Understanding income at small area level

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Abstract

The Office for National Statistics has produced experimental estimates of average household income for Middle Layer Super Output Areas (MSOAs) in England and Wales. These are based on the Family Resources Surveys of 2004/05 and 2007/08, using a model which draws on administrative data to produce estimates for small areas.

This article looks at spatial disparities in average income, in particular how it was distributed within regions and local authorities.

The article found wide variation in patterns of average household income, in particular London had the widest spread whilst Wales had the narrowest spread, based on net income before housing costs (BHC) in 2007/08.

Wales had the largest increase in average household income BHC since 2004/05, with the North West and South West having the smallest.

West Midlands and the North East had seen the gap between the richest and poorest areas decrease the most, with only the East Midlands having a large increase in gap.

Summary guidance is provided on issues associated with using model-based estimates.

The article should be of interest to planners and regeneration specialists, and those who want to understand local economies.

Introduction

This article focuses on the model-based estimates of average household income[1] for Middle Layer Super Output Areas (MSOA) – see Glossary – produced by the Office for National Statistics. It aims to explore how income was spread within regions and whether there had been any major changes over a three-year time period.

The article consists of the following sections:

- An introduction to the model-based estimates and how they should be used

- A study of how income was distributed across and within Wales and the nine regions of England

- An assessment of how income in each region has changed between 2004/05 and 2007/08. Also, whether the variation in income within-region has changed, including whether the gap between the areas with highest incomes and those with lowest incomes has changed.

Small area income estimates, 2007/08

The new model-based income estimates for England and Wales have been produced to fulfill a requirement for more up to date income information at the local level. They are estimates of average weekly household income for MSOAs based on data from the Family Resources Surveys (FRS) of 2004/05 and 2007/08. They are currently classed as experimental statistics.

Four estimates of average weekly household income were produced:

- Gross income

- Net income

- Net income before housing costs (equivalised) (BHC)

- Net income after housing costs (equivalised) (AHC).

This article focuses mainly on the equivalised BHC data, but also shows the impact of housing costs particularly in London and the South East using AHC income.

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1 For brevity, this article uses the term 'income' to refer to 'average household income'.

Equivalisation adjusts the income estimates to take account of household size and composition, so that more meaningful comparisons can be made between households with different numbers of occupants.[2]

Gross income includes earnings, self-employment, investments, various benefits and other sources of income. Net income is gross income less income tax and national insurance payments, council tax, pension contributions, maintenance and child support payments and parental contribution to students living away from home.

Because the estimates were averages of household incomes within each MSOA, households with very high levels of income were combined with those of low levels. This resulted in distributions of average income that were much less extreme than the distributions of individual household income. Therefore caution needs to be exercised when comparing this analysis with other analyses of spread of income that use household level data.[3]

Box 1: Model-based estimates

The model-based approach to producing the estimates was based on determining a relationship between household income measured in the FRS, and administrative data for the MSOAs. Having established this relationship, the administrative data are used to estimate household income for each MSOA. Both sources of data borrow strength from each other to arrive at an unbiased and consistent set of small area estimates that could not be produced from either source in isolation.

The main limitation of estimates for small areas is that they are subject to uncertainty due to survey sampling and the modelling process. ONS have produced confidence intervals associated with the estimates to make the accuracy of the estimates clear. The model-based confidence intervals provide a range of income for each MSOA within which one would expect the true value to fall 95 per cent of the time.

Box 2: Guidance on using the income estimates

There are five main considerations when using the income estimates.

1. **Other geographical areas**. MSOA estimates can be aggregated to provide average income for higher geographical levels, for example, local authorities. No accuracy estimates are available for such aggregations.

2. **Ranking**. Care needs to be taken when using ranks based on MSOA estimates due to their uncertainty.

3. **Extreme areas.** The modelling process tends to shrink estimates towards the average level, so the true distribution of MSOA average incomes will have more extreme high and low values than the estimated values.

4. **Consistency between the four estimates**. Due to the modelling approach, some inconsistencies may arise when comparing the different estimates.

5. **Comparison over time**. Consistent estimates have been produced using 2004/05 data and 2007/08 data. If the confidence intervals of estimates at the two time points for a particular MSOA do not overlap, then there is evidence of change over time. However, the difference between the estimates should not be interpreted as an accurate measure of change.

Regional patterns of income

The first stage in this analysis looks at regional patterns in average household net income, firstly using estimates from the FRS, and then the model-based MSOA estimates which were constrained to add up to the regional estimates from the FRS.

Income distribution across the English regions and Wales

Table 5.1 shows a wide range of net average household income when looking across England and Wales.[4] The highest income levels before housing costs were in London, followed by the South East and East of England. The lowest occurred in the North East, closely followed by the North West, and the West Midlands. London's average income BHC was 55 per cent greater than the North East average, a difference of £220 per week.

For net income after housing costs (AHC), Table 5.2 shows the same regional distribution of income, with all income levels lowered by the amount spent on housing costs. After the cost of housing had been taken into consideration, London's income was 46 per cent greater than the North East, a difference of £160, illustrating the impact of housing

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2 In the 2007/08 estimates, the OECD method of equivalisation has been used. Previously the McClements method was used, the differences between the two are minor, marginally changing the estimates of the MSOAs with highest levels of income. For more information, see: *Economic and Labour Market Review*, Vol 14, No 1, January 2010, Grace Anyaegbu.

3 For example, see *Economic and Labour Market Review*, Vol 3, No 8, August 2009, Andrew Barnard or Department of Work and Pensions data series on Households Below Average Income http://research.dwp.gov.uk/asd/hbai/hbai2008/contents.asp

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4   All data rounded to the nearest £10 as additional precision is beyond the accuracy of the estimates.

1

Table 5.1

Average weekly household net income (equivalised BEFORE housing costs)

April 2007 to March 2008	£ per week
North East	400
North West	420
West Midlands	420
Wales	430
Yorkshire and The Humber	430
East Midlands	440
South West	460
East of England	510
South East	570
London	620

Source: Family Resources Survey.

Table 5.2

Average weekly household net income (equivalised AFTER housing costs)

April 2007 to March 2008	£ per week
North East	350
North West	370
West Midlands	370
Wales	380
Yorkshire and The Humber	380
East Midlands	390
South West	400
East of England	440
South East	490
London	510

Source: Family Resources Survey.

Box 3: Spread of income

Four percentiles are used to help determine the spread of income within each region.

- P10 (lower decile): the income level below which 10 per cent of MSOAs lie.

- P25 (first quartile): the income level below which 25 per cent of MSOAs lie.

- P75 (third quartile): the income level below which 75 per cent of MSOAs lie.

- P90 (upper decile): the income level below which 90 per cent of MSOAs lie.

Percentiles are defined in three different ways in this article:

- Nationally, using all MSOAs in England and Wales

- Regionally, using all MSOAs in a selected region

- Locally, using all MSOAs in a selected local authority.

The spread of income is defined by the ratios of these percentiles.

- P90/P10 is the spread of the extremes of income levels.

- P75/25 is the spread of the central part of the distribution.
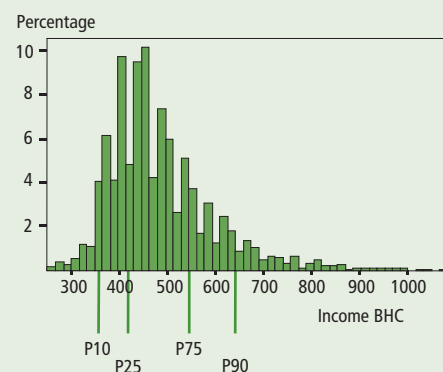
Example calculation of P90/P10 ratio:

P90 - £630

P10 = £370

P90/P10 = 630/370 = 1.7

Or P90 is 70% bigger than P10.

