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Public Sector Resource Allocation Since the Financial Crisis

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Public Sector Resource Allocation Since the Financial Crisis.

Abstract

Purpose

Distinguishing what employers in different areas of Great Britain need to pay to attract and retain labour has been a central component of public sector resource allocation decisions. This paper examines how changes in the pattern of spatial wage differentials following the global financial crisis have impacted on the formulae which allocates government funding to local government and health providers in the NHS.

Design/methodology/approach

Using employer-reported data on earnings we examine spatial patterns of private sector wages in Great Britain between 2007 and 2017. Our method permits the analysis of finely defined geographical areas and controls for differences in industry and workforce composition to distinguish those differences that are attributable from unmeasured characteristics, such as differences between areas in the cost-of-living and amenities. These standardised spatial wage differentials (SSWDs) underpin the funding allocation formulae.

Findings

The analysis shows that since 2007 private sector wage dispersion, both within and between regions, has reduced: lower paid areas have experienced a relative increase in wages and higher paid a relative decline. Over the period there was a significant reduction in the London wage premium.

Originality/value

This paper demonstrates the importance of ensuring established policies are applied using contemporary data. The SSWDs used to distribute government funds have not been re-estimated for some time. As a result, the current resource allocation model has overcompensated the London region and undercompensated others during this period.

Keywords: resource allocation; labour cost variations; Market Forces Factor, Area Cost Adjustment, spatial wage differentials, regional wage differentials

JEL classification: E24, J31, H51

1. Introduction

During the period from 2007 to 2017 the British labour market experienced substantial change, most notably due to the recession which followed the Global Financial Crisis and the policies adopted in response to this. The impact of the recession differed between industries and occupations, and thus both between and within regions (Gregg *et al.*, 2014; Conlon *et al*., 2016; Cribb *et al*., 2017). In consequence, the pattern of private sector spatial wage differentials changed.

The level of services provided by the NHS and local government is determined by both the quantity and quality of the inputs they employ. To ensure that each health care provider or local authority in England and Wales has the opportunity to provide a common level of service the formulae distributing central government funding to these bodies contain an estimate of the differences in the price of the inputs required to deliver the services. Principal among these inputs is labour, which accounts for between 65% and 100% of the total cost of the factor inputs to these services. Spatial differences in the price of the labour input, are revealed by estimating spatial wage differentials. Those which cannot be attributed to differences in labour type or quality, are revealed by estimating standardised spatial wage differentials (SSWDs). SSWDs are estimates of spatial wage differences after controlling for the occupational and industrial composition of the workforce in each area, along with other factors determining wages such as age and gender.

The link between patterns of spatial wage differentials and the formulae determining public sector resource allocation makes the British context of empirical interest as an example of evidence-based policymaking. SSWDs have direct policy implications since they are used to construct the labour cost element of the Area Cost Adjustment (ACA) (Elliott *et al*., 1996) and the staff Market Forces Factor (sMFF) (Elliott *et. al*., 2006) which compensate, respectively, local authorities and health care providers for the, unavoidable, higher costs some

will encounter when purchasing labour inputs. Because labour is the most substantial factor input, differences in labour costs significantly affect the distribution of funds to health care providers and local authorities. The sMFF and the ACA have not been updated for some time. The sMFF at the time of writing was still based on wage data from the period 2007-09, while the ACA was based on wage data from 2009-2011. Because the pattern of spatial wage differentials has changed substantially over the period since 2007 these formulae reflect neither the current nor the recent pattern of labour cost differentials. As a result, some areas have been overcompensated while others have been undercompensated. This paper contributes to the literature on wage differentials by demonstrating that methods estimating SSWDs are sufficiently sensitive to identify different elements of labour market changes across time periods. The changing pattern of private sector SSWDs in Great Britain is documented and the implications for public resource funding allocation are considered. This paper is not intended to produce a critique of the use of SSWDs in the sMFF and ACA, our primary purpose is to provide a critique of the current implementation of this established policy. More generally, our results highlight the importance of ensuring the best available evidence base is still being used within established policies, especially following periods of economic crisis.

1.1. *Recent Research into Spatial Wage Differences*

The pattern of spatial wage differences has changed since 2007. Gregg *et al.* (2014) illustrate how recent patterns of real wage growth differ across the UK. From around 2000, real wages stagnated for all but the highest earners. Following the financial crisis, real wages declined more rapidly for the highest earners than for median and low wage employees. Likewise, Cribb *et al.* (2017) suggest that decreasing income inequality since 2007 is due to falling wages at the 90th percentile and rising wages at the 10th percentiles of the income distribution. Cribb *et al.* (2017) also note that differences both between and within regions remain. Conlon *et al.* (2016) demonstrate that the wage floor provided by the national minimum wage (NMW) had

a differential impact across regions of the UK. Although the 'bite' of the NMW (the minimum wage as a percentage of median earnings) increased across all regions of Great Britain after 2008, the magnitude of this change has differed between regions.

