PRB occupations in the same and adjacent SOC Major Groups 1, 2 and 3 (Table 9, row 1). The gap is similar when accounting for compositional change.

Nearest neighbour matching reduces the absolute standardised bias by around half. PRB Physios' nearest neighbour is non-PRB Nurses: since their earnings fell a little less than that for non-PRB occupations, the relative earnings decline for PRB Physios is a little larger (0.59 percentage points per annum). The gap more than doubles to -1.38 percentage points having accounted for compositional change (Table 9, row 2, column 6). Results look very different when PRB Physios are compared with their nearest five neighbours. Those nearest five neighbours experience positive, albeit small wage growth over the period so that the gap between these comparators and the PRB Physios widens, with the PRB group experiencing differential wage decline of -1.73 percentage points per annum. However, this switches to a positive gain of 1.01 percentage points per annum when accounting for compositional change partly because adverse compositional change among PRB Physios drags their earnings growth down, but primarily

because compositional change among the five nearest neighbours pushed up their wages revealing marked wage decline when this is accounted for.

Table 9: Annual Growth in Median Real Wages, PRB Physios

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-1.33	-0.86	-0.47	-0.74	-0.19	-0.55	7.28	
NN	-1.33	-0.74	-0.59	-0.74	0.64	-1.38	3.41	53.16
5NN	-1.33	0.40	-1.73	-0.74	-1.75	1.01	5.88	19.18

Notes:
(1) Nearest neighbour is SOC(2010) 2231, non-PRB Nurses
(2) Five Nearest Neighbours are: non-PRB nurses; Dancers/Choreographers; Solicitors; Secondary Education Teaching Professionals; Police Officers.

6.2.4. PRB Midwives

PRB Midwives experienced a 0.35% per annum decline in their median real earnings between 2005 and 2015, putting them at the 64th percentile in the distribution of all wage growth rates observed in the sample of 232 occupations in the balanced panel. This growth rate was 0.51 percentage points per annum higher than the average for the 101 non-PRB occupations in the same and adjacent SOC Major Groups 1, 2 and 3 (Table 10, row 1). The gap increased to 0.80 percentage points when accounting for compositional change.

Table 10: Annual Growth in Median Real Wages, PRB Midwives

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-0.35	-0.86	0.51	0.61	-0.19	0.80	131.78	
NN	-0.35	-0.74	0.39	0.61	0.64	-0.03	20.66	84.32
5NN	-0.35	0.20	-0.55	0.61	-0.96	1.57	61.98	52.96

Notes:
(1) Nearest neighbour is SOC(2010) 2231, non-PRB Nurses
(2) Five Nearest Neighbours are: non-PRB nurses; Sports Coaches/Instructors; R&D Managers; Dancers/Choreographers; and Child and Early Years Officers.

Nearest neighbour matching reduces the absolute standardised bias by more than four-fifths (Table 10, Row 2, final column). However, the absolute standardised bias remains substantial at 20.66, and so the matching has not identified a particularly close comparator in this case.

PRB Midwives' earnings decline is a little less steep than that for their nearest neighbour, non-PRB Nurses, the differential being 0.39 percentage points per annum in favour of the PRB group. However, the differential disappears having accounted for compositional change (Table 10, row 2 column 6).

Using the five nearest neighbour occupations as the counterfactual produces quite different results. PRB Midwives' median real earnings growth is 0.55 percentage points per annum lower than the average for the five nearest neighbour occupations, but the differential is reversed having accounted for compositional change. The comparators' residual wages fell by nearly 1% per annum over the period, while that for PRB Midwives rose, resulting in PRB Midwives experiencing residual wage growth that was 1.57 percentage points higher each year than their comparator group.

6.2.5. PRB Occupational Therapists

Real median hourly earnings fell by 0.80% per annum for PRB Occupational Therapists over the period 2005-2015, placing them at the 40th percentile of the distribution of all wage growth rates observed in our panel of 232 occupations. The rate of decline was similar to the average for the 101 non-PRB occupations in the same and adjacent SOC Major Groups 1, 2 and 3 (Table 11, row 1, data columns 1 and 2). Residual wage growth was 0.30 percentage points higher for the PRB group (row 1, column 6).

Table 11: Annual Growth in Median Real Wages, PRB Occupational Therapists

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-0.80	-0.86	0.07	0.11	-0.19	0.30	7.53	
NN	-0.80	-0.06	-0.74	0.11	-0.09	0.20	5.21	30.84
5NN	-0.80	0.40	-1.20	0.11	-0.45	0.56	3.86	48.71

Notes:
(1) Nearest neighbour is SOC(2010) 3442, Sports Coaches/Instructors
(2) Five Nearest Neighbours are: Sports Coaches/Instructors; Residential, Day and Domiciliary Care Managers and Proprietors; Dancers/Choreographers; Quantity Surveyors; and Welfare Professionals n.e.c..