So the lowest average income of the upper 10% group of MSOAs is 70% higher than the highest average income of the bottom 10% of MSOAs.

costs in London (the difference between London and the North East has reduced from £220 to £160 per week).

Income distributions within the English regions and Wales

Patterns of income for each region show relative levels across England and Wales. They do not mean that all households within each region had the same level of income. To look at how income was distributed within each region, MSOA estimates are useful.

Figure 5.3 shows distributions of net average income before housing costs for MSOAs within each English region and Wales in 2007/08. The two regions which had the broadest distributions of

MSOA income were London and the South East. These were the two regions which also had the highest average income levels (Table 5.1). The average MSOA income for the remaining regions was much more tightly distributed, with Wales seeming to have a particularly small spread of income.

The spread of income was explored numerically in Table 5.4 using P10, P25, P75 and P90 thresholds, and the two ratios P90/P10 and P75/25 (see box for a full explanation of the P values) where the percentiles were calculated from MSOAs within each region.

Looking at all MSOAs in England and Wales, Table 5.4 shows that 10 per cent of MSOAs had an average net income BHC

Figure 5.3

Distribution of MSOA average household net income BHC, model-based estimates, 2007/08

Percentages

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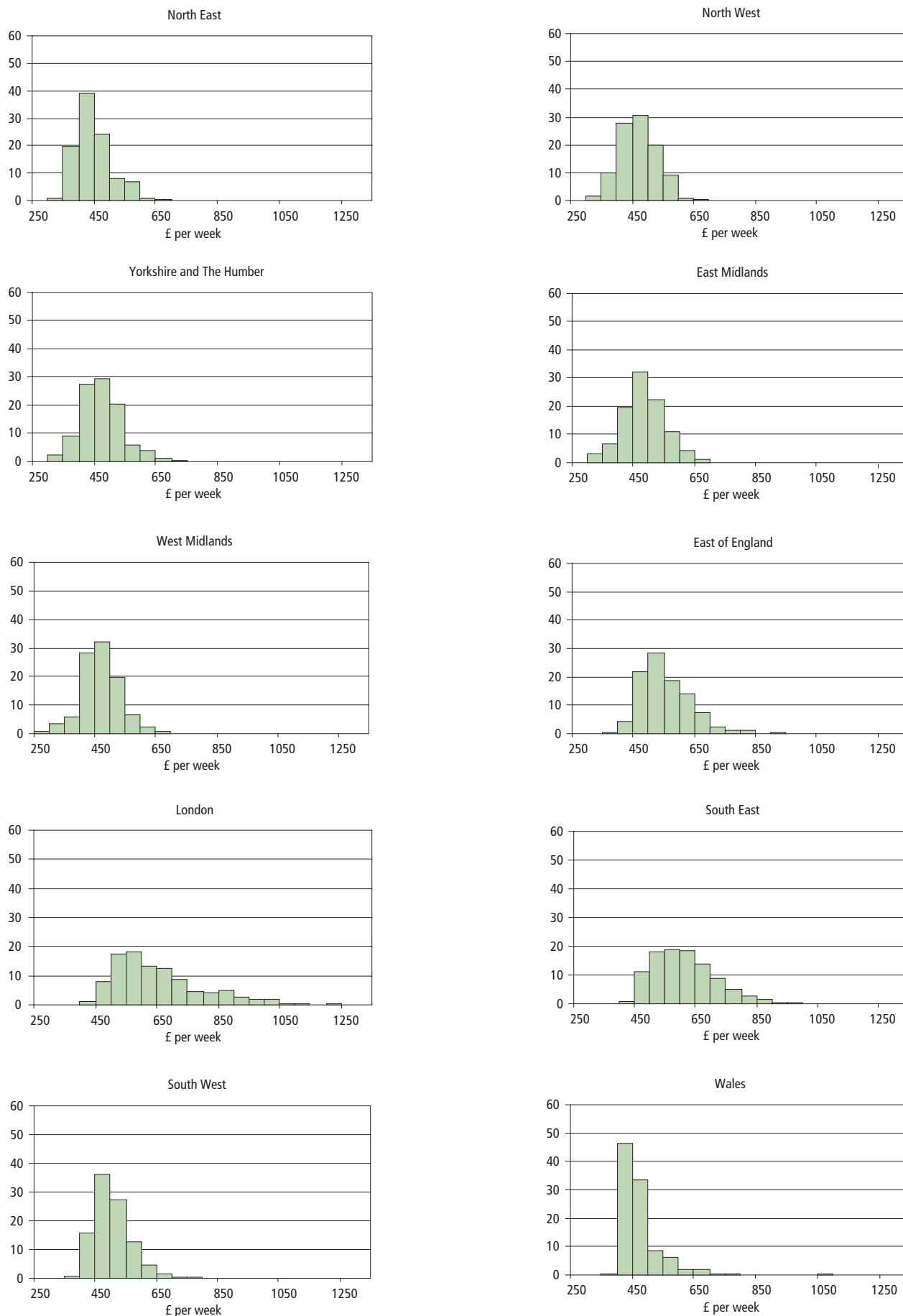
less than the P10 threshold of £370 per week, and 25 per cent less than the P25 threshold of £410 per week. At the upper end of the distribution, 25 per cent of all MSOAs had BHC income greater than £540 per week and 10 per cent greater than £630 per week. A P90/P10 ratio for all MSOAs of 1.7 means that the lowest average income of the upper 10 per cent of MSOAs was 70 per cent higher than the highest average income of the bottom 10 per cent of MSOAs. The P75/P25 ratio of 1.3 means that the upper end of the centre of the distribution was 30 per cent higher than the lower end of the centre.

The region with the smallest ratios (for both the P75/P25 and P90/P10) was Wales, confirming what Figure.5.3 is showing. For MSOAs in Wales, the upper end of the distribution (P90) was 34 per cent higher than the lower end (P10). For the centre of the income range, the top was 13 per cent higher than the bottom.

Although Wales had the narrowest spread of income, it did not have the lowest percentage of extreme incomes. The P10 value for MSOAs in Wales of £380 per week was higher than the P10 values for North East, North West, Yorkshire and The Humber, West Midlands and East Midlands. At the higher end of the distribution, only the North East and West Midlands had a lower P90 value.

In contrast, London was the region with the highest P10 value (£460 per week), the highest P90 value (£820 per week) and the highest percentage difference between the two (78 per cent). This high P90/P10 ratio arose mainly from the very high P90 value. Comparing the P90 value for London (£820 per week) with the South East (£710 per week) we found a difference of £110 per week, whereas the P10 values for these two regions differed only by £10 per week.

The South West was interesting in that it was the region with

the fourth highest average income, and yet had the third smallest spread as measured by P90/P10.

Similar patterns emerge when looking at the central part of the spread of regional income, the P75/P25 measure. London still has the highest spread, but was a lot closer to the South East which, in turn, was close to spreads in the North West, Yorkshire and The Humber, and the East of England. The English region with the smallest central spread was the South West.

In summary, this section showed that regions with the highest average income levels also had the highest spread of income. However, the regions with the smallest spread of income were not necessarily the regions with the lowest average levels of income.

Spatial patterns of income

Map 5.5 shows the pattern of MSOAs which had the highest and lowest average income estimates within England and Wales. When looking at spatial patterns of income distribution using the small area model estimates, it is important that model uncertainty is taken into consideration. MSOAs were included in the map if their entire 95 per cent confidence interval lay within the thresholds which define the top and bottom deciles (10 per cent) of MSOAs in England and Wales, or if their confidence interval fell within the top and bottom quartile (25 per cent). These were areas that we were very confident had high or low levels of income.