1.2. *Compensating Differences and Standardised Spatial Wage Differentials*

Wages differ between occupations and industries. Much research has focused on detailing differences in the spatial incidence of industries and occupations (for example, Gibbons *et al.* 2014). The different regional incidence of industries and occupations gives rise to spatial differences in average wages. However, even after controlling for these factors, spatial differences in average wages will remain. The theory of net advantages, more recently called the theory of compensating differences, first proposed by Adam Smith in *The Wealth of Nations* (Smith 1776, Book 1, Chapter X), explains why. Beyond differences necessary to compensate employees for the attractiveness and unattractiveness of working in different industries and the human capital investment associated with different occupations, it is necessary to compensate employees for differences in the cost-of-living and the attractiveness or unattractiveness of different areas. The theory of compensating differences informs the General Labour Market (GLM) hypothesis (Elliott *et al*., 1996) which argues that after standardising for all relevant compositional factors, spatial wage differentials, reflecting variations in the cost-of-living and amenity of different areas, will remain. For example, areas with high housing costs such as London, would be expected to offer higher wages than areas with lower housing costs, ceteris paribus. SSWDs are estimated to identify these underlying spatial wage differentials.

The GLM method provides the theoretical basis for the sMFF (Department of Health, 2008) and SSWDs are its empirical realisation. They are estimated to enable construction of the sMFF (Elliott *et al*., 2010a) and similarly the ACA (Elliott *et al*. 1996) using data for private sector employees. The most recent set of SSWDs estimated to construct the sMFF are for the

period 2007-2009. Details of this update are presented in Elliott *et al.* (2010b) and have been used in all subsequent periods to 2017.

Using identical data and methods, we reproduce the SSWDs for the 2007-2009 period, then calculate SSWDs for each subsequent three-year rolling period to identify how the pattern of spatial wage differences has changed over the decade to 2017. We use employer-reported, individual employee-level, wage data for private sector employees from the Annual Survey of Hours and Earnings (ASHE) (ONS, 2018). These data reveal that over the sample period (2007 to 2017) there has been a narrowing of the spatial dispersion of wage differentials in the Great Britain, with the advantage of those in the highest paid regions diminishing and the disadvantage of those in the lowest paid regions reducing. In particular, the like-for-like comparisons between regions enabled by the use of SSWDs reveal that the London premium has diminished in the period following the Global Financial Crisis. These results have important implications for public sector resource allocation. Most importantly, the failure to update the SSWDs which underpin funding formulae determining public sector resource allocation has resulted in high wage, the more affluent areas, being relatively overcompensated in periods following the Global Financial Crisis. This resulting allocation of resources will have been expected to influence recruitment and retention within the public sector workforce, and service delivery.

The next section outlines the conceptual framework underpinning our analysis. Section 3 gives details of the methods and data employed. Results are presented in Section 4. Section 5 discusses the implications arising from the analysis and Section 6 concludes.

2. Existing Evidence and Conceptual Framework

The increasing availability of employee-level data, which detail the key characteristics which define the composition of the workforce, has enabled analyses of the proximate causes of

regional labour market differences. Several papers identify variations in the skill level of the workforce, approximated by education or occupation, as a major determinant of spatial wage differentials. A key paper highlighting how sorting of employees into areas leads to regional wage differences comes from Duranton and Monastiriotis (2002). They show that the North-South divide in wages grew between 1982 and 1997 due to the migration of highly educated workers into London. Over this period returns to education increased throughout the UK, so regions with larger proportions of highly educated workers became more affluent relative to the rest of the UK. Once the level of education was controlled for, Duranton and Monastiriotis (2002) provide evidence that all key returns to workforce characteristics converged across regions. Dickey (2007) attributes increasing within-region income inequality between 1976 and 1995 to increasing returns to occupations and age. Likewise, Blundell and Etheridge (2010) attribute the growth in inequality during the 1980s and 1990s to area education differentials, but state that this became less important from 2000 onwards.

Other studies have gone beyond skill differences. Gibbons *et al*. (2014) use data from ASHE covering the period from 1998 to 2008 to control for the sorting of individuals into areas offering the greatest relative return for their skills. A range of time-varying individual characteristics (age, gender, occupation, industry, public sector employee, union membership, and part time status) are included in the wage equation. The inclusion of these characteristics greatly reduces the magnitude of observed spatial wage differentials. An alternative specification which includes an individual-specific fixed effect, rather than the time-varying characteristics, exhibits a similar pattern. Related to this, a novel method applied by Gibbons *et al.* (2011) adjusts wages for both skill and housing quality. Their main conclusion is that variations in wages between areas are offset by differences in the cost-of-living resulting from housing costs.

The General Labour Market (GLM) approach suggested by Elliott *et al.* (1996) acknowledges the range of factors controlled for in the studies cited above, but argues that beyond these there still remain, largely unmeasured, cost-of-living and amenity differences. Among the above studies, only that by Gibbons *et al*. (2011) attempts to capture this dimension. The GLM argues that in the competitive labour markets that characterise the private sector of the economy in Great Britain employers seek to attract and retain staff by paying higher wages in high cost and/or low amenity areas. The existence of these compensating differentials leads to variations in pay across the country. Moreover, in those labour markets in which the public sector competes for employees with the private sector, those same patterns reveal what the public sector should pay if it wishes to attract and retain employees. The empirical realisation of the GLM hypothesis is the spatial pattern of wage differentials within the private sector (SSWDs). For this reason, SSWDs are used to construct the sMFF and ACA, which are key components of the formula which distribute government funding to health care providers in the NHS and to local authorities. The sMFF and ACA are intended to provide an objectively justifiable indicator of relevant geographical pay differentiation. However, this may not be true if these measures are not regularly updated.

