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15

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The welfare consequences of the suburbanisation of poverty in UK cities: air pollution and school quality

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Abstract

The suburbanisation of poverty has been noted in the cities of a large number of countries, including the UK. The main drivers are labour market restructuring on the one hand, and market-driven change in the housing system on the other although social and housing policies are also factors. This paper explores the possible consequences for the welfare of low-income groups in relation to two dimensions: exposure to air pollution and access to good quality schools. Results show that, for these groups, suburbanisation has had mixed impacts on welfare. In most cities, suburbanisation is likely to bring improvements in air quality but there are only a minority where it improves access to good quality schools. Overall, it is clear that suburbanising low income households enjoy fewer of the benefits of suburban locations than middle class households.

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Introduction

Historically, the urban cores of cities in many western European countries as well as other English-speaking countries such as the US and Australia had an over-representation of poorer households. This reflected the patterns of selective migration to suburban locations by more affluent groups as cities spread outwards over the twentieth century. The suburbs achieved a reputation for quality of environment but also social desirability. The inner cities, by contrast, were associated with social decline and disorder (Robson 1988).

As a number of studies have shown, this pattern appears to be undergoing a structural change. Higher income groups are returning to core city areas. What was a 'trickle' under earlier waves of gentrification has now become a steady flow, albeit with significant variations between neighbourhoods and urban areas (Smith 2002; van Gent 2013). As older inner urban neighbourhoods are renovated and property values rise, working class residents and would-be residents are finding themselves priced out. Their situation is made worse by the polarisation of urban labour markets which has removed much of the skilled and semi-skilled work which these groups previously relied on (Goos & Manning 2007), so they find themselves in a weakening economic position in a rising housing market.

As a result, the share of low income groups in inner neighbourhoods is falling and simultaneously rising in outer locations: poverty is suburbanising (Hulchanski et al. 2007; Cooke and Denton 2015; Randolph & Tice 2017; Bailey & Minton 2018). However, poverty is not spreading equally in all suburban locations. In the US context, T. J. Cooke and C. Denton (2015) show that growth is restricted to the older, inner suburbs. In the UK context, N. Bailey and J. Minton (2018) show that low income groups may be moving to locations further from the centre of the city, but they tend to go to the denser (cheaper) suburban locations in particular.

For low income households, suburbanisation processes are generally viewed in negative terms because they are seen as arising not from positive choices but from direct or indirect displacement from central locations as a result of gentrification processes. This displacement is seen as negatively impacting on the welfare of these households because it denies them access to valued communities which may be a source of identity, solidarity and hence reciprocity or mutual support (Darcy & Gwyther 2012). Such communities are said to provide access to social capital which helps low income households get by (Forrest & Kearns 1999) although others have questioned some of the claims here (Bailey et al. 2015). Suburbanisation may also result in loss of access to public

and third sector services which are designed to meet the needs of low income groups (Kneebone & Berube 2014).

On the other hand, suburbanisation may offer low income households new opportunities. The suburbs have usually been portrayed as aspirational locations and places of social advantage, both in terms of social composition and in terms of the physical and social amenities they can offer. The physical environment may be better due to lower densities which lead to lower air pollution or better provision of green space. And while access to specialist services explicitly for low income groups may be worse, the quality of general public services may be better, both because more affluent suburban locations have a stronger tax base to support these and because the 'sharp-elbowed' middle classes are more adept in competing for a larger share of public resources (Hastings et al. 2013). Suburbanisation may therefore provide low income households with a means to escape from the congested, polluted and poorly-served urban cores.

The aim of this paper is to shed some new light on the debate about the welfare impacts of the suburbanisation of poverty. It does this by examining two aspects of the process: how it affects the levels of air pollution to which low income groups are exposed, and how it affects their access to publicly-funded schools, a key public service. These are chosen both because there are some grounds to anticipate welfare gains in each case and because there are readily available data. The two dimensions also make for a useful comparison because the basis on which these amenities are distributed over space is quite different. The key point, however, is to demonstrate an approach which could be more widely adopted to examine welfare impacts in other domains and other urban contexts.