The nearest neighbour for PRB Occupational Therapists was Sports Coaches and Instructors. Although matching to them reduced absolute standardised bias by only one-third, the absolute standardised bias is small even in the absence of

matching. The earnings growth for Sports Coaches and Instructors was relatively flat over the period, so PRB Occupational Therapists' median real wages fell by 0.74 percentage points per annum in comparison (Table 11, row 2, data column 3). However, the difference was accounted for by differences in compositional change between the two occupations such that residual wage growth was marginally higher for the PRB occupation having netted that out (by 0.20 percentage points per annum – row 2, data column 6).

If one compares PRB Occupational Therapists' earnings growth to the nearest five neighbours absolute standardised bias falls by nearly a half suggesting that, in this particular case, the five nearest neighbours provide a better comparison that the nearest neighbour. A similar picture emerges to that shown by the nearest neighbour, however: the PRB occupation experiences lower wage growth (by 1.20 percentage points per annum) but higher residual wage growth (0.56 percentage points per annum).

6.2.6. PRB Doctors

PRB Doctors experienced very substantial median real earnings reductions over the period 2005-2015 placing them in the 7th percentile of the distribution of all wage growth rates observed in our sample of 232 occupations. This decline of 2.25% per annum was 1.38 percentage points lower than the average for the 101 non-PRB occupations in the same and adjacent SOC Major Groups 1, 2 and 3 (Table 12, row 1). However, most of the decline in PRB Doctors' earnings can be accounted for by compositional change in the occupation: residual wages fell by 0.35% per annum, that is, 0.16 percentage points per annum faster than non-PRB occupations in SOC Major Groups 1, 2 and 3.

There are only 98 non-PRB Doctors in the ASHE sample in 2005, and relatively few in subsequent years (ranging between 66 and 246 observations). There are therefore too few to meet the threshold we set ourselves to enter the matching process. (It is notable, however, that they experience earnings decline of 3.05% per annum between 2005 and 2015, a rate of decline that outstrips that for PRB Doctors by 0.81 percentage points per annum).[30]

Despite a model accounting for reasonable variance in the probability of being a PRB Doctor[31] the matching exercise is not successful. Compared to PRB Doctors – who have a propensity score of 0.44 under the model – the nearest neighbour is CEOs and Senior Officials. Their propensity score is 0.19. However, the balancing test indicates that matching to the nearest neighbour generates no gains relative to a comparison to the 101 non-PRB occupations, and a comparison with the five nearest neighbours only does marginally better. This is largely due to the fact that the size of the absolute standardised bias is small at the outset (3.57) compared to other cases. Nevertheless, what emerges from the matching exercise is a clear impression that the declining earnings experienced by PRB Doctors are also experienced by their matched comparators but that, having accounted for compositional change (notably a decline in their age and tenure), PRB Doctors' residual wage growth is better than it is for their matched

[30] If we had relaxed this criterion non-PRB Doctors would have made a good nearest neighbour because absolute bias would have been 2.92, a reduction of 18 percent when compared to the absolute bias of 3.57 when balancing PRB Doctors against all 101 non-PRB occupations in our panel.
[31] The adjusted R-squared is 0.36.

comparators (2.48 percentage points per annum better in the case of the nearest neighbour and 0.44 percentage points per annum when compared to the average for their nearest five neighbours).

Table 12: Annual Growth in Median Real Wages, PRB Doctors

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-2.25	-0.86	-1.38	-0.35	-0.19	-0.16	3.57	
NN	-2.25	-3.17	0.92	-0.35	-2.83	2.48	3.78	5.88
5NN	-2.25	-1.45	-0.80	-0.35	-0.79	0.44	3.05	14.57

Notes:
(1) Nearest neighbour is SOC(2010) 1115, CEOs and Senior Officials
(2) Five Nearest Neighbours are: CEOs and Senior Officials; non-PRB Nurses; Restaurant and Catering Establishment Managers; Police Officers; and Health Professionals.

6.2.7. PRB Nursing Auxiliaries

At 0.75% wage growth for PRB Nursing Auxiliaries is at the 91st percentile in the distribution of all wage growth rates observed in our sample of 232 occupations. Because Nursing Auxiliaries are in SOC Major Group 6, matching was undertaken among those occupations in the same or adjacent SOC Major Groups, that is, the 57 non-PRB occupations in SOC Major Groups 5, 6 and 7. They experienced negative wage growth of about -0.34%, so PRB Nursing Auxiliaries saw their wages rise by around 1 percentage point per annum relative to non-PRB occupations in that part of the occupational distribution. The difference increased a little having accounted for occupational change (Table 13, row 1).

Table 13: Annual Growth in Median Real Wages, PRB Nursing Auxiliaries

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	0.75	-0.34	1.09	1.34	0.12	1.22	6.55	
NN	0.75	-0.58	1.33	1.34	-0.17	1.51	3.37	48.61
5NN	0.75	-0.51	1.26	1.34	0.09	1.25	4.11	37.30

Notes:
(1) Nearest neighbour is SOC(2010) 7113, Telephone Sales People
(2)Five Nearest Neighbours are: Telephone Sales People; House Parents/Residential Wardens; Welding Trades; Nursery Nurses/Assistants; Cooks.