The patterns shown in Map 5.5 reveal how London and the South East were very different to the midlands and north of England. The majority of MSOAs with high levels of income in England and Wales (green stars) were to be found in London and the South East. Equally, none of the MSOAs with very low levels of income (grey circles) were to be found in these regions.
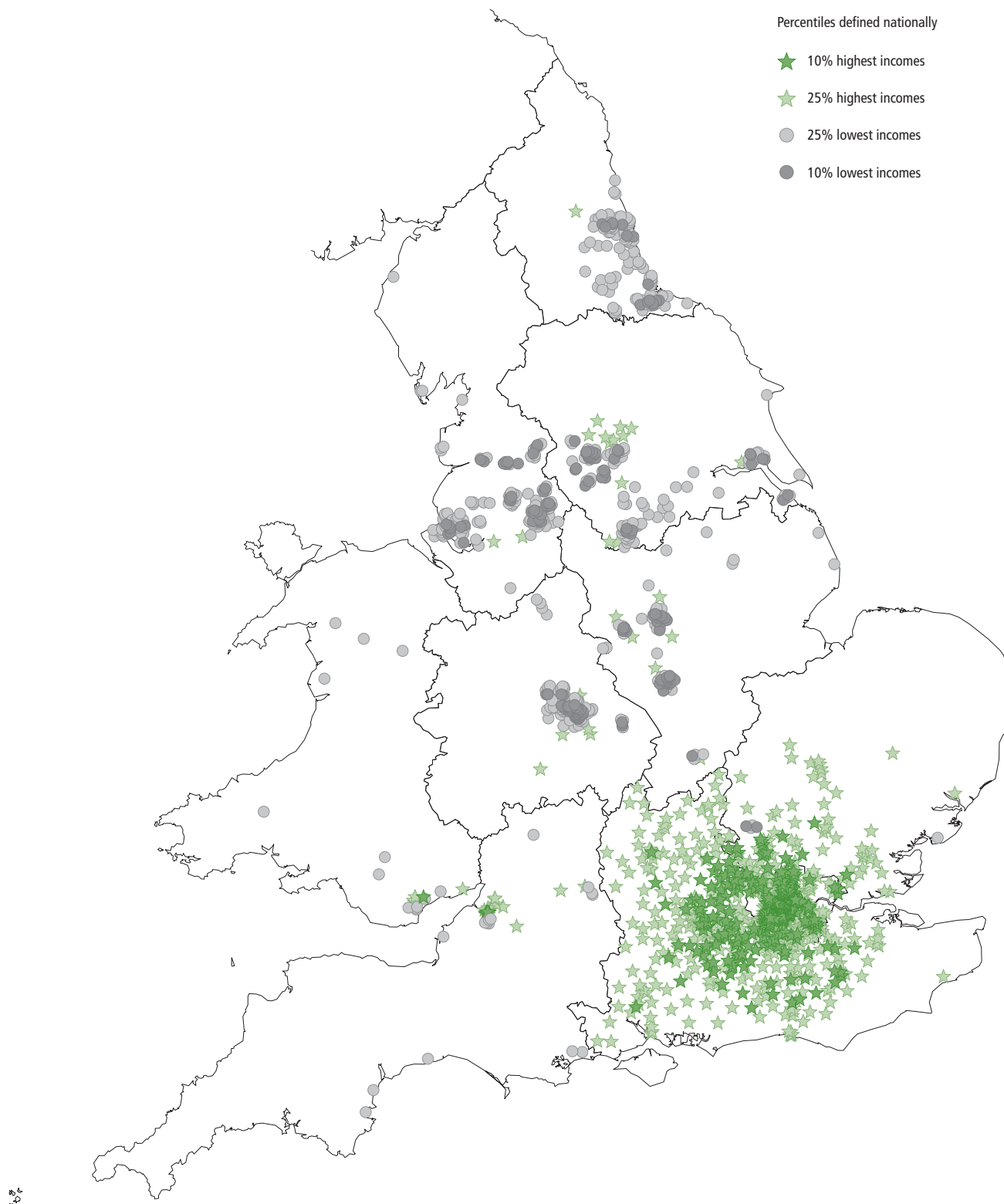
Table 5.4

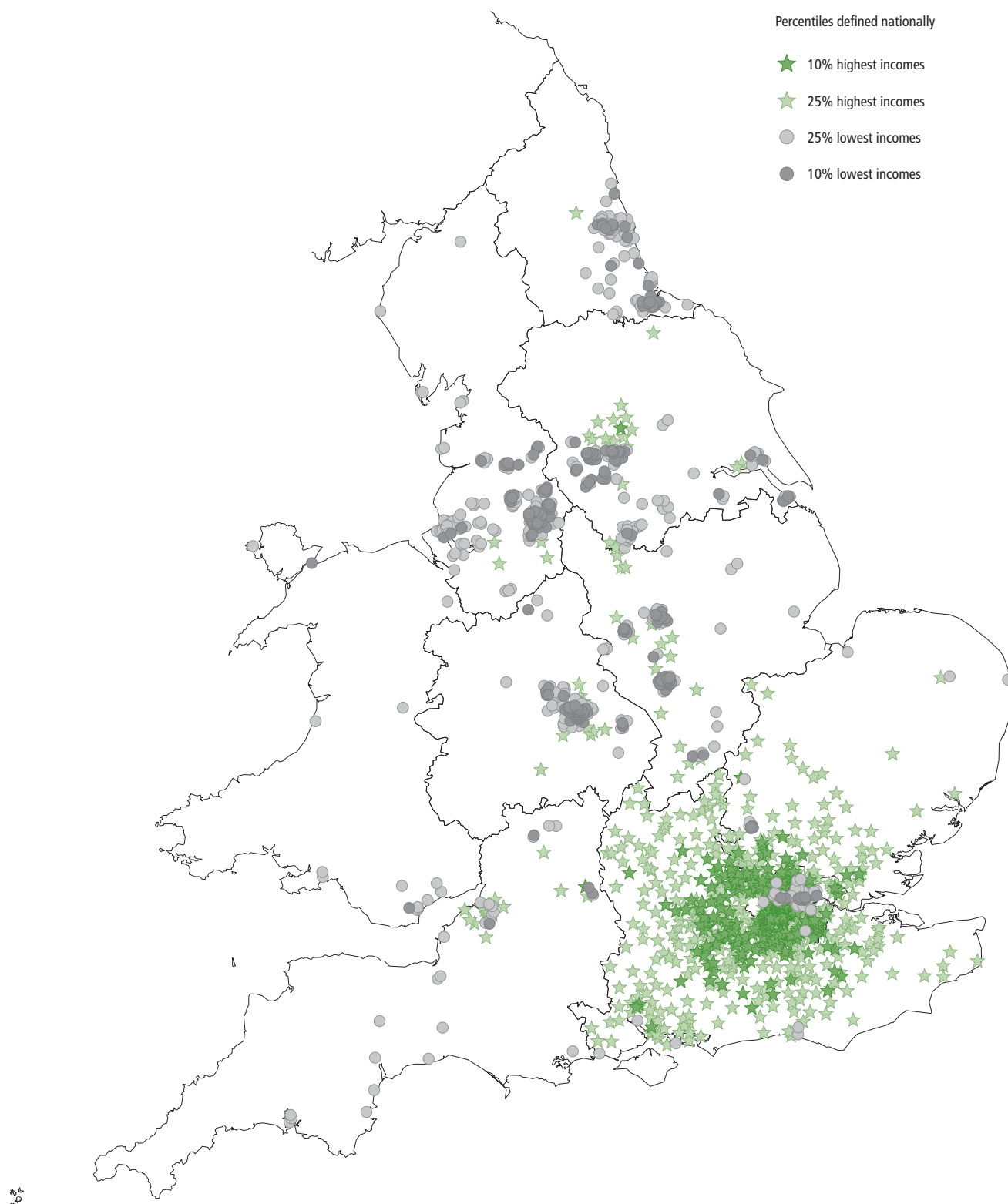### Thresholds and ratios for MSOA BHC net income estimates, model-based estimates 2007/08