The paper focuses on the 12 largest UK cities where suburbanisation processes have been shown to be proceeding most clearly at present (Bailey & Minton 2018). It draws on a data from a variety of government sources, relating changes in neighbourhood poverty levels for the period 2004-2016 to variations in air pollution and school quality as measured by educational attainment. We start by justifying the focus on these two outcome measures before detailing data sources and explaining the analytical approach. We then report results before concluding with a discussion of the implications of the findings and directions for further research.

Suburbanisation and air pollution

Air pollution in cities is an issue which has been attracting much greater attention in public policy debates in recent years due to the growing evidence of the harms to public health. In the UK, for example, the Royal College of Physicians (2016: pxii) estimates that air pollution

leads to 40,000 premature deaths a year. In most cities in Europe, the loss of manufacturing industry in recent decades resulted in significant improvements in air quality overall but this has been offset by rising road traffic volumes. It is these which are now the primary source of air pollution with the result that there is a strong relationship between pollution and density, and hence inner urban location (Bailey et al. 2018). The move by the middle classes back to inner urban areas may also have served to push the issue of air quality in cities up the political agenda.

In this context, we would expect the suburbanisation of poverty to result in improvements in air quality for lower income households: they are moving to less dense, less congested locations where traffic-based air pollution would be expected to be lower. It might seem counter-intuitive that higher income groups are competing to access locations with worse environmental quality but, as Bailey et al. (2018) highlight, there are several reasons why they might do so. First, these inner urban locations offer a range of compensating advantages precisely because they are dense and congested, and therefore polluted. They sit at the centre of urban agglomerations offering access to employment, leisure opportunities and a lifestyle widely deemed desirable. Worse air pollution is just part of the overall trade-off made in this locational choice. Second, the decision process is far from 'rational'. Awareness of air pollution is generally poor, and the risks of harm which lie somewhat in the future are easily discounted. Indeed, there is some evidence from social psychologists that it is precisely the more advantaged groups who are most inclined to underestimate their exposures and vulnerability (Bickerstaff 2004).

As the debates on suburbanisation have pointed out, however, low income households may be decentralising within major cities but this does not mean that they are found in all kinds of suburban location. This means we need to address the question not only of whether air quality is improving for poor households through suburbanisation but also whether it is as good as (or better than) the quality enjoyed by the existing suburban residents. We frame this as two research questions:

RQ1: Do the locations where poverty is increasing have lower air pollution than those where poverty is declining?

RQ2: Do the locations where poverty is increasing have air pollution levels the same as (or better than) locations where poverty is not increasing?

Suburbanisation and school quality

With air quality, the relationship with urban location emerges through the relationship of pollution with

density. With public services such as schools, the basis for the relationship lies in social inequalities in access to publicly-funded services and public goods. Even when services are nominally free and universal in their coverage, more affluent groups tend to enjoy a disproportionate share of the benefits (Bramley & Evans 2000). In local government systems such as the US where funding for services is quite decentralised, this can arise because of variations in the strength of the local tax base available to support these amenities. But it can also arise in systems where funding is more centralised and there are efforts to equalise resources between different locations. In the UK, for example, a substantial fraction of local authority spending comes through a central funding allocation which reflects differences in population and social needs but the level of redistribution may be insufficient to fully address the higher levels of need in poorer authorities (Hastings et al. 2015). In addition, within each authority, higher income groups are often able to lobby for a larger share of resources for their neighbourhoods – the 'sharp elbows' thesis (Hastings et al. 2013).

For many universal public services and public goods, we would expect this social gradient to translate into an urban gradient with the more affluent suburban locations enjoying higher levels of resources and hence quality. The suburbanisation of poverty might therefore be expected to lead to improved access to such services for low income groups. That would include access to better quality schools since residential location is a major influence on which school a child attends (even if it is not the only factor). Under the English educational system, the great majority of parents select a school from those available within their local authority. Within each authority, the friction of distance in the daily school commute steers children towards nearby schools; some schools also use proximity in decisions about who to admit. Living closer to better quality suburban schools should help low income groups gain access to these, even if it does not guarantee it.