Our approach in this paper uses SSWDs, which are the foundation of the sMFF and ACA and which account for relevant observable differences in workforce and industry composition, to investigate the evolution of private sector wages in Great Britain. This allows us to assess the extent to which public sector resource allocation would have differed if the sMFF had been updated to reflect changes in local labour markets following the Global Financial Crisis.

3. Method

Our empirical approach is driven by methods and data which are used to calculate the sMFF and ACA, as detailed in Elliott et al. (2010b) and used within the NHS during our sample period (Department of Health, 2008). Although other empirical approaches exist, particularly in relation to investigating income inequality, our objective is to assess the effect of spatial wage differential on public resource allocation. Consequently, we adopt the specific approach used to determine the distribution of resources and our model specification is determined by what is used in practice, rather than the range of alternative specifications proposed in tangential literature.

The basis for our analysis is a set of SSWDs. The standardisation process controls for differences in the industrial and occupational composition of the private sector workforce between areas. If the standardisation process is complete and without error, any remaining variation in wages between areas is assumed to reflect differences in amenity and the cost of living (Elliott *et al.*, 1996; Gibbons *et al.*, 2011). To enable comparison between different areas of Great Britain we estimate SSWDs for the private sector using the following formula:

$$\ln w_{ij} = x'\beta + \nu_j + \varepsilon_{ij} \quad (1)$$

where w_{ij} is the natural log of hourly wages (gross pay divided by hours, including overtime) of individual *i* who works in area *j*. A vector of control variables *x* enables standardisation across areas. We control for age, age^2 (divided by 100), gender, part-time status, industry, occupation, and year.

The individual-specific error terms are captured by ε_{ij}. Population weights (provided by ASHE to calibrate to population totals from the Labour Force Survey based on classes defined by occupation, region, age and sex) are applied to the regressions to improve the national representativeness of the results.

Each three-year rolling period uses approximately 300,000 individual-level observations. From the regression output we extract 379 SSWDs. The SSWDs are captured by the area-specific dummies v_j, which are effects coded such that the reference category becomes the overall mean of the SSWDs for Great Britain. This process aids the interpretation of the SSWDs which would otherwise be relative to an arbitrarily chosen reference category. Within the final measure, the mean private sector wage at the national level will always be exactly 100, due to effects coding. Any area with an SSWD above 100 has average private sector wages above the national average, while SSWDs below 100 indicate relatively low-paid areas.

After estimating the SSWDs on the natural logarithmic scale, we then express this based on the original wage scale by taking the exponent of the SSWD. The final SSWDs can be expressed as:

$$SSWD_j = 100 \cdot \frac{\exp(v_j)}{\exp(\bar{v})} \quad (2)$$

The Local Authority District (LAD) geography was found to be the most appropriate for estimating SSWDs by Elliott *et al.* (2006). A benefit of the LAD classification is that this ensures the greatest number of boundaries amongst the available geographical identifiers, which limits the scope for extreme differences in estimates between neighbouring areas. Since our analysis concentrates on spatial variations in wages it was necessary to apply a consistent classification of geography across the sample period. We applied the LAD classification from the 2013-15 period across all other periods. This approach ensures that the effect of LAD mergers in England during the sample period will not influence our results.

3.1. *Data*

To estimate SSWDs we use data from the ASHE (ONS, 2018) for the ten-year period since the beginning of the Global Financial Crisis (2007-2017). ASHE is an annual survey of employers which provides a number of variables for approximately 1% of employees in Great Britain.

One key feature of ASHE is that information on hours and earnings are reported by the employer, rather than the employee, to improve the accuracy and reliability of the data. Providing accurate information for this survey is a statutory requirement. Our sample includes all private sector employees, aged 16 to 70, with no loss of pay due to absence during the ASHE reference period. We pool these observations over three-year rolling periods in order to provide sufficient data to estimate SSWDs for finely identified geographical areas, thus improving the precision of the estimates. This approach also has the advantage of reducing volatility between periods which may result from sampling variation.

A key employee characteristic within the GLM model is the occupation of an individual. We control for occupation using Standard Occupational Classification 2010 (SOC2010) dummies constructed at the 3-digit level. These capture differences in skills between individuals, both those acquired through formal education and those acquired in through on-the-job training, in addition to other characteristics of the employment which may determine wages.

One challenge when estimating SSWDs across our sample period is the change in occupation classification within the UK which took place in 2010 and was incorporated into ASHE in 2011. Under the previous classification, Standard Occupational Classification 2000 (SOC2000), a relatively high proportion of the workforce was classified as managers (SOC2000 major group 1) in comparison to other developed economies. This was addressed in the SOC2010 revisions where a number of SOC2000 major group 1 codes were reclassified. Further changes included the reallocation of nursing and IT-related occupations. Elias and Birch (2010) show that the overall effect of the classification change is to reduce the relative proportion of the male workforce in major group 1, and increase the proportions in major groups 2 (Professional Occupations), 3 (Associate Professional and Technical Occupations), and 5 (Skilled Trades Occupations). For females there is a reduction in both major groups 1

and 3, and an increase in major groups 2, 4 (Administrative and Secretarial Occupations), 5, and 7 (Sales and Customer Service Occupations).