£ per week/ratios

	P10	P25	P75	P90	P75/P25	P90/P10
Wales	380	390	440	510	1.13	1.34
North East	350	360	430	480	1.19	1.37
South West	390	420	490	540	1.17	1.38
West Midlands	354	380	460	500	1.21	1.41
East of England	420	450	560	610	1.24	1.45
North West	350	380	460	510	1.21	1.46
Yorkshire and The Humber	350	380	470	510	1.24	1.46
East Midlands	360	400	480	530	1.20	1.47
South East	450	490	630	710	1.29	1.58
London	460	500	680	820	1.36	1.78
All MSOAs	370	410	540	630	1.32	1.70

Source: Office for National Statistics

Map 5.5   High and low levels of average household net income BHC,[1] England and Wales, 2007/08

Percentiles defined nationally

★ 10% highest incomes

★ 25% highest incomes

○ 25% lowest incomes

● 10% lowest incomes

1 Before housing costs.

Source: Office for National Statistics

Map 5.6 **High and low levels of average household net income AHC,[1] England and Wales, 2007/08**

Percentiles defined nationally

★ 10% highest incomes

☆ 25% highest incomes

○ 25% lowest incomes

● 10% lowest incomes

1 After housing costs.

Source: Office for National Statistics

There was also a band of MSOAs towards the southern end of the East of England region with high levels of income, reflecting the influence of the economic prosperity of London in this region. There were two MSOAs with very low levels of income in the south west of the East of England (partially overlapping dark grey circles); these were neighbouring MSOAs located in Luton.

The South West and Wales were interesting due to a lack of MSOAs with very low levels of income, and only one MSOA in each with very high levels of income.

The remaining regions had similar patterns with many MSOAs around the towns and cities having low levels of income, and very few having high levels. Where MSOAs in these regions had high levels of income, they tended to be on the outskirts of a town or city.

Map 5.6 shows the pattern of high and low income levels after housing costs had been removed. It shows the same general pattern of high income in and around London, with low income levels in the midlands and the north of England. However, taking housing costs into consideration shows that there were MSOAs in London and along the South East coast with low and very low levels of income.

Also, AHC income levels in the midlands and the North of England were relatively higher than BHC reflecting the relatively lower costs of housing. This was shown by a small increase in the number of green stars in these areas. However, for Manchester and Leeds in particular, there was an increase in the number of very low income MSOAs, indicating that housing costs were disproportionately higher in these cities than any increase in income associated with the prosperity that the city generates.

Taking housing costs into consideration, Wales and the South West had more areas with low and very low levels of income.

Focus on London and the influence of housing costs

Map 5.7 shows the distribution of MSOAs in London which had the highest or lowest levels of BHC income, defined using the same national thresholds as Map 5.5.

There was a broad swathe of MSOAs to the west of the city centre, predominantly but not exclusively to the north of the river, that had very high or high average net BHC income levels. Other MSOAs with high income levels were spread around the region, particularly towards its perimeter. There were areas towards Heathrow in the west and in the north east of the region which had few MSOAs with high average income levels.

It is noteworthy that in London there were no MSOAs with average income levels that were below the 10 or 25 per cent thresholds of MSOAs in England and Wales.
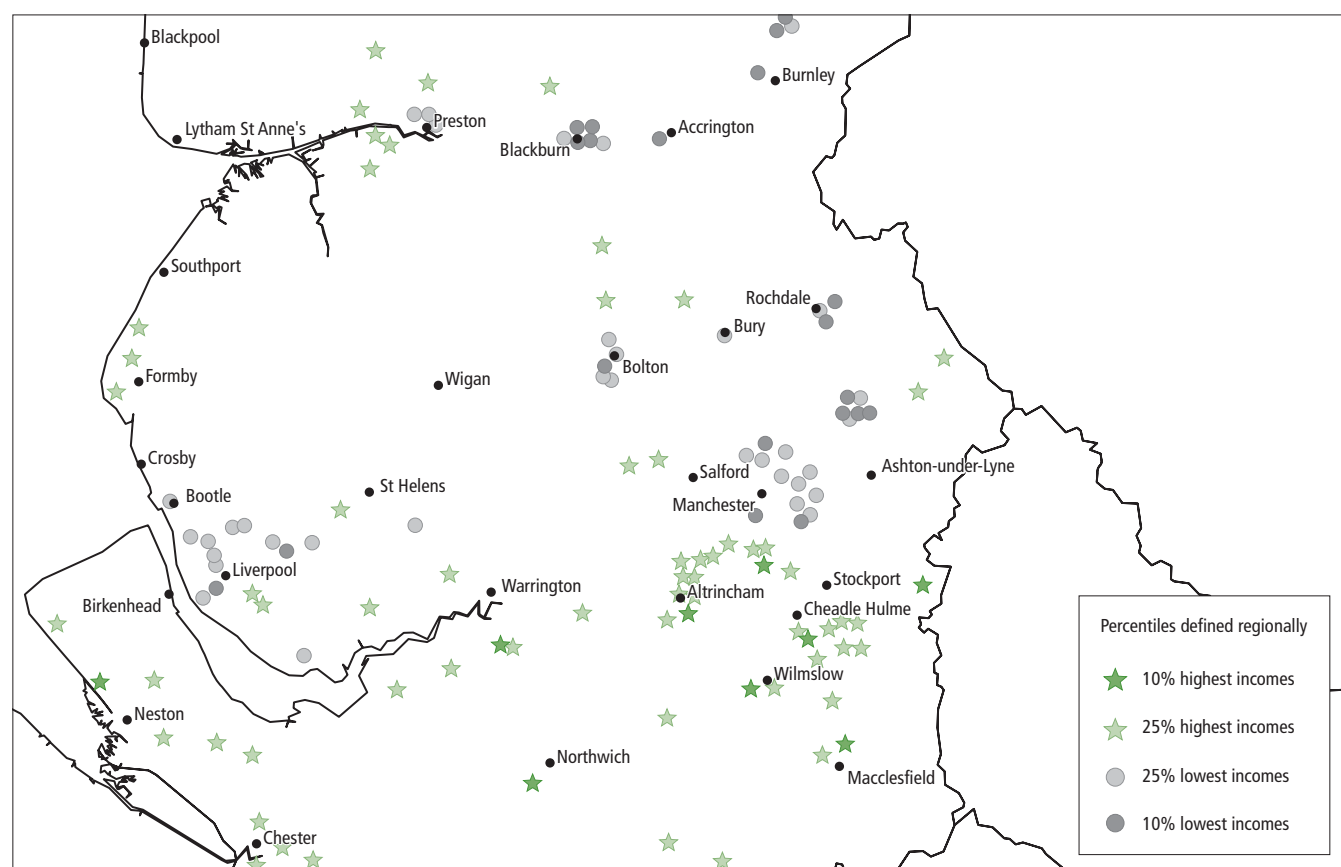
Map 5.7   High and low levels of average household net income BHC,[1] London, 2007/08