The matching estimator reduced absolute standardised bias by about half. PRB Nursing Auxiliaries experience earnings growth that is 1.33 percentage points per annum higher than their nearest neighbour, Telephone Sales People, a differential that rises to 1.51 percentage points when accounting for compositional change (Table 13, row 2). Compared to their nearest five neighbours wage growth is 1.26 percentage points per annum higher, a differential that remains unchanged accounting for compositional change.

6.2.8. PRB Teachers

PRB Teachers' median real gross hourly earnings fell by 1% per annum between 2005 and 2015, placing them at the 30th percentile in the distribution of all wage growth rates observed in our 232 occupation panel. However, accounting for compositional change, their residual wages were stable (Table 14, row 1). Matching performs well, reducing absolute standardised bias by around one-half.

Their nearest neighbour is non-PRB Teachers. They experience steeper wage decline than PRB Teachers so that, over the period, PRB Teachers' wage growth is 0.35 percentage points above that for their nearest neighbour. The advantage is similar accounting for compositional change (Table 14, row 2, data columns 3 and 6).

PRB Teachers' wage growth is on a par with that of their nearest five neighbours but is higher having accounted for compositional change (Table 14, row 3, data columns 3 and 6).

Table 14: Annual Growth in Median Real Wages, PRB Teachers

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-1.01	-0.86	-0.14	0.08	-0.19	0.27	4.73	
NN	-1.01	-1.35	0.35	0.08	-0.29	0.37	2.40	49.18
5NN	-1.01	-0.94	-0.06	0.08	-0.48	0.55	2.52	46.68

Notes:
(1) Nearest neighbour is SOC(2010) 2314, non-PRB Teachers
(2)Five Nearest Neighbours are: non-PRB Teachers; Dancers/Choreographers; Higher Education Teaching Professionals; Business and Financial Project Managers R&D Managers

6.2.9. PRB Police Officers

PRB Police Officers are those at sergeant rank or below employed by police authorities in England and Wales. (The remit group also includes Inspectors, Chief Inspectors and Superintendents but these are a small group so they are not part of our analysis). As shown in Table 2 we identify too many PRB Police

Officers relative to the OME Business Plan, something that merits investigation in future research. With that proviso in mind Table 15 presents results.

PRB Police Officers experienced annual rates of decline in median real earnings of 0.75% placing them 42nd in the distribution of all wage growth rates observed in our 232 occupation panel, very close to PRB Occupational Therapists. The decline was also similar to the average for all non-PRB occupations in SOC Major Groups 1, 2 and 3 (Table 15, row 1 data columns 1 and 2). However, residual wage growth was somewhat lower for PRB Police Officers (columns 4 and 5).

PRB Police Officer wages declined at a similar rate to their nearest neighbour occupation Fire Service Officers but their residual wages grew more quickly (0.71 percentage points per annum) due to compositional changes in the workforce which lowered Fire Service Officers' wages more than it did PRB Police Officers' wages.

In contrast, both earnings growth and growth in residual earnings were lower for PRB Police Officers than they were for the average of their five nearest neighbours.

Table 15: Annual Growth in Median Real Wages, PRB Police Officers

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-0.75	-0.86	0.11	-0.63	-0.19	-0.44	5.71	
NN	-0.75	-0.68	-0.08	-0.63	-1.34	0.71	3.28	42.47
5NN	-0.75	-0.09	-0.67	-0.63	-0.19	-0.43	1.71	69.98

Notes:
(1) Nearest neighbour is SOC(2010) 3313, Fire Service Officers
(2) Five Nearest Neighbours are: Fire Service Officers; Brokers; non-PRB Police Officers (eg. those in Scotland); School Secretaries; Sports Coaches/Instructors

6.2.10. PRB Prison Officers

PRB Prison Officers experienced median real hourly wage reductions of 0.91% per annum between 2005 and 2015, similar to the rate of decline among the 103 non-PRB occupations in the same SOC Major Group 3 and the adjacent Groups 2 and 4. The relative position of PRB Prison Officers deteriorates a little taking account of compositional change (Table 16, row 1, comparing data columns 3 and 6).

The comparison between PRB Prison Officers and all non-PRB occupations in the same part of the occupational distribution is not a sound basis for comparison because the two groups differ a great deal on their observed traits in 2005 (absolute standardised bias is 61.39). Nearest neighbour matching reduces this imbalance by 90%. Compared with their nearest neighbour, Fire Service Officers, earnings growth is 0.23 percentage points lower per annum for PRB Prison

Officers. However, compositional change adversely affects Fire Service Officers more than it does PRB Prison Officers such that residual wage growth is higher for PRB Prison Officers (0.85 percentage points per annum, Table 16, row 2, data column 6).

Table 16: Annual Growth in Median Real Wages, PRB Prison Officers

	Wage growth (%)			Residual wage growth (%)			Absolute standardised Bias	Bias Reduction (%)
Matching approach	PRB group	Comparator(s)	Diff (ppts)	PRB group	Comparator(s)	Diff (ppts)		
None	-0.91	-0.80	-0.10	-0.49	-0.15	-0.33	61.39	
NN	-0.91	-0.68	-0.23	-0.49	-1.34	0.85	5.93	90.34
5NN	-0.91	-0.31	-0.60	-0.49	-0.29	-0.20	25.76	58.04

Notes:
(1) Nearest neighbour is SOC(2010) 3313, Fire Service Officers
(2) Five Nearest Neighbours are: Fire Service Officers; Protective Service Associate Professionals n.e.c.; Brokers; Transport and Distribution Clerks; Public Service Associate Professionals

PRB Prison Officers also experience lower earnings growth compared with their nearest five neighbours (0.60 percentage points per annum), two-thirds of which is accounted for by differences in compositional change (Table 16, row 3).