In addition, and unlike air pollution, some measures of school quality are easily – and keenly – observed by parents through regularly-published league tables of exam results. Educational attainment is arguably a poor measure of the quality of teaching in a school. To a large extent, attainment is driven by the composition of pupils entering the school and not by what happens during their time there. Nevertheless, it is the main factor which parents have to refer to when making choices about schools and it is clearly an important influence on where people choose to live. For one UK city, P. Cheshire & S. Sheppard (2004) show that house prices in areas close to the best performing primary school are around one third higher

than those near the worst. For secondary schools, the difference was around one sixth.

As previously, the questions are whether suburbanisation does indeed put poorer households closer to the better performing schools, but also whether this puts them in a position which is as good as the existing, non-poor suburban households. Mirroring the questions above, we ask:

RQ3: Do the locations where poverty is increasing have schools with higher attainment levels than those where poverty is declining?

RQ4: Do the locations where poverty is increasing have schools with attainment levels as good as (or better than) locations where poverty is not increasing?

Data and methods

Cities

In this study, we focus on the 12 largest urban areas in the UK, ten from England and two from Scotland. In N. Bailey and J. Minton's (2018) study, these emerged as the group where the processes of suburbanisation were most clearly at work. In alphabetical order these are: Birmingham, Bristol, Edinburgh, Glasgow, Leeds, Leicester, Liverpool, London, Manchester, Newcastle, Nottingham, and Sheffield.

In the UK, defining cities by administrative boundaries is problematic as these have been developed on a very variable basis. Many administrative boundaries significantly under-bound the functional urban area so that much of the suburbanisation within the functional urban region would be lost if we used them to define our cities. Following N. Bailey and J. Minton (2018), we use cities as defined by the official travel-to-work areas (TTWAs)¹. These were developed by the Office for National Statistics (ONS) (2015) to reflect commuting patterns in the 2011 Census.

Neighbourhoods and neighbourhood poverty rates

To measure neighbourhood poverty status, we use the official area deprivation measures published by the English and Scottish governments – the Indices of Multiple Deprivation (IMD) (for details see Noble et al. 2006).

1. The London area was split into two TTWAs by the ONS methodology, with a new TTTWA identified covering Slough & Heathrow to the west of London. This area centres on employment focussed on Heathrow Airport and its related industries. However, it merges with the western suburbs of London and, although commuting flows are sufficient to reach the self-containment-threshold, it still forms part of the London housing market. Following N. Bailey and J. Minton (2018) we elected to merge these into one TTWA, referred to as London.

These have been constructed on a consistent basis since 2004. The earliest English IMD (EIMD) was published in 2004 with the latest in 2015. The earliest Scottish IMD (SIMD) was in 2004 and the latest 2016. The EIMD uses spatial units termed Lower Super Output Areas (LSOAs) with a population between 1000 and 2000, whilst the SIMD uses Datazones (DZs) with a population of between 500 and 1000. Differences in population size were not viewed as likely to affect results since we are making comparisons within each city and looking at changes over time. For simplicity we refer to 'LSOAs' in the rest of the paper. LSOA boundaries were updated prior to the most recent updates of the EIMD and SIMD to reflect population changes. We re-apportion data for the earlier years to the latest boundaries, following the approach of N. Bailey and J. Minton (2018)².

To compare LSOAs in terms of their centrality within each city, we measure distance from city centre using the definitions of city centres adopted by N. Bailey and J. Minton (2018). This distance is used to group LSOAs into deciles from most central (1) to most suburban (10).

To compare LSOAs in terms of poverty levels, we use the measure of Income Deprivation provided by both EIMD and SIMD. This captures the proportion of people in an area in receipt of a means-tested welfare benefit or low-income tax credit. It covers people on a low income regardless of their age or employment status. This is important as more than half of working age adults in low income poverty (and two thirds of children) were in working families (DWP 2018). While there are some minor differences in the construction of the EIMD and SIMD Income Deprivation measures, they are highly comparable (Payne and Abel 2012). Differences are very unlikely to impact on our results as we are comparing the relative levels within each city.