1 Before housing costs.

1
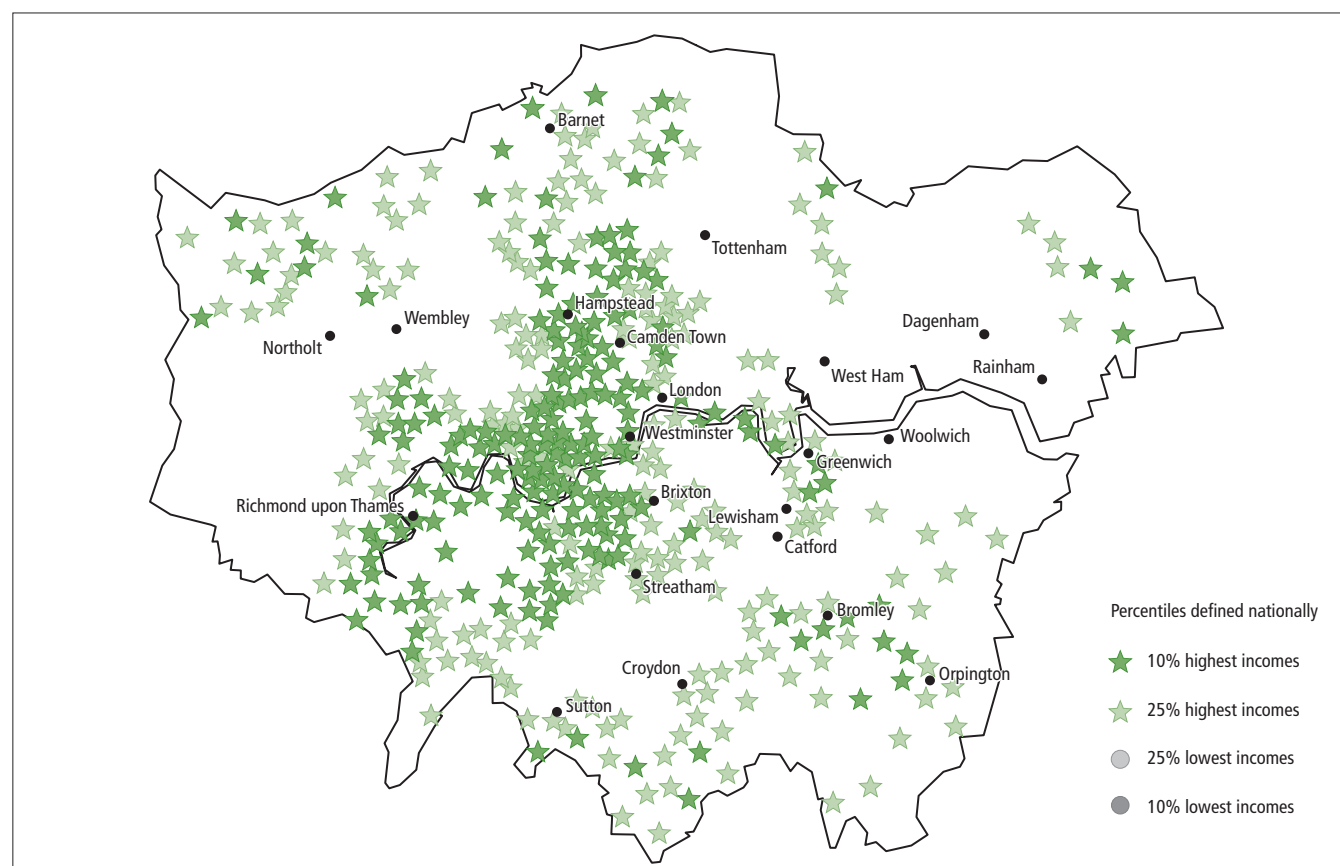
Map 5.8   High and low levels of average household net income AHC,[1] London, 2007/08
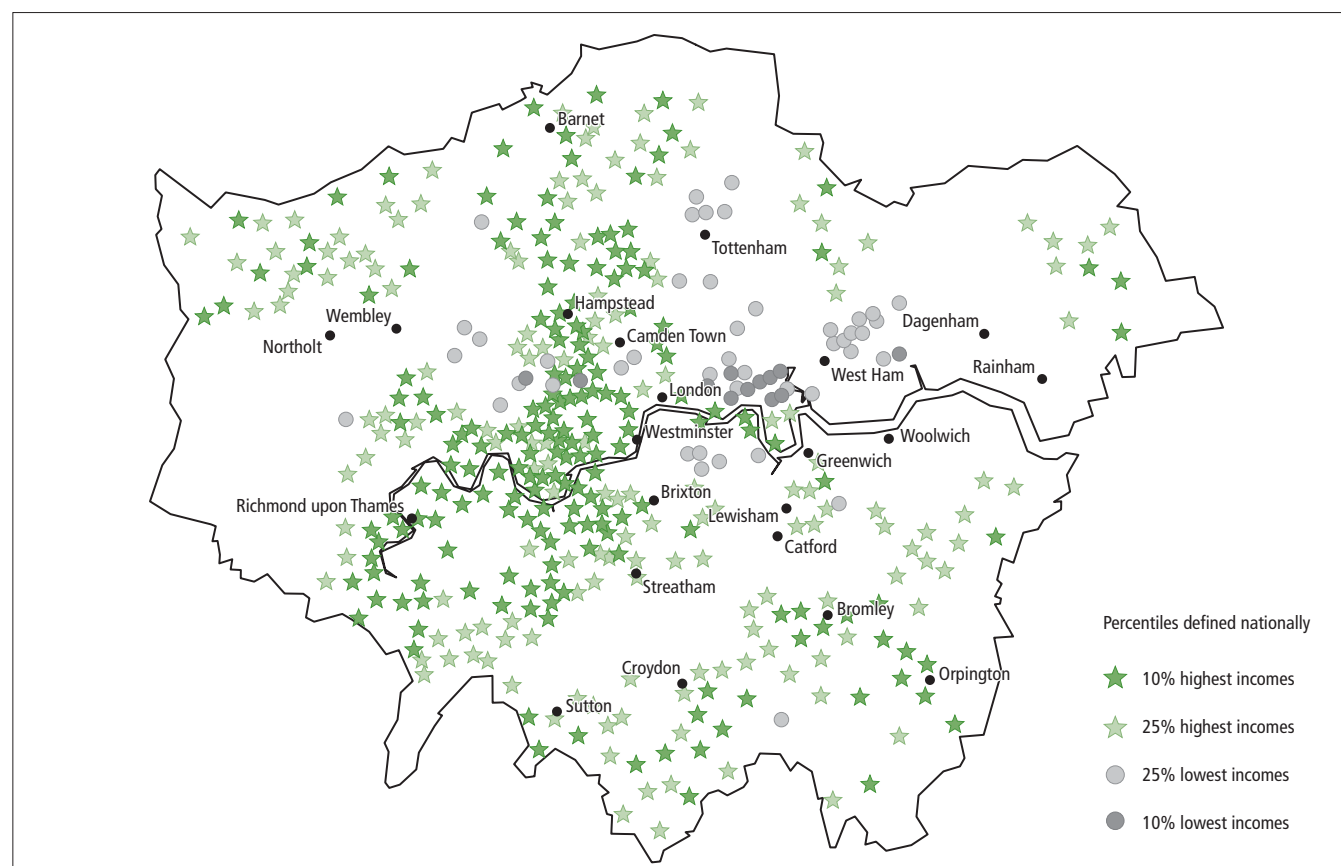
1 After housing costs.

Map 5.9   High and low levels of average household net income within the North West, 2007/08

Map 5.8 repeats this analysis for average net income after housing costs (AHC). The pattern of high income was similar to the BHC income levels, albeit with fewer MSOAs with green stars.

The main change was the emergence of MSOAs in London whose income levels after housing costs had been taken into consideration that now lie within the thresholds for the bottom 10 per cent and 25 per cent in England and Wales. The MSOAs whose incomes lay below the P10 threshold were predominantly located in Tower Hamlets, with one each in Barking & Dagenham, Westminster, and Kensington & Chelsea. In addition, local authorities which had more than one MSOA with income below the P25 threshold were: Brent, Havering, Enfield, Newham, Hackney and, to the south of the Thames, Southwark.