6.3. Micro-analysis of Employees in Matched Occupations

To see whether the differences in earnings growth between PRB occupations and their matched comparators are statistically different from one another we run regression estimates at individual employee level to recover standard errors for those differences.

Table 17 presents results for the ten PRB occupations we focus on. In each case we construct an ASHE employee-level data set containing only those employees in the PRB and its nearest neighbour occupation, as identified in the matching exercise described in Section 5.2. We retain only those employees observed in 2005 and 2015 and run a quantile regression on median real wages for the pooled 2005/2015 data set. The regression contains a dummy variable for the PRB group where 1=PRB occupation, a year dummy where 1=2015, and the interaction between the two which captures the differential in median real gross hourly earnings between 2005 and 2015.[32]

[32] We are unable to incorporate all the covariates used in the matching estimator because those drawn from the APS such as education do not exist in the ASHE data at employee level. However, this does not matter in that these variables have already featured in the analysis by identifying the nearest neighbour comparator.

In the first row of Table 17 results are presented for PRB Nurses relative to their nearest neighbour non-PRB Nurses. PRB Nurses experience earnings growth of 1.4% between 2005 and 2015 compared with a fall of 7.3% for their nearest neighbour. This gap of 8.7 percentage points is virtually identical to the 0.88% per annum shown in row 2 of Table 6 and it is statistically significant.

Table 17: Change in Hourly Median Real Wages 2005-2015 – Micro-Analysis

PRB occupation	% growth	Non-PRB comparator	% growth	Percentage point difference	Significant?
Nurses	+1.4	Non-PRB Nurses	-7.3	+8.7	Yes
Radiographers	-19.6	Non-PRB Nurses	-7.3	-12.3	Yes
Physios	-13.4	Non-PRB Nurses	-7.3	-6.1	No
Midwives	-3.5	Non-PRB Nurses	-7.3	+3.8	No
Occupational Therapists	-8.0	Sports Coach/instructor	-0.6	-7.4	No
Doctors	-22.7	CEOs/Senior Officials	-31.8	+9.0	No
Nursing Auxiliaries	+7.5	Telephone Sales People	-5.8	+13.3	Yes
Teachers	-11.4	Non-PRB Teachers	-14.9	+3.5	No
Police Officers	-7.6	Fire Service Officers	-7.3	-0.3	No
Prison Officers	-9.1	Fire Service Officers	-7.3	-1.8	No

Notes:
(1) The non-PRB comparator is the 'nearest neighbour' occupation identified via propensity score matching.
(2) Rounding means percentage point differences in column 5 may not be exactly the difference between column 2 and column 4.
(3) These estimates, run at individual employee level for change between 2005 and 2015, may differ slightly from those presented at occupation level.

The only other PRB occupation which experienced significantly faster wage growth than its non-PRB comparator occupation was Nursing Auxiliaries. They experience earnings growth of 7.5% between 2005 and 2015 compared with a fall of 5.8% for their nearest neighbour, Telephone Sales People, a gap of 13.3 percentage points.

PRB Teachers experienced a decline of 11.4% in their median real gross hourly earnings over the period, whereas non-PRB Teachers experienced a decline of 14.9%, resulting in a gap of 3.5 percentage points over the ten-year period, identical to the 0.35 percentage point per annum from the matching estimates in row 2 of Table 14. However, the difference is only on the margins of statistical significance (t=1.66).

Although PRB Doctors experienced a decline of 22.7% in their median real gross hourly earnings over the period, the earnings of their non-PRB comparator fell

even further, such that PRB Doctors saw an increase in their relative earnings of 9 percentage points. However, again, the difference was not statistically significant.

PRB Midwives experienced only a moderate decline in their median real earnings: they fell 3.5% over the period. This was 3.8 percentage points less than their nearest neighbours, non-PRB Nurses, but the difference was not statistically significant. Again the figure replicates the 0.39 percentage point per annum difference recovered from the occupation-level matching (Table 10, row 2).

The remaining five PRB occupations saw faster earnings decline than their non-PRB comparators over the period but only in the case of PRB Radiographers was that difference statistically significant. They saw their median real earnings fall 19.6% over the decade, 12.3 percentage points more than their nearest neighbours, non-PRB Nurses (row 3 in Table 17). The difference is virtually identical to the difference of 1.2 percentage points per annum from the matching estimator presented in Table 8.

PRB Physios experienced a substantial decline in their median real earnings relative to non-PRB Nurses who were their nearest neighbour, but the 6.1 percentage point difference was not statistically significant (Table 17 Row 4). (The occupation-level matched estimates indicated a differential of 0.59 percentage points per annum, which is very similar).