To enable valid comparisons between periods with different occupation classifications, we convert the majority of SOC2000 codes to SOC2010 at the four-digit level using crosswalks suggested by UK Visas and Immigration (2014) and Office for National Statistics (2010). The final analysis presented within this paper uses SOC2010 codes at the three-digit level.[1]

4. Results

4.1. *Descriptive statistics*

Descriptive statistics for our sample are contained within the Table 1. The mean age of employees is approximately 39 years old in all periods shown in Table 1, while there appears to have been a slight decrease in the male share of total employment over the sample period. Table 1 indicates that the mean hourly wage has increased slightly with mean basic hours worked remaining stable, overtime hours being reduced, and an increase in part-time employees - who are historically paid at an average hourly rate below that of equivalent full-time employees. Given that the incidence of part-time employment increased, and this would be expected to reduce the observed mean of basic hours worked, this suggests that full-time employees are in general working a greater number of hours per week than before the crisis. These additional hours may be neither classified nor remunerated as overtime.

< Table 1 >

[1] In cases where a one to one conversion was not possible, we separately identified SOC2000 codes by adding a prefix to the code. For example, SOC2000 code 1123 was reclassified as 201123 to avoid confusion with SOC2010 code 1123. This auxiliary classification was necessary since analysis indicated statistically significant differences between identical SOC2000 and SOC2010 codes. Therefore, a small number of observations within the sample use the auxiliary coding at a five-digit level – i.e. 3-digit SOC2000 codes with a two-digit prefix added.

The regional composition of the sample (defined by ONS classification RGN16CD) has changed very little throughout the sample period. One exception to this is that the proportion of the sample based in London has increased from 14.6% to 16.0% between the first and last three-year period. This increase in the London sample share appears to result from several small decreases in other regions, the largest of which is a 0.4% decrease in the East of England share. Each of the changes indicated by the descriptive statistics may reflect an underlying change in the structure of the national economy, such as continued population growth in London. However, we cannot rule out that the changes simply result from sampling variation in ASHE. Further investigation of the source of changes is not essential to justify our findings since our model specification controls for variation in observable differences. The SSWDs are area effects over a three-year period based on all other things being equal. This is the standardisation process within the GLM approach which controls for changes in the structure of economies and sampling variation.

4.2. National changes in private sector wages

The GLM method standardises the spatial wage differentials by including characteristics of the employee and employment relationship. To investigate the relative contribution of each category to explaining spatial wage differentials we introduce the controls sequentially. Table 2 illustrates the relative explanatory power of the control variables. To enable clear presentation, three periods are shown (2007 to 2009, 2011 to 2013, and 2015 to 2017) which represent the first, last, and middle period within the sample. These periods span the period of the Global Financial Crisis within Great Britain, from the beginning of the recovery through to the most recent period. Table 2 is representative of trends throughout the sample period and the selection of periods within our sample does not substantially alter the interpretation of the results (as can be seen from Figures 1 and 2 in the next section). Columns 1, 5, and 9 report the exponent of the area dummies generated by the main estimating equation prior to including

any additional controls. These results can be considered as the 'raw' spatial wage differentials prior to standardisation. For each period reported, the next three columns progressively introduce a greater number of control variables to our model.

The addition of more control variables in Table 2 consistently reduces the level of dispersion observed within the national-level distribution of SSWDs by narrowing the range and lowering the standard deviation. Additional controls are also observed to greatly increase the explanatory power of the model. In keeping with the extant literature, for example Gibbons et al (2014), controlling for variation across areas in the occupation structure of the workforce explains the greatest proportion of spatial differences in private sector wages.

< Table 2>

A comparison of columns 4, 8, and 12 in Table 2 indicates the changes in standardised spatial wage differentials during the ten years following the financial crisis. Over this period, we observe that the range between the 90th and 10th percentile has narrowed. Furthermore, there has been a reduction in the standard deviation, and the lowest SSWD observed has increased. The maximum value of the SSWDs shows a slightly different pattern with an initial increase followed by a substantial decrease. By the end of the period the maximum value has fallen below the maximum SSWD value in the first period of our sample.

Over the sample period the rate of change in these characteristics of the distribution differs. The reduction in the standard deviation between 2011-2013 and 2015-2017 (10.90%) is approximately double the rate of reduction between 2007-2009 and 2011-2013 (4.73%). Conversely, the range between the 90^{th} and 10^{th} percentiles decreased by 11.63% between the first period (2007-2009) and 2011-2013, while the equivalent figure is 4.90% between the later periods reported in Table 1. This suggests that changes in the national-level distribution of private sector wages between 2007-09 and 2011-13 are due to rising wages within many low-

wage areas, which results in the minimum observed value increasing and the range between the 90th and 10th percentiles to decreasing. The trend of rising wages within many low-wage areas appears to have continued, although possibly at a slower rate, beyond the mid-point of our sample period. From this time point, the rate of reduction in dispersion of the SSWDs increased due to a concurrent decrease in wages within areas with the highest wages – above the 90th percentile of the national distribution. This evidence combines to indicate that the changes in local labour markets within the sample period will depend on an area's average wage and position within the national private sector wage distribution.