Analysis of incomes within a region

As with the regional income spread analysis shown in Table 5.2, this section uses percentiles defined regionally. In this way, analysis of spatial patterns of income within a region is not overly dominated by the high incomes in London and the South East. The important thing to note in this analysis is that the highlighted MSOAs do not represent the same income bands as shown in Map 5.5.

The following section provides an example of within-region analysis, exploring the industrialised band across the centre of the North West region, shown in Map 5.9. The broad pattern was one of low income levels around the major cities and towns (Manchester, Liverpool, Bolton, Burnley, Rochdale, Blackburn and Preston).

MSOAs with income in the top decile or quartile were to be found predominantly to the south of Manchester and away from the main towns and cities.

Local patterns of Income

This analysis drills down to examine income levels within local authorities (LAs). This section highlights the local authorities of Manchester and Liverpool in the North West.

To provide a meaningful comparison between two local authorities in the same region, percentiles based on MSOAs within the region were used to define regional high and low

levels of income. Thus the colours of MSOAs in both parts of Map 5.11 were both based on the same threshold.

Manchester had a swathe of MSOAs to the north and east of the city centre with income levels below the regional P10 and P25 thresholds. There was also one additional MSOA to the south of the city centre whose income lay below the P10 threshold. Further south, there was one MSOA whose income lay above the P90 threshold, and three above the P75 threshold.

Liverpool had only one MSOA whose income was below the regional P10 threshold, and none above the P90. The pattern of MSOAs below the P25 threshold was more spread out than for Manchester.

The spatial patterns shown in Map 5.11 suggest that Manchester had a wider spread of income than Liverpool, and that the areas with very high and low levels of income were more clustered in Manchester than in Liverpool.

Table 5.10 provides basic data for these two local authorities. Manchester and Liverpool are similarly sized LAs containing 53 and 59 MSOAs respectively. Average weekly BHC income for the two was the same at £390 per week.[5] However, the spreads of income were different with Manchester having a lower P10 value and higher P90 value than Liverpool.[6]

This difference in spread was revealed by the P90/P10 ratio. For Manchester, the upper end of the income distribution was 50 per cent higher than the lower. The equivalent for Liverpool was slightly lower at 42 per cent. Thus the data support the messages shown in Map 5.11.

Changes in regional patterns of income

This section looks at how regional income levels in 2007/08, both across regions and within regions, had changed compared with 2004/05.

Table 5.12 provides changes in average net income before housing costs for the English regions and Wales. The largest percentage change occurred in Wales, increasing from £370 to £430 per week, a change of 16 per cent. Next was the South East (14 per cent), which was the region with the biggest actual change of £70 per week. Thus the largest changes
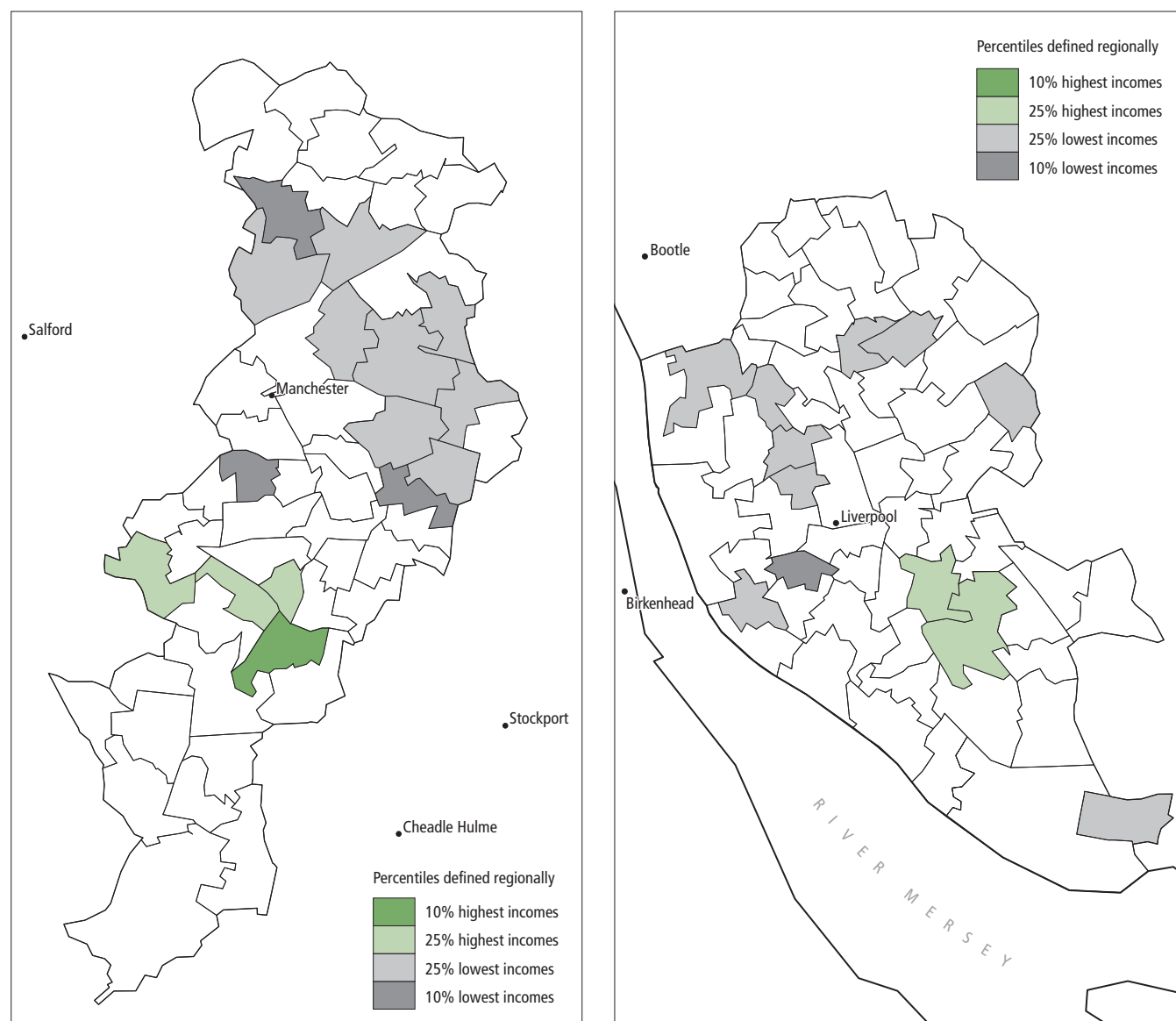
Table 5.10

BHC net income distributions from MSOAs in Manchester and Liverpool, 2007/08
£ per week/ratio

Local Authority	Number of MSOAs	Average BHC income	P10	P90	P90 / P10
Manchester	53	390	322	480	1.49
Liverpool	59	390	330	470	1.42

Source: Office for National Statistics

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5   Calculated as a household weighted average

6   To explore spread within a local authority, local percentiles are used.

1

Map 5.11   **Local patterns of average household net income for Manchester[1] and Liverpool[1] by MSOA[2], 2007/08**

1 These maps represent the local authority districts of Manchester and of Liverpool.
2 Middle Layer Super Output Area.

Table 5.12

Changes in net income before housing costs

Regions	2004/05	2007/08	2004/05–2007/08	2004/05–2007/08
	£ per week	£ per week	£ per week	percentage difference
Wales	370	430	60	16
South East	500	570	70	14
Yorkshire and The Humber	380	430	50	13
East Midlands	390	440	50	13
North East	360	400	40	11
East of England	460	510	50	11
London	560	620	60	11
West Midlands	380	420	40	11
North West	390	420	30	8
South West	430	460	30	7