These figures indicate that the fortunes of employees in PRB occupations have varied quite markedly over the course of the last ten years, even among those in occupations covered by the same PRB. The rates of earnings growth also vary a great deal when compared to their nearest neighbour occupations and, in some cases, the differences are both sizeable and statistically significant.

7. SUMMARY AND CONCLUSIONS

7.1. Key Findings

Between 2005 and 2015 there was a decline of 5.8% in median real hourly occupational earnings across all occupations. The decline was steeper among non-PRB occupations compared to PRB occupations (6.1% compared to 3.1%).

Among the 10 largest PRB remit occupations the arithmetic mean of the real median hourly occupational earnings fell 10.1% between 2005 and 2015. However, wage growth varied considerably across PRB occupations, even among occupations whose pay was set by the same PRB.

Relative to their nearest non-PRB comparators, earnings growth was higher for the PRB group in five cases and lower in five cases. However, differences were only statistically significant in three instances, with PRB Nurses and PRB Nursing Auxiliaries experiencing higher earnings growth than their non-PRB comparators, while PRB Radiographers experienced significantly lower growth than their non-PRB comparator occupation (Table ES1).

Accounting for compositional differences in the workers entering different occupations between 2005 and 2015, relative to their nearest non-PRB comparators, earnings growth was higher for the PRB group in seven cases and lower in three cases (Table ES2).

7.2. Findings in Detail

Table ES1: Growth in Real Median Hourly Earnings, 2005-2015

PRB occupation	% growth	Non-PRB comparator	% growth	Percentage point difference	Significant?
Nurses	1.4	Non-PRB nurses	-7.4	+8.8	Yes
Radiographers	-19.4	Non-PRB nurses	-7.4	-12.0	Yes
Physios	-13.3	Non-PRB nurses	-7.4	-5.9	No
Midwives	-3.5	Non-PRB nurses	-7.4	+3.9	No
Occupational Therapists	-8.0	Sports Coach/instructor	-0.6	-7.4	No
Doctors	-22.5	CEOs/Senior Officials	-31.7	+9.2	No
Nursing Auxiliaries	7.5	Telephone Sales People	-5.8	+13.3	Yes
Teachers	-10.1	Non-PRB Teachers	-13.5	+3.5	No
Police Officers	-7.5	Fire Service Officers	-6.8	-0.8	No
Prison Officers	-9.1	Fire Service Officers	-6.8	-2.3	No

Note: rounding means percentage point differences in column 5 may not be exactly the difference between column 2 and column 4

Table ES1 presents growth in median real gross hourly earnings for the 10 largest PRB occupations and their non-PRB comparator occupations between 2005 and 2015. Table ES2 presents earnings growth in the same way, having netted out the effects of workforce compositional change in the PRB and non-PRB comparator occupations.

Table ES2: Growth in Real Median Hourly Earnings Having Netted Out Changes in Workforce Composition, 2005-2015

PRB occupation	% growth	Non-PRB comparator	% growth	Percentage point difference
Nurses	8.6	Non-PRB nurses	6.4	+2.2
Radiographers	-13.9	Non-PRB nurses	6.4	-20.3
Physios	-7.4	Non-PRB nurses	6.4	-13.8
Midwives	6.1	Non-PRB nurses	6.4	-0.3
Occupational Therapists	1.1	Sports Coach/instructor	-0.9	+2.0
Doctors	-3.5	CEOs/Senior Officials	-28.3	+24.8
Nursing Auxiliaries	13.4	Telephone Sales People	-1.7	+15.1
Teachers	0.8	Non-PRB teachers	-2.9	+3.7
Police Officers	-6.3	Fire Service Officers	-13.4	+7.1
Prison Officers	-4.9	Fire Service Officers	-13.4	+8.5

The chief findings are as follows:

- PRB Nursing Auxiliaries experienced the highest absolute earnings growth, and the highest earnings growth relative to their non-PRB comparator. Their earnings gains were apparent having accounted for changes in occupational workforce composition.
- PRB Nurses experienced very low earnings growth, but it was significantly higher than the earnings growth experienced by their non-PRB comparator. However, the gap closes when accounting for changes in occupational workforce composition. Relative to their non-PRB comparator PRB Nurses experienced relative growth in the proportion working in London and the South East, increasing tenure and they were ageing more rapidly, all of which are conducive to relative improvements in earnings.
- PRB Midwives experienced a small decline in earnings, one that was a little smaller than that of their non-PRB comparator, although not significantly so. Accounting for changes in occupational workforce composition, they experienced earnings growth which was very similar to that of their non-PRB comparator.
- PRB Doctors have seen the biggest fall in median real gross hourly earnings out of the 10 PRB occupations, but the fall was not as large as that experienced by their non-PRB comparator. Furthermore, the decline is largely accounted for by compositional change among PRB Doctors, including a decline in their relative age and tenure. Having accounted for this the earnings growth PRB Doctors experience relative to their non-PRB comparator increases quite considerably.
- PRB Radiographers experienced a big decline in median real gross hourly earnings which is statistically significantly larger than the decline experienced by their non-PRB comparator occupation. The deficit remains large having accounted for changes in occupational workforce composition.