Finally, we classify neighbourhoods on the basis of changes in poverty between 2004 and 2015 (England) or 2016 (Scotland). To remove the effects of changes over time in absolute levels of Income Deprivation and the effects of minor changes in the definition of each measure, we calculate the share of each city's Income Deprived population residing in each LSOA in 2004 and in 2015/2016, and hence the change in share. Using this score, LSOAs are grouped into neighbourhood poverty change quintiles within each city, from those with the largest decrease in their poverty share (1) through those where poverty was little changed (3) to those with the largest increases in poverty share (5).

2. This was done on the basis of the distribution of unit postcodes, using a lookup file kindly provided by Dr Paul Norman, Leeds University

It is worth noting that this approach compares the distribution of poverty within the city at one point in time with its distribution at another point in time. It is measuring the relative distribution rather than absolute changes. It is not possible to measure the absolute change because figures are based on the Income Deprivation measure which can rise or fall as welfare policies change. One consequence is that our analysis cannot identify a situation where low income households are being driven out of the major cities altogether, an important limitation.

Air pollution

We measure air quality in terms of levels of two indicators: particulate matter (PM_{10}) and nitrogen dioxide (NO_2). These are among the most hazardous pollutants for the population. PM_{10} is a collection of solid or liquid materials which are hazardous to human health. Prolonged exposure to PM_{10} has been shown to increase the risk of lung cancer and respiratory and cardiovascular diseases (Castro, Künzli & Götschi 2017; Kim, Kabir & Kabir 2015; World Health Organisation 2013). Sources of PM_{10} include road transport but also a range of other processes including the burning of fossil and biomass fuels or dust from construction and quarries, for example (AQEG 2005). NO_2 is a gaseous pollutant which is more narrowly associated with road traffic. High concentrations can cause significant inflammation of the airways and increases the incidence of lung cancer (Castro, Künzli & Götschi 2017; Hamra et al. 2015; Pannullo et al. 2017).

Data on PM_{10} and NO_2 levels for 1km grid squares for 2012 were downloaded from the Department for the Environment, Food, and Rural Affairs (DEFRA). Having considered a variety of smoothing methods to estimate LSOA pollution levels from these, we elected to use the data point closest to the population-weighted centroid of the LSOA. Sensitivity analysis revealed that there were only very small differences using alternative more complex spatial interpolation or smoothing methods. There are moderate to high correlations between levels of PM_{10} and NO_2 in each city but there are also some differences in their distribution (Pearson's R ranged from 0.95 in London and Glasgow to just 0.51 in Edinburgh). Using both therefore provides a better understanding of the potential impacts of poverty suburbanisation.

School quality

England and Scotland have different educational systems with pupils taking different examinations, so direct comparisons of educational outcomes are problematic. To avoid such problems, we just focussed on educational outcomes in the ten English cities only.

Since school attainment is strongly influenced by pupil intake, we have to measure this in the period before the suburbanisation of poverty that we are studying. Otherwise, attainment scores may reflect the impacts of suburbanisation rather than measuring the nature of the opportunity it may provide. Educational outcomes for the period 2001-2004 in England were therefore used. To reduce noise, we calculate the mean percentage of 15-year-old pupils achieving five or more GCSE/GNCQs at grades A*-C across these four years. These were the examinations which students in England sat at the end of their compulsory education at that time. Fee-paying schools and schools for children with special educational needs are excluded. School locations were geocoded from their postcode. Since pupils usually attend a school in the local authority in which they reside, LSOAs were matched to the nearest school within the same local authority.

Analysis

The analysis proceeds in three stages. First we use our measure of neighbourhood poverty change to confirm that the process of poverty suburbanisation is identified in our data as expected. We do this by comparing the centrality of neighbourhoods where poverty is falling (quintile 1) with that of the neighbourhoods where poverty is rising (quintile 5). We also examine the relative poverty levels of the neighbourhoods in these different groups to gain more insight into the nature of these places.