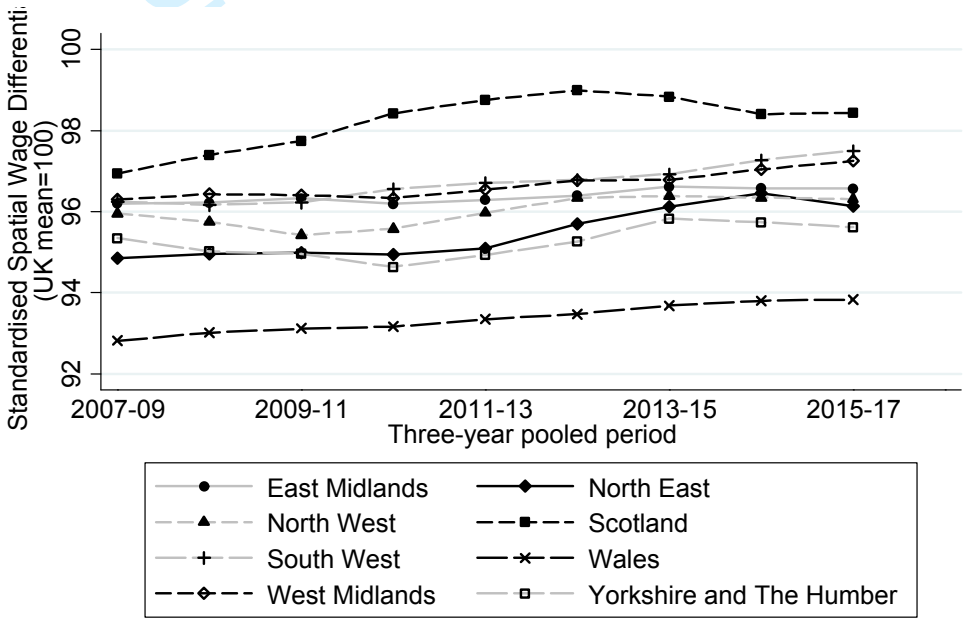
4.3. *Inter-region differences in private sector wages*

A similar pattern of falling wages at the top of the distribution is observed when we aggregate LAD-level SSWDs to investigate region-level labour markets. Figure 1 presents the trend over time of SSWDs within the three regions with private sector wages above the national average.

Source: Authors' calculations using the Annual Survey of Hours and Earnings
Notes:
Mean standardised spatial wage differential (SSWD) of all Local Authority Districts (LADs) within each region (defined by classification RGN16CD).

Figure 1. Trends in Mean SSWD for Regions above the National Mean

Very little change is observed from the initial period to 2009-11. However, beyond this point a persistent and substantial decline is observed within London, the region with the highest level of private sector wages. It appears that the reduction in private sector wages in London, relative to other regions in Great Britain, reduces the maximum value observed within the national-level distribution of private sector wages. Although the extent of the change differs by region, even after standardising for relevant compositional factors, all regions above the national mean in the first period have a lower mean SSWD at the end of the sample period.



Source: Authors' calculations using the Annual Survey of Hours and Earnings
Notes:
Mean standardised spatial wage differential (SSWD) of all Local Authority Districts (LADs) within each region (defined by classification RGN16CD).

Figure 2. Trends in Mean SSWD for Regions below the National Mean

Below the national mean we observe a general pattern of rising wages. Figure 2 illustrates how the minimum observed SSWD value has increased over the sample period, and when combined with the findings from Figure 1 this has reduced the overall spatial dispersion of standardised private sector wage differentials. Within Scotland, the area closest to the national mean, we observe a rapid increase in private sector wages at the start of the sample period. This is followed by a levelling off, or even slight decline, towards in later periods. Other

region-level trends differ between periods, however, all regions below the national mean have a higher mean SSWD at the end of the sample period compared to the initial level.

Overall, the changes in private sector wages (summarised in Table 3) show a sustained reduction in inter-region dispersion, rather than a sudden change following the onset of the financial crisis. Although the direction of movement has not always been consistent between periods, those regions below the national average have seen the disadvantage reduce while regions above the national average have seen the advantage reduced. For regions with average private sector wages above the national mean, two of the three regions have experienced a statistically significant ($P<0.1$) reduction in average wages. Below the national mean, four of eight regions have experienced a statistically significant ($P<0.1$) increase in private sector wages between the first and last period. Due to the consistent geography, occupation, and industry classification applied to the dataset we can be confident that the observed narrowing of dispersion in the SSWDs is due to factors which have changed over time and which are not determined by compositional factors within the regional labour markets.

< Table 3 >

The advantage of employees in the private sector in the highest paid region, London, has reduced by over 3% (115.789% - 112.139%) of the national average in the years 2007-2009 to 2015-17. No region has experienced changes of the magnitude observed in London, which indicates that the London premium paid to private sector employees has fallen over the sample period. Since the figure for London and all other regions is the mean of the SSWDs for the individual LADs within a region, this reduction may be driven by a reduction in the intra-region dispersion of SSWDs. We investigate this latter point in the next section.

4.4. *Intra-region differences in private sector wages*

The analysis in the previous sections focused on measures of dispersion relating to the national-level distribution of SSWDs and compared trends in the means of the region-level distributions of SSWDs. In this section we compare measures of dispersion relating to the region-level distributions of SSWDs over the sample period.