- PRB Physiotherapists' median real gross hourly earnings fell at nearly twice the rate of their non-PRB comparator occupation, though the difference is not statistically significant. The rate of earnings decline doubled relative to its non-PRB comparator occupation having accounted for changes in occupational workforce composition.
- PRB Occupational Therapists' earnings performed poorly relative to their non-PRB comparator occupation but this was wholly accounted for by changes in occupational workforce composition.
- PRB Teachers experienced real earnings decline which was slightly smaller than that experienced by its comparator occupation, non-PRB Teachers, but the difference is not statistically significant. For both occupations earnings decline is largely accounted for by changes in workforce composition.
- Police Officers and Prison Officers experienced moderate earnings decline that was similar to that for their non-PRB comparator occupation. Accounting for compositional changes in their workforces reduced the rate of earnings decline a little for both PRB occupations, whereas it doubled the rate of decline for their non-PRB comparator occupation, improving the relative position of the two PRB occupations.

7.3. Implications and Future Research

Earnings growth varies markedly across PRB occupations, even those whose pay is set by the same PRB. So it is important to understand earnings growth at the level of individual occupations. Comparing those movements to "like" non-PRB occupations is one way to assess whether PRB earnings growth is similar or different to what might have been anticipated given the position of PRB occupations in the earnings distribution and the nature of the workers undertaking the occupation. It is also possible to quantify earnings growth in PRB occupations relative to "like" non-PRB occupations having netted out the effects of compositional change in the individuals in those occupations.

There are various ways of identifying non-PRB comparator occupations. Previous studies use regression techniques to compare earnings in PRB occupations with other occupations, such as those in the rest of the public sector, or else they rely on "benchmarking" techniques based on case studies or qualitative assessments of occupational similarity. In this paper we have used propensity score matching to identify "nearest neighbours". The approach has a number of strengths and weaknesses compared to methodologies used to date.

Its chief strengths are:

- It permits comparison between specific occupations, as opposed to broader comparisons made across groups of occupations
- It quantifies the "closeness" of comparators in a transparent fashion which other analysts can replicate and, potentially, improve upon
- In contrast to standard regression techniques it assists the analyst in avoiding comparisons with occupations that may not constitute good comparators to PRB occupations
- The methodology is simple to implement
- It can be replicated over time to inform policy with up-to-date information

- By "balancing" PRB and comparator non-PRB occupational traits at the outset, one can argue that differences in subsequent earnings trajectories are independent of those observed traits at the outset.

Its chief weaknesses are:

- It is reliant on data capturing occupational features that are liable to affect the outcome of interest, in this case earnings growth.
- It can be sensitive to the methods used to estimate the metric for "closeness" and, having done so, the choices made as to which potential comparators to use.

Of course, the second of these weaknesses might also be perceived as a strength in the sense that it provides the basis for sensitivity analyses.

Regarding the first weakness, the data used in this paper do not contain information on job tasks: these may vary both within and across occupations and may drive some of the differences in earnings trajectories across PRB and comparator non-PRB occupations.

To our knowledge this sort of matching exercise has not been undertaken before and it is innovative for a number of reasons. First, we needed to construct a panel of PRB and non-PRB occupations going back some time which meant constructing those occupations whose occupational codes changed in 2010. This task is harder than one might think and there is value in researchers spending more time investigating the construction of occupational panel data series for exercises such as this one.

Second, the matching exercise itself was unusual in that we derived propensity scores from (0,1) regressions where only one of the observations – the PRB – scored '1' on the dependent variable. (Usually matching is applied to scenarios in which there are a number of treated as well as control cases). We therefore resorted to linear estimation. There are other ways one could undertake matching which might result in the identification of different counterfactual scenarios.

Third, there is little guidance as to what might reasonably enter a matching estimator to identify suitable comparators to PRB occupations when estimating relative earnings growth. Although we did some experimentation regarding the set of covariates used and their functional form, there is value in future work experimenting with different model specifications to establish how sensitive the identification of comparator occupations might be to choices made. That work could also usefully add in further data, such as data relating to job tasks, to improve the match across occupations. That said, the exercise shows one can do a reasonable job balancing on what appear to be relevant covariates to reduce bias when comparing wage growth across PRB and non-PRB occupations. Some matches obtained pass a face validity test in that they seem quite obvious (non-PRB Nurses for PRB Nurses, non-PRB Teachers for PRB Teachers, and so on), but this was not always the case.

Fourth, results will be sensitive to the period over which the analysis is undertaken. Our descriptive analyses illustrated how we would probably have obtained quite different results if we had begun the exercise in 2010. Instead we

chose a longer time-frame going back to the period prior to the recession, showing growth rates in the two sub-periods 2005-2010 and 2010-2015. When interpreting the results from the matching exercise it is important to recall that we are examining wage growth over 2005-2015, a decade that included the biggest recession in living memory, unprecedented declining real wage growth and a deterioration in public sector finances which resulted in public sector pay restraint from 2010 onwards.