Source: Office for National Statistics

Figure 5.13

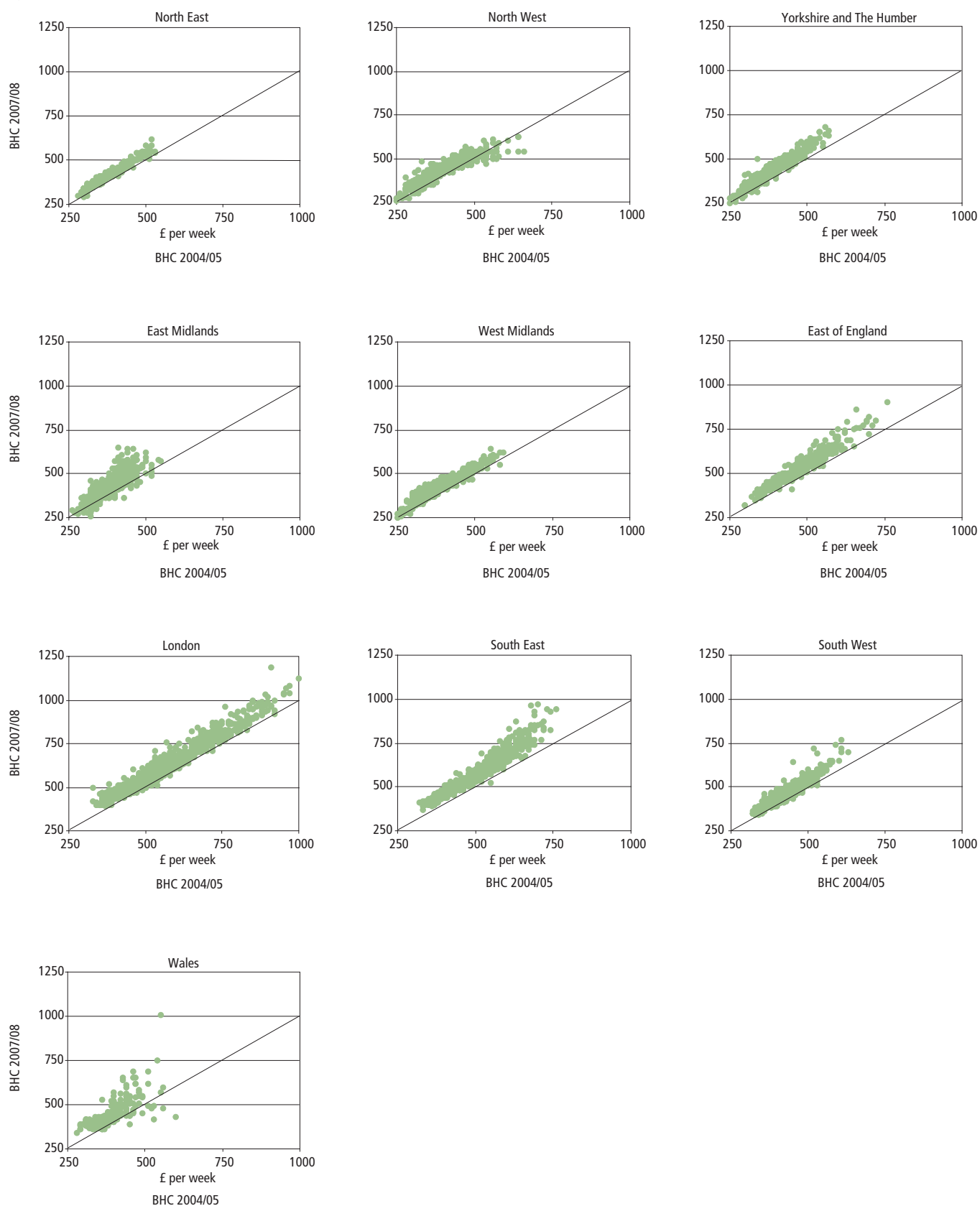## Regional distributions of change in BHC income[1]

Percentages

1 Before housing costs.

1
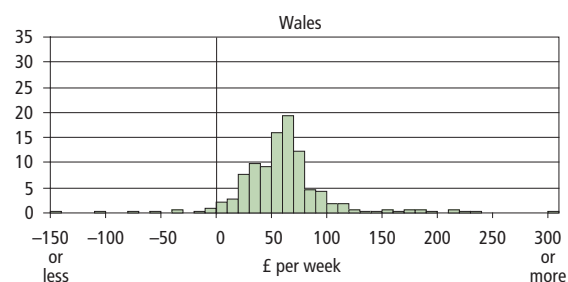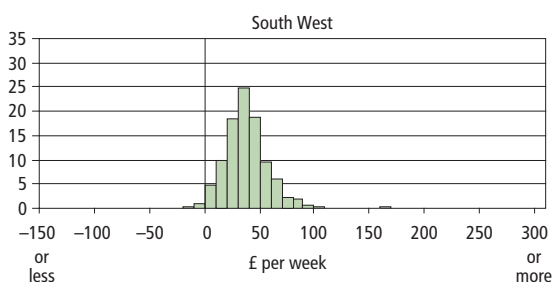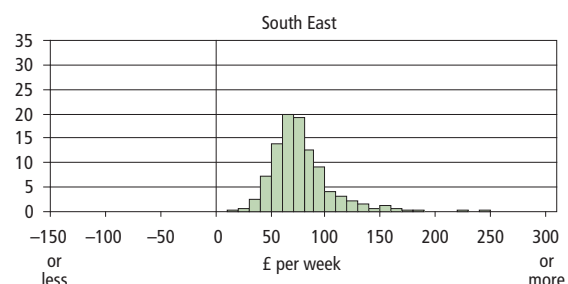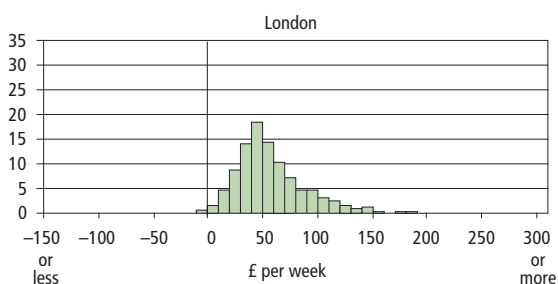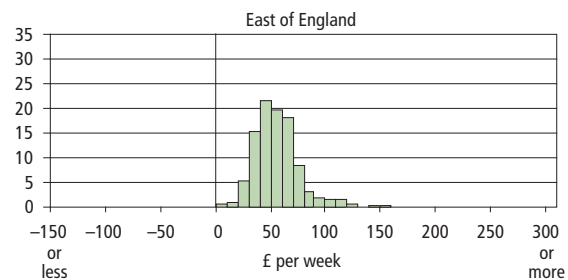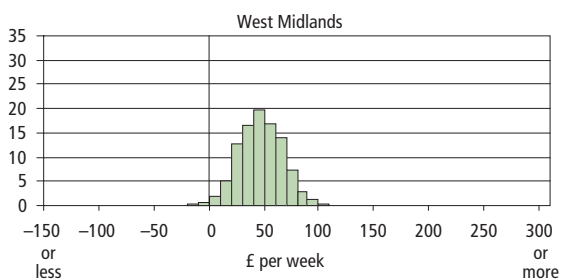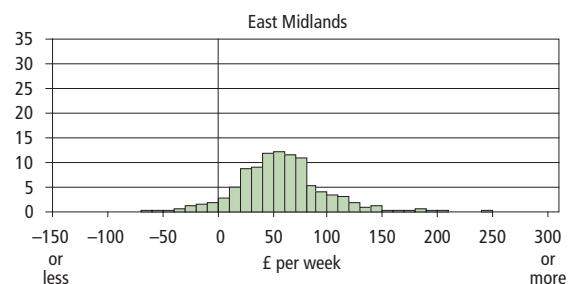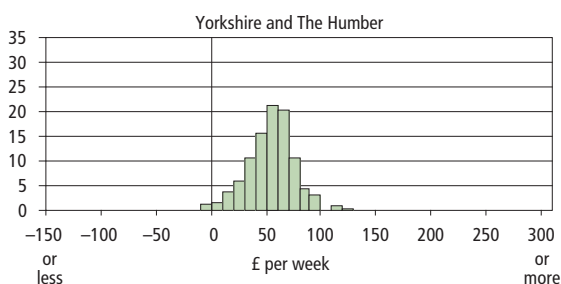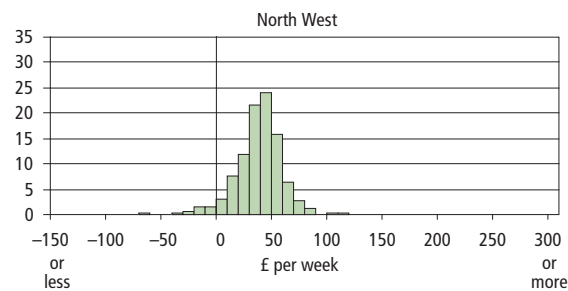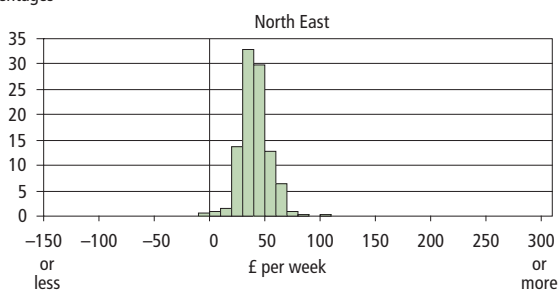
Figure 5.14