Second, we use our outcome measures of pollution and school quality to show that there is an urban gradient for each of these, as theorised above. This is a prerequisite for the suburbanisation of poverty to have the welfare consequences hypothesised. Third, we examine welfare impacts directly by comparing air pollution and school quality in neighbourhoods where poverty is rising with that in neighbourhoods where poverty is falling in order to address RQ1 and RQ3. We also compare these outcomes in neighbourhoods where poverty is rising with those where poverty is unchanged to address RQ2 and RQ4.

Findings

Suburbanisation of poverty

N. Bailey and J. Minton (2018) show that poverty is decentralising in all the cities being examined here. They illustrate this by showing how change in poverty for each neighbourhood were associated with distance from city centre. Figure 1 illustrates this same process in a slightly different way. It shows, for each of our neighbourhood poverty change quintiles, how they vary in their location within each city. Neighbourhoods in quintile 1 (largest

FIGURE 1

Neighbourhood poverty change quintiles by distance decile

Notes: Neighbourhood poverty change quintiles: 1 = share of poverty falling faster; 5 = share of poverty rising faster. 'X' indicates mean for each quintile. Box indicates quartile range and horizontal bar within box indicates median.

Source: own study based on EIMD data from *UK Government website*. SIMD data from *Scottish Government website*

FIGURE 2

Levels of Income Deprivation in 2004 by neighbourhood poverty change quintiles

Notes: neighbourhood poverty change quintiles: 1 = share of poverty falling faster; 5 = share of poverty rising faster. 'X' indicates mean for each quintile. Box indicates quartile range and horizontal bar within box indicates median.

Source: own study based on EIMD data from *UK Government website*. SIMD data from *Scottish Government website*

decrease in poverty) tend to be located closest to the city centre on average in every city. This supports the argument made by Bailey and Minton (2018) that between 2004 and 2015/16 the suburbanisation of poverty in these places was underway.

Figure 1 also shows how patterns of changes are vary between cities. In four of the 12 (Edinburgh, Liverpool, London and Newcastle), there is a fairly steady progression across the quintiles with the neighbourhoods where poverty is rising most strongly (quintile 5) located furthest from the centre on average. In the other eight cities, there is more of an inverted U relationship. It is the neighbourhoods seeing neither growth nor decline in poverty which are the most decentralised. The neighbourhoods where poverty is increasing fastest (quintile 5) are less central than those where poverty is falling (quintile 1) but they are not generally in the most suburban locations. This echoes findings from the US that poverty is rising most quickly in the older inner suburbs where housing is of lower quality. Similarly for the UK context, N. Bailey and J. Minton (2018) showed that, while poverty is moving to less central locations, it was not moving to locations with the lowest densities suggesting that it is the inner suburbs rather than the outermost areas where poverty is rising.

To shed more light on the characteristics of the neighbourhood quintiles, Figure 2 shows

the starting levels of poverty for each. In all of the cities, the neighbourhoods where poverty is falling fastest (quintile 1) had the highest levels of poverty in 2004 on average. This indicates that poverty is becoming less concentrated over time, as N. Bailey and J. Minton (2018) also found. The places where poverty has been growing fastest (quintile 5) had lower poverty levels in 2004 on average than the first group but still higher than those where poverty was little changed. Poverty levels were lowest in the quintiles where it remained largely unchanged (quintile 3) or grew only slowly (quintile 4). Thus poverty is decentralising and dispersing away from the poorest locations but it is not moving to the most affluent locations.

Urban gradients in air pollution and school quality

Figure 3 shows the broad relationship between centrality and each of the two measures of air pollution, summarised by correlation coefficients. Figures A1 and A2 (in the Appendix) show the relationships in much more detail, with plots for each city showing pollution levels by distance from city centre. The negative correlations show that, overall, air pollution falls with distance from the city centre on both measures, as expected; Sheffield is a minor exception in relation to PM_{10} . In almost every case, the correlation is stronger for NO_2 which is more closely associated with road traffic.