Finally, we chose to estimate growth rates for median earnings rather than mean earnings so as to minimise the impact of changes in earnings variance over time. Of course, examining growth in the variance in occupational earnings is, perhaps, just as important from a policy perspective as it is to compare median earnings growth, but that would be a study in its own right.

Four further points are pertinent when considering future work. First, further work is merited to investigate why earnings growth differs so much across occupations within the same PRB. Differences may relate to issues such as changes in overtime work undertaken and the amount of bonus payments received. These components of pay and hours are available in ASHE for the reference period. Exploiting them could be valuable in helping further OME's understanding of the way earnings diverge. Second and relatedly, there is value in tracking individual workers over time to see how and why their earnings change. A focus on the earnings trajectories of individuals using the ASHE panel data could investigate issues such as the returns to changing occupations, changing jobs within and across employers, and the returns to tenure. Third, analysts are likely to do a reasonable job in estimating wage growth for PRB occupations relative to non-PRB occupations using a combination of ASHE and the APS. But it would be preferable if ASHE was larger to increase the precision of estimates and to permit analyses of smaller occupations. Finally, there are discrepancies between the number of OME and non-OME jobs in the economy as indicated by ASHE and APS. In some instances, the number of ASHE employees in particular OME PRB occupations is greatly in excess of the numbers recorded in APS. Although we think these discrepancies do not affect the chief findings in this paper, we do think they are important for staff planning more broadly.

The findings presented in this paper are informative from a policy perspective when PRBs consider pay setting for their remit occupations. The naïve description of earnings trajectories appears to be very valuable in its own right. It indicates remarkable variance in earnings growth even among occupations that fall within the remit of the same PRB. In the matching estimates we have shown that this variance is partly attributable to changes in the types of workers who enter and leave occupations, and the nature of employers and employment contracts. But, even when we account for these by focusing on change in residual wage growth, substantial differences in wage growth persist. This is likely to reflect what in the industrial relations literature is termed "wage drift", that is, movements in earnings over and above those relating to base wages, that arise due to changes in grading structures and premium payments, some of which we may not adequately account for in our analysis. The degree to which earnings growth varies across occupations even within the PRB sector is, perhaps, the biggest finding from the study. There is value in taking this analysis further by investigating what might lie behind it, for instance through more careful scrutiny of movements in sub-components of earnings. This sort of analysis is necessary if PRB's are to understand the links between the broad recommendations they

make for groups of occupations and the actual earnings growth for individual occupations covered by the same PRB.

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9. DATA APPENDIX

Identifying Pay Review Body Occupations in ASHE

This appendix outlines the means by which we identify 33 PRB remit occupations in ASHE. As ASHE changed from SOC(2000) to SOC(2010) in 2011, we give the codes for both classifications. There is a direct correspondence between the cited SOC(2010) and SOC(2000) codes, unless otherwise specified.

A number of PRB remit employees are excluded, for a variety of reasons:

- The version of ASHE in the Secure Data Service only covers employees in Great Britain; accordingly, any remit employees in Northern Ireland are excluded, as are the self-employed.

- The Armed Forces PRB is not covered in our study as the relevant persons are not included in ASHE.

- Both the Senior Salaries PRB and the National Crime Agency PRB are not covered in our study as the remit groups are too small (approx. 7,000 and 4,000 persons respectively) to attract sufficient numbers of observations in ASHE.

Appendix Table A1: PRB Occupations

	PRB	OCCUPATION	SOC2010	SOC2000	REGION	SECTOR/INDUSTRY
DOCTORS/ DENTISTS	1	Medical practitioners	2211	2211	All GB	Public sector
	2	Dentists	2215	2215	All GB	Public sector
NHS	3	Psychologists	2212	2212	All GB	Public sector
	4	Pharmacists	2213	1182, 2213	All GB	Public sector
	5	Opthalmic opticians	2214	2214	All GB	Public sector
	6	Radiographers	2217	3214	All GB	Public sector
	7	Podiatrists	2218	3215	All GB	Public sector
	8	Health professionals n.e.c.	2219	No equivalent	All GB	Public sector
	9	Physios	2221	3221	All GB	Public sector
	10	Occupational therapists	2222	3222	All GB	Public sector
	11	Speech and language therapists	2223	3223	All GB	Public sector
	12	Therapists n.e.s.	2229	3229	All GB	Public sector
	13	Nurses	2231	3211	All GB	Public sector
	14	Midwives	2232	3212	All GB	Public sector
	15	Paramedics	3213	3213	All GB	Public sector
	16	Medical and dental technicians	3218	3218	All GB	Public sector
	17	Nursing auxiliaries and HCAs	6141	6111	All GB	Public sector
	18	Ambulance staff	6142	6112	All GB	Public sector
	19	Dental nurses	6143	6113	All GB	Public sector
	20	Non-medical staff: Managers	1000s	1000s	All GB	Not in 1-19, but in public sector hospital
	21	Non-medical staff: Professionals	2000s	2000s	All GB	Not in 1-19, but in public sector hospital
	22	Non-medical staff: Assoc Prof and Technical	3000s	3000s	All GB	Not in 1-19, but in public sector hospital
	23	Non-medical staff: Admin and clerical	4000s	4000s	All GB	Not in 1-19, but in public sector hospital