< Table 4.>

Table 4 provides the standard deviation, interquartile range, and range for each region within our study over the three periods which we focus upon. Computing region averages enables us to look in detail at the wage structure, to distinguish a variety of measures of dispersion, and to identify changes in wage dispersion in each of the separate labour markets which exist at this level. The intra-region analysis is less compelling, in terms of statistical significance, than the inter-region analysis. However, there is some indication that the trend of reduced dispersion, a narrowing of the private sector wage distribution, observed at the national level is also broadly evident at the region level.

Analysis of region averages reveals that in all regions the dispersion of wages around the mean has fallen, often with substantial changes occurring at the top of the earnings distribution. Thus, in London the maximum value within the region has fallen from 151.842% in 2007-2009 to 147.270% of the national average in 2015-2017, while the interquartile range has decreased from 15.503 to 14.950. However, the picture is not one of universal narrowing at the top. In Scotland, the West Midlands, and Yorkshire and The Humber the highest observed value is largely unchanged over the period, while in the North East it has increased from 98.958% to 101.191%. In the East Midlands and North West the interquartile range has increased, despite a reduction in the maximum value and standard deviation. However, the

intra-region reduction in dispersion of SSWDs is only statistically significant in Scotland and the East of England, although most regions have a lower standard deviation and interquartile range in the last period compared to the first. Overall, it appears that inter-region rather than intra-region changes have driven the reduction in dispersion observed at the national level.

5. Discussion

Our analysis clearly demonstrates that the pattern of standardised spatial wage differentials has changed. All the evidence indicates reduced dispersion in private sector wages between regions, and some evidence suggests this change has also occurred within regions. Our results are consistent with the findings of Gregg *et al.* (2014) and Cribb *et al.* (2017) in demonstrating that at the national level the wages of the highest earners have fallen while the lowest earners have received a relative increase in wages. Our analysis adds to this literature by demonstrating that this pattern is also observed using finely detailed geographical identifiers. We observed that the advantage of areas with the highest levels of private sector wages has diminished, while the disadvantage of the lowest wage areas has reduced. One implication of our results is that wage inequality appears to have declined nationally. Whereas Dickey (2007) attributed rising inequality in an earlier period to increasing within-region inequality, our results suggest that changes in the ten years to 2017 have been substantially driven by reduced between-region wage differentials. The focus of the analysis is the private sector, the section of the economy which accounts for 8 out of every 10 employees and in which wages are least regulated. There has been little regulation of private sector wages during the sample period, save for the impact of the National Minimum Wage which has set a floor under wages but does not directly affect the higher earners. Thus, the pattern revealed here does not appear to be wholly attributable to increases in the NMW, rather the result of interplay in market forces determining wages.

We find that substantial differences, between areas, exist in average wages even after controlling for differences in the characteristics of the workforce in different areas. Duranton

and Monastiriotis (2002) and Gibbons et al. (2014) have previously identified relevant compositional factors which influence spatial wage differentials. The measure employed in our analysis, SSWDs, controls for differences between regions in hours worked, share of part-time employment, in the age and gender composition of the employed workforce in the private sector, and in the industrial and occupational composition of employment in the private sector. Therefore, the differences we observe over multiple periods cannot be explained by short-run changes, such as sorting of high ability workers into cities. Consistent with the GLM hypothesis (Elliott et al., 1996), this implies that the observed changes in private sector wage differentials reflect shifts in the amenity and cost of living within areas.

Our analysis suggests that the largest changes in amenity and cost of living have occurred within the London region, although this region continues to have levels of private sector wages which are substantially above the national average. The evident London differential reveals that within any given occupation or industry those who work in London enjoy higher pay than those in other regions. This advantage is sometimes referred to as the London premium and has been evident for decades (Davies and Wilson, 2002).

The existence of the London premium has historically led to difficulties in recruiting and retaining public sector employees in London (Dickerson and Wilson, 2003). Pay setting within the public sector is often governed by national rates with a London premium directly added to compensate employees for living within a high cost area. The size of the London premium can be determined with reference to comparable jobs in the private sector. For example, throughout our sample period the high cost area supplement determined by the NHS Pay Review Body (NHS, 2019) was stable at between 5% and 20%, depending on the proximity to inner London. Our analysis suggests that in the period following the financial crisis the London wage premium in the private sector has declined by around 3% of the national average wage in the private sector. Changes in the spatial pattern of private sector pay will have

implications for the relative ability of public sector employers in different locations to attract and retain employees. Pay setting which does not reflect the decline in the London premium identified by our analysis would result in public sector employers being overcompensated relative to equivalent private sector employees in the same region, and public sector employees in the other regions. If public sector jobs are overcompensated relative to the private sector, public sector vacancies would appear more attractive in the labour market. Likewise, existing public sector employees may find pay offers from alternative employment less attractive if they are currently overcompensated relative to the private sector.