FIGURE 3
Correlations of air pollution with distance from centre for 12 cities
Source: own study based on DEFRA website

FIGURE 4
 Correlations of educational attainment with distance from city centre for 10 cities
 Notes: two Scottish cities omitted due to lack of comparable data
 Source: own study based on data from *Compare school performance website*

Coefficients range from -0.5 to -0.8 for NO_2 compared with -0.3 to -0.6 for most cases with PM_{10} . The relationship is not always a simple linear one in each city as the more detailed Figures in the Appendix show, reflecting variations in built form and, for example, the presence of major roads which cut through the cities. Nevertheless, there is a consistent picture of improving air quality with distance from the centre.

Figure 4 shows the relationship between distance from city centre and average educational attainment, again summarised through correlation coefficients. This also has the expected direction but correlations here appear much weaker (coefficients between 0.1 and 0.3 in most cases). Figure A3 shows the relationships in more detail for each city, revealing that several are non-linear. This was particularly evident in Bristol and Sheffield where educational attainment was higher in schools in the most central decile and the outer most areas than those in between. With centrality having less bearing on school quality, there are fewer grounds to expect the suburbanisation of poverty to bring advantages in this sphere.

Impacts of poverty suburbanisation on exposure to air pollution

Given the relationship between air pollution and centrality, we would expect poverty suburbanisation to

be associated with improvements in air quality (RQ1), i.e. we expect that neighbourhoods where poverty is rising would have better air quality than those where it is falling. That is indeed the case overall but there are also some exceptions and some variation within the neighbourhood quintiles as we see in Figure 5 for PM_{10} and Figure 6 for NO_2 . Using NO_2 estimates (Fig. 6.), the neighbourhoods with the fastest growth in poverty (quintile 5) have lower pollution than those with the biggest drop (quintile 1) in ten out of the 12 cities; exceptions are Leeds and Sheffield. Using PM_{10} (Fig. 5.), this is true in 8 out of 12; additional exceptions are Bristol and Manchester.

When we compare neighbourhoods with rising poverty (quintile 5) with the neighbourhoods where poverty was unchanged (quintile 3) (RQ2), we see a more mixed picture. Looking at NO_2 (Fig. 6.), there are just four cities where neighbourhoods with the fastest rises in poverty have air quality which is as good as the more affluent areas where poverty was not rising. The more common pattern is that the neighbourhoods where poverty is rising enjoy worse pollution than those where it is not changing. With PM_{10} (Fig. 5.), there is a similar picture with around half the cities where air quality is as good in the neighbourhoods of rising poverty as it is in those where poverty is not rising.

FIGURE 5

PM₁₀ levels by neighbourhood poverty change quintile

Notes: Neighbourhood poverty change quintiles: 1 = share of poverty falling faster; 5 = share of poverty rising faster. 'X' indicates mean for each quintile. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on DEFRA website and EIMD data from UK Government website. SIMD data from Scottish Government website

FIGURE 6

NO₂ levels by neighbourhood poverty change quintile

Notes: Neighbourhood poverty change quintiles: 1 = share of poverty falling faster; 5 = share of poverty rising faster. 'X' indicates mean for each quintile. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on DEFRA website and EIMD data from UK Government website. SIMD data from Scottish Government website

FIGURE 7

Educational achievement and neighbourhood poverty change quintile

Notes: neighbourhood poverty change quintiles: 1 = share of poverty falling faster; 5 = share of poverty rising faster. 'X' indicates mean for each quintile. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on data from *Compare school performance* website and EIMD data from *UK Government website*

Impacts of poverty suburbanisation on access to good quality schools

Figure 7 shows the school quality measure for each of the neighbourhood quintiles across the ten English cities. In this case, suburbanisation is less clearly associated with an improvement in amenity. In five of the ten English cities, school quality is better on average in neighbourhoods where poverty is rising (quintile 5) than in those where it is falling (quintile 1). London is one of these, along with Leeds, Leicester, Liverpool and Manchester. There is only one city where neighbourhoods of rising poverty (quintile 5) have school quality which is as good as those where poverty is not rising (quintile 3). In other cases, the relationship is more of an inverted 'U'. It is the neighbourhoods where poverty rates are unchanged (also the most affluent as noted above) which enjoy access to the best quality schools or, at least, those with the highest levels of educational attainment.