	24	Non-medical staff: Skilled trades	5000s	5000s	All GB	Not in 1-19, but in public sector hospital
	25	Non-medical staff: Personal and protective service	6000s	6000s	All GB	Not in 1-19, but in public sector hospital
	26	Non-medical staff: Sales	7000s	7000s	All GB	Not in 1-19, but in public sector hospital
	27	Non-medical staff: Routine operatives and drivers	8000s	8000s	All GB	Not in 1-19, but in public sector hospital
	28	Non-medical staff: Elementary	9000s	9000s	All GB	Not in 1-19, but in public sector hospital
POLICE	29	Senior police officers	1172	1172	England and Wales	Local authority only
	30	Police officers (sergeant and below)	3312	3312	England and Wales	Local authority only
PRISONS	31	Operational managers	1173	1173	England and Wales	Justice and judicial activities in the public sector
	32	Prison officers	3314	3314	England and Wales	Public sector
TEACHERS	33	School teacher	2314, 2315, 2316 or 2317	2314 2315 or 2316	England and Wales	Public sector primary or secondary schools

Notes

(1): The following Standard Industrial Classifications were used to identify relevant PRB employees. Public sector hospitals: SIC(2007)=86.101 or SIC(2003)=85.111. Public sector justice and judicial activities: SIC(2007) 84.23 or SIC(2003) 75.23. Public sector primary and secondary schools: SIC(2007)=85.20, 85.30, 85.31, 85.32 or SIC(2003) 80.10, 80.21 or 80.22.

(2) 'Public sector' is defined using the IDBR Legal Status codes for 'Public Corporations', 'Central government' and 'Local authorities'. Accordingly, organisations coded on the IDBR as 'Private companies', 'Sole proprietors', 'Partnerships' and 'Non-profit organisations' are treated as not belonging to the public sector.

Appendix Table A2: Variables used in matching and regression analyses

Variable name	Description	Mean in 2005	Standard Deviation in 2005
p50_0515pc	Average annual percentage increase in occupation median wage, after adjusting for inflation (CPI), 2005-2015 (ASHE)	-0.540	1.415
xmale	Proportion of employees who are male (ASHE)	0.595	0.316
kids	Mean number of children per employee (including zeros) (APS)	0.675	0.181
age	Mean age of employees (ASHE)	40.211	4.145
married	Proportion of employees who are married (APS)	0.539	0.163
white	Proportion of employees who are from a white ethnic group (APS)	0.925	0.073
nqf78	Proportion of employees who are qualified to Level 7 or above in the National Qualifications Framework (APS)	0.075	0.121
nqf46	Proportion of employees who are qualified to Level 4-6 or above in the National Qualifications Framework (APS)	0.270	0.218
xlonsegor	Proportion of employees whose workplace is located in London or the South East (ASHE)	0.280	0.119
orglarge	Organization with 10+k employees (ASHE)	0.30	0.461
p50_xahe_d	Occupation median wage in 2005 (ASHE)	14.717	6.494
wchg02053	Real median earnings rose between 2002-2005 (ASHE)	0.32	0.468
dxmale	Change in proportion male, 2005-2015 (ASHE)	0.002	0.101
dage	Change in mean age, 2005-2015 (ASHE)	1.431	2.568
dnqf78	Change in proportion qualified to NQF Level 7 or above, 2005-2015 (APS)	0.040	0.092
dnqf46	Change in proportion qualified to NQF Level 4-6, 2005-2015 (APS)	0.045	0.119
dxoccent	Change in occupational entry rate (share of employees who were not in this occupation last year), 2005-2015 (ASHE)	-0.017	0.108
dxfirment	Change in inter-firm mobility rate (share of occupational non-entrants who were in a different firm last year), 2005-2015 (ASHE)	-0.013	0.072
dxft	Change in proportion of employees who work full-time, 2005-2015 (APS)	-0.007	0.103
dxtemp	Change in proportion of employees on temporary contracts , 2005-2015 (APS)	0.012	0.059
dxanyot	Change in proportion of employees who received overtime payments, 2005-2015 (ASHE)	-0.035	0.077

dxanysp	Change in proportion of employees who received shift premia, 2005-2015 (ASHE)	-0.015	0.076
didbrnemp	Change in average firm size , 2005-2015 (ASHE)	-1862.911	10059.730
dxtenure	Change in average employee tenure (years) , 2005-2015 (APS)	0.603	2.227
dxjprp2	Change in proportion of employees in PRP jobs , 2005-2015 (ASHE)	-0.066	0.109
dxabany	Change in proportion of employees in receipt of performance-related payment in the year, 2005-2015 (ASHE)	-0.029	0.122
dxcolag	Change in proportion of employees covered by a collective agreement, 2005-2015 (ASHE)	-0.082	0.128
dxanypen	Change in proportion of employees receiving employer pension contribution, 2005-2015 (ASHE)	0.142	0.155
dxlonsegor	Change in proportion of employees whose workplace is located in London or the South East, 2005-2015 (ASHE)	0.003	0.087