Scatter plot showing MSOA level BHC[1] income in 2004/05 and 2007/08: by region

£ per week

1   Before housing costs.

occurred in regions with one of the highest and one of the lowest levels of income.

In contrast, the South West had the smallest increase of £30 per week, a 7 per cent increase, along with the North West which had an 8 per cent increase.

Variation within each region

This section looks at how change within each region varied, and specifically asks how the gap was changing between MSOAs with the highest levels of income and MSOAs with the lowest levels of income.

Figure 5.13 provides histograms showing the proportions of MSOAs that had different changes in income levels for each region. The black vertical line represents no change in income.

Looking at the spread of income change, the East Midlands and London stand out as having a wider spread than the other regions. The South East, London and Wales have a particularly long 'tail' at the upper end of the distribution, indicating that some of the biggest increases occurred in these regions. Wales also appears to have a long tail at the lower end of the distribution.

The narrowest distribution was in the North East where most MSOAs had very similar changes in income levels, around £40 per week.

Figure 5.14 shows the relationship between income levels in 2004/05 and 2007/08 for each region. Each point on the plot represents the income for a particular MSOA for both years, with the y=x line superimposed. Dots above the line show MSOAs with an increase of income between 2004/05 and 2007/08.

Figure 5.14 shows that Wales in particular has a broader spread of points above and below the line, indicating that more

change in average income was occurring in Wales than the English regions.

To explore these differences in a more methodical way, Table 5.15 shows the changes in the thresholds for P10 and P90 within each region for 2004/05 to 2007/08 (note regions are sorted by increasing P90/P10 threshold – the top region is where the gap between the highest and lowest income MSOAs has reduced the most).

The largest percentage increase in the P10 threshold occurred in Wales where the 2007/08 value was 19 per cent greater than that for 2004/05. Thus the income levels for the MSOAs with the lowest average income levels in Wales increased in percentage terms by more than equivalent MSOAs in any England region.

The region with the second largest increase in P10 threshold was the South East, at 15 per cent, followed by a number of regions that had increases of around 12–14 per cent. The regions with the lowest increases in P10 threshold were the South West (5 per cent), the East Midlands (9 per cent) and the North West (9 per cent).

The largest change in the P90 threshold was in the East Midlands (18 per cent), followed by the South East (16 per cent) and Wales (16 per cent). For these regions, those areas which had the highest levels of income in 2004/05 increased them further.

The change in the P90/P10 ratio provides evidence for changes in the spread of income distributions within the regions. A decrease in the P90/P10 ratio means that the difference between the bottom group of MSOAs and the top group of MSOAs was smaller in 2007/08 than it was in 2004/05. Regions with decreasing P90/P10 ratios had a reduction in the gap between the poorest and the most affluent MSOAs.

Table 5.15

Differences in within-region percentile thresholds and ratio for BHC[1] income, 2004/05 to 2007/08

	Differences				
	P10 (£ per week)	P10 (percentage)	P90 (£ per week)	P90 (percentage)	P90/P10 (ratio)
West Midlands	40	14	30	6	−0.10
North East	40	13	31	7	−0.08
London	50	12	70	9	−0.05
North West	30	9	30	6	−0.04
Wales	60	19	70	16	−0.03
Yorkshire and The Humber	40	13	50	11	−0.03
East of England	50	14	60	11	−0.03
South East	60	15	100	16	0.01
South West	20	5	40	8	0.03
East Midlands	30	9	80	18	0.11
All MSOAs	40	12	70	13	0.01

1 Before housing costs.

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The West Midlands had the biggest decrease in the P90/P10 ratio of −0.10. This means that the West Midlands had a 10 percentage point decrease in the income gap between the thresholds defining the top and bottom groups. This decrease can be seen from the percentage changes in the P10 and P90 values, where the P10 value for the West Midlands increased by 14 per cent compared with a smaller increase in the P90 value of 6 per cent.

The North East also saw the gap between the bottom and the top decrease, with a fall of 8 percentage points. The only area to see a large increase in the gap was the East Midlands – the consequence of a fairly small increase in the threshold for the poorest areas and a large increase for the most affluent. Other regions had small increases or decreases in the gap between lowest and highest incomes.

Conclusions

Using the model-based estimates of average income helps understand patterns of income nationally, regionally and locally.

Locally, spatial patterns of neighbourhoods with low income help identify communities that may suffer due to low average income levels. These estimates, therefore, can complement the income domain for the Indices of Multiple Deprivation.[7] The model-based estimates also provide good discrimination at the upper end of the income distribution, locating areas with high average income. Using the before and after housing cost income levels reveals where the high cost of housing causes communities to have low levels of income, once housing costs have been deducted.

Regionally, the model-based estimates permit measures of spread of income to be analysed. This analysis has shown that:

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7   See 'Understanding patterns of Deprivation' in *Regional Trends* 41, pp 93-114 for more details on the Indices of Multiple Deprivation.

- The North East had the lowest average income and the second narrowest spread behind Wales

- London and the South East had the highest average income and the widest spread

- After taking housing costs into consideration, London and the South East still had the highest average incomes, but they moved much closer to other regions

- The West Midlands, East of England, North West, Yorkshire and The Humber, and the East Midlands all had very similar spreads of average income

- Since 2004/05, Wales has seen the greatest increase in average income, rising 16 per cent over the three-year period

- The lowest regional increases between 2004/05 and 2007/08 were in the North West and South West

- The regions where the gap between the highest and lowest average income closed the most were the West Midlands and the North East. Conversely, the gap increased by 11 percentage points for the East Midlands

At national level, this article has helped to demonstrate the income gap between those areas influenced by London and those that are not. Virtually all the MSOAs which had income levels in the top 10 per cent for England and Wales were in or around London. Equally, virtually all the MSOAs which had income levels in the bottom 10 per cent for England and Wales were in the midlands and the north of England.

Finally, this article has shown some of the insights that are possible using model-based estimates despite the uncertainty in the estimates. It has presented cautions regarding comparisons that should not be attempted, whilst demonstrating the value that these estimates offer in understanding the distribution of average household income throughout the country.