We have shown that changes in the British labour market have resulted in changes in the SSWDs which determine the allocation of funding of health providers in the NHS and local government in England and Wales. SSWDs should provide an objectively justifiable approach to distributing funding which is underpinned by strong theoretical foundations and robust approach to estimation. Crucially this is only true if the SSWDs are updated regularly to reflect changes in the pattern of spatial wages differentials. However, the failure to update the SSWDs used to determine the sMFF and ACA has resulted in the incorrect allocation of funding. Although the London premium has diminished in the private sector, and other changes of a smaller magnitude have occurred, this has not been reflected in the funding formulae determining resource allocation in the public sector. The most recent review of the sMFF methodology was conducted prior to calculating the rate using the 2007-2009 period (Elliott et al., 2010b). Within this review was a recommendation to estimate the sMFF annually based on a 3-year rolling period of pooled ASHE data, as has been done in our analysis using identical data and methods. Implementing this recommendation fully would have resulted in changes being made to resource allocation regardless of the statistical significance of changes in the SSWDs. However, in practice, the sMFF rate for the 2007-2009 period was used in all subsequent periods when determining resource allocation during our sample period.

Consequently, our analysis suggests that NHS resource allocation in England will have overcompensated Clinical Commissioning Groups (CCGs) in London and the South East while undercompensating many less affluent regions. The most substantial difference is within the London region, where on average CCGs are estimated to have been overcompensated by 3.65% in terms of the SSWD value in the final period of our sample. It is beyond the scope of this paper to provide details of how the changes in the SSWDs recorded here would feed through the multifaceted allocation formulae and impact the funding provided to individual health care commissioners. This would require the complete allocation formula to be run within the simulation models employed by the two government departments responsible for allocating funding. Neither the formulae nor the simulation models are in the public domain. However, as way of illustration, CCGs channelled approximately £75.6bn (70% of NHS England's budget) through to Hospital Trusts in 2018/19. Of that, London CCGs were allocated £11.8bn. An overestimated SSWD for London that feeds through, for example, to a 1.5% overestimated allocation of funds equates to £177m. Local authorities within the London region will also have been overcompensated, since the ACA used to determine the allocation of funding has been based on the 2009-2011 period. These relative differences in resource allocation may have influenced the level of staffing and service delivery between regions.

6. Conclusions

In this paper we have presented a set of private sector spatial wage differentials which are standardised to remove the influence of variations in workforce and industry composition between areas. The results show that in the ten years following the Global Financial Crisis there has been a narrowing of dispersion in SSWDs. Furthermore, there has been changes in the London labour market which have reduced private sector wage differentials with the rest of Great Britain.

This paper clearly demonstrates that SSWDs cannot be assumed to be constant, even over relatively short periods. Consequently, public sector pay-setting and resource allocation decisions which are informed by changes in private sector wage differentials should be regularly updated to ensure decisions are made which reflect the current circumstances. The relevance of this point extends to all established policies which are designed and determined by an underlying distribution. Such policies will have undergone substantial development to ensure they are conceptually sound and well implemented in the initial stages. However, a failure to update distributional assumptions, particularly following periods of economic crisis, may undermine confidence and understanding of a policy amongst relevant groups. Ensuring an established policy continues to be soundly implemented is an efficient approach to policymaking, and an appreciation of fluctuations in the evidence base is essential to this approach.

A policy may not be effective in achieving the desired outcomes when it is based on a historical distribution. This is most pertinent to the staff Market Forces Factor and Area Cost Adjustment since their formulae are underpinned by the SSWDs presented within this paper. Our analysis demonstrates that recent allocations using these formulae will have been incorrect due to their overreliance on historical area differentials in private sector wages. Further research is needed to investigate the impact of the failure to update the sMFF and ACA, but it seems likely that the relative over or under compensation of CCGs and local authorities will have impacted on staff recruitment and retention, and this may have influenced the effectiveness of service delivery.

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Table 1. Employment Characteristics and Regional Composition of the Sample

	2007-09	2011-13	2015-17
Log of gross hourly pay (overtime adjusted)	2.379	2.432	2.517
	(0.572)	(0.565)	(0.543)
Age	38.748	39.185	39.463
	(12.901)	(12.952)	(13.078)
Male	0.593	0.587	0.581
Basic hours	33.675	33.095	33.358
	(10.875)	(10.918)	(11.708)
Overtime hours	1.451	1.225	1.122
	(4.758)	(3.885)	(3.692)
Part-time employee	0.235	0.259	0.257
Region			
East Midlands	0.076	0.077	0.076
East of England	0.101	0.098	0.097
North East	0.037	0.036	0.035
North West	0.108	0.108	0.108
Scotland	0.080	0.081	0.078
South East	0.148	0.147	0.148
South West	0.087	0.088	0.088
Wales	0.040	0.040	0.039
West Midlands	0.100	0.097	0.097
Yorkshire and The Humber	0.077	0.075	0.074
London	0.146	0.153	0.160
Observations	284,198	333,837	345,272

Standard deviation in parentheses for continuous variables only.
Source: Annual Survey of Hours and Earnings

Table 2. The Effects of Standardisation on the Spatial Wage Differentials Regressions (2007-2017)

	1	2	3	4	5	6	7	8	9	10	11	12
	2007-2009				2011-2013				2015-2017			
	No control variables	Age, Sex, and part-time dummies added	Occupation dummies added	Full Set of Control Variables: Industry dummies added	No control variables	Age, Sex, and part-time dummies added	Occupation dummies added	Full Set of Control Variables: Industry dummies added	No control variables	Age, Sex, and part-time dummies added	Occupation dummies added	Full Set of Control Variables: Industry dummies added
Mean	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
Standard Deviation	18.471	16.541	9.591	9.085	17.874	15.870	9.229	8.655	15.902	14.290	8.115	7.712
10th Percentile	83.664	84.700	90.727	91.171	84.180	86.353	91.395	92.149	85.688	87.072	92.127	92.684
50th Percentile	96.017	95.124	97.485	97.607	95.809	96.041	97.932	97.953	96.471	96.627	98.304	98.371
90th Percentile	121.624	120.161	111.867	111.900	119.853	118.806	110.676	110.467	120.473	117.002	110.605	110.105
90th minus 10th percentile	37.960	35.461	21.140	20.729	35.673	32.452	19.281	18.318	34.785	29.930	18.477	17.421
Minimum	73.905	78.913	84.492	85.168	75.642	79.355	86.827	87.753	76.463	78.855	87.807	89.385
Maximum	239.859	222.700	159.821	151.842	238.725	223.208	162.815	155.544	222.642	208.651	153.177	147.270
Adj. R^2	0.131	0.347	0.625	0.644	0.137	0.353	0.607	0.630	0.129	0.332	0.598	0.621

Source: Authors' calculations using the Annual Survey of Hours and Earnings

Notes:

Summary statistics for all periods are reported at the Local Authority District (LAD) level for a total of 379 LADs.

The minimum and maximum is the estimated regression coefficient for a single LAD.

One LAD with less than 10 individuals in each year was merged with a neighbouring LAD for the analysis.

Table 3. Mean Regional Standardised Spatial Wage Differentials (Great Britain mean =100)

Region	2007-2009	2011-2013	2015-2017
London	115.789	114.209***	112.139***
South East	105.708	105.493	104.833*
East of England	101.438	100.899	101.122
Scotland	96.940	98.754***	98.442***
South West	96.249	96.704	97.503**
West Midlands	96.304	96.538	97.249*
East Midlands	96.203	96.295	96.575
North West	95.956	95.974	96.311
North East	94.846	95.098	96.136*
Yorkshire and The Humber	95.348	94.936	95.620
Wales	92.814	93.342	93.836
Great Britain	100.000	100.000	100.000

Source: Authors' calculations using the Annual Survey of Hours and Earnings
* p < 0.10, ** p < 0.05, *** p < 0.01
Notes:
Mean standardised spatial wage differential (SSWD) of all Local Authority Districts (LADs) within each region.
Regions defined by classification RGN16CD using a total of 379 LADs.
Statistical significance provided for a two-tailed t-test for equality, to the first period, of the region-level mean.
One LAD with less than 10 individuals in each year was merged with a neighbouring LAD for the analysis.

Table 4. Measures of Dispersion for Regional Standardised Spatial Wage Differentials (Great Britain mean =100)

Region	2007-2009	2011-2013	2015-2017
London	11.917 (15.503) [101.432-151.842]	12.994 (15.735) [100.278-155.544]	11.662 (14.950) [97.873-147.270]
South East	8.594 (14.570) [90.351-127.653]	8.576 (12.065) [88.993-127.516]	7.716 (12.103) [90.442-122.101]
East of England	7.959 (10.225) [89.922-127.685]	6.348 (11.211) [88.101-110.916]	5.908** (6.154) [92.197-113.664]
Scotland	4.231 (5.659) [90.889-110.013]	5.010 (5.444) [89.481-113.283]	4.087** (4.054) [90.601-110.595]
South West	4.933 (6.939) [88.509-108.068]	4.692 (5.772) [87.753-106.239]	4.414 (6.618) [89.422-106.357]
West Midlands	4.010 (6.868) [90.784-107.897]	4.597 (7.413) [90.12-106.331]	4.452 (6.099) [90.918-107.552]
East Midlands	4.468 (5.066) [86.067-107.146]	4.055 (5.778) [89.109-105.372]	3.481 (6.154) [89.842-102.573]
North West	4.038 (4.864) [88.142-105.994]	3.414 (4.538) [88.211-103.836]	3.534 (5.834) [89.695-103.083]
North East	2.763 (4.194) [89.967-98.958]	1.988 (1.124) [91.131-98.281]	2.750 (3.691) [92.900-101.191]
Yorkshire and The Humber	2.875 (3.381) [90.842-102.426]	2.685 (1.799) [90.652-102.319]	2.815 (2.342) [89.385-102.231]
Wales	4.873 (7.110) [85.168-102.539]	3.535 (4.578) [87.857-101.285]	3.056 (4.909) [89.513-99.728]

Source: Authors' calculations using the Annual Survey of Hours and Earnings

* p < 0.10, ** p < 0.05, *** p < 0.01

Notes:

Standard deviation, (interquartile range) and [range] for standardised spatial wage differentials (SSWDs) based on all Local Authority Districts (LADs) within each region.

Regions defined by classification RGN16CD using a total of 379 LADs.

Statistical significance provided for a two-tailed F-test for equality, to the first period, of the region-level standard deviation.

The minimum and maximum is the estimated regression coefficient for a single LAD.

One LAD with less than 10 individuals in each year was merged with a neighbouring LAD for the analysis.