On the other hand, we could also note that there are no cities where the quality of schools is worse in the neighbourhoods where poverty is rising compared with locations where it is falling. In this sense, suburbanisation may not bring gains in terms of access to better schools but it is not bringing a worsening of the situation either, at least on this measure.

Summary

Table 1 provides a simple summary of the results from the previous two sections. The first three columns show

that the measures of pollution and school quality have the expected relationship with distance from city centre in every case – with the exception of PM₁₀ levels in Sheffield. There is therefore some basis for expecting that the suburbanisation of poverty might lead to welfare improvements on these measures.

It then summarises results for the two main tests: whether amenity was better in neighbourhoods where poverty was increasing than in those where it was decreasing (RQ1/3); and whether amenity in neighbourhoods where poverty was increasing was as good as those where it was unchanged, i.e. the group of relatively affluent, suburban neighbourhoods (RQ2/4). On the first, we conclude that the suburbanisation of poverty brings mixed results depending on which amenity we consider. There are improvements in air quality in most cases, particularly in relation to NO₂ levels, but only half of the cities show an improvement in the access to better quality schools. On the second, results are more clearly negative. Compared with the neighbourhoods where poverty was not growing, the neighbourhoods where poverty is rising tend to have worse schools in nine out of ten cities and worse levels of NO₂ in eight out of 12 cities. With PM₁₀, there is a more even split.

The table also highlights the variation between cities, both in the geography of suburbanisation and in

TABLE 1

Summary of results

Notes: Q1 = quintile of neighbourhoods where share of poverty falling faster; Q3 = quintile of neighbourhoods where poverty neither rising nor falling; Q5 = quintile of neighbourhoods where share of poverty rising faster

Source: own study based on data from: *Compare school performance website*, *DEFRA website*, *Scottish Government website* & *UK Government website*

City	Measure has expected relationship with distance from city centre			Amenity in Q5 better than Q1 (RQ1/3)			Amenity in Q5 as good as Q3 (RQ2/4)		
	PM10	NO2	Schools	PM10	NO2	Schools	PM10	NO2	Schools
	Decreases	Decreases	Increases	Q5 < Q1	Q5 < Q1	Q5 > Q1	Q5 ≤ Q3	Q5 ≤ Q3	Q5 ≥ Q3
Birmingham	1	1	1	1	1	0	0	0	0
Bristol	1	1	1	0	1	0	0	1	0
Edinburgh	1	1	n/a	1	1	n/a	1	1	n/a
Glasgow	1	1	n/a	1	1	n/a	0	0	n/a
Leeds	1	1	1	0	0	1	0	0	0
Leicester	1	1	1	1	1	1	1	0	1
Liverpool	1	1	1	1	1	1	1	1	0
London	1	1	1	1	1	1	1	0	0
Manchester	1	1	1	0	1	1	0	0	0
Newcastle	1	1	1	1	1	0	1	1	0
Nottingham	1	1	1	1	1	0	1	0	0
Sheffield	0	1	1	0	0	0	0	0	0
Total	11/12	12/12	10/10	8/12	10/12	5/10	6/12	4/12	1/10

the consequences. Within the limited scope of our study, Leicester and Liverpool are the cities where the consequence of poverty suburbanisation appear most positive, with improvements on five of the six outcome measures. London and Newcastle also show gains on the four of the six indicators and Edinburgh shows gains on all four pollution indicators. Three of that group were the cities where suburbanisation is most substantial with poverty moving to the fringes rather than the inner suburbs as in most UK cities. That might be expected to bring gains in air quality in particular. At the other end, Sheffield shows no improvements on any of the six measures. This city-region has a more complex form than the others, as it includes a major secondary centre (Rotherham) which also has relatively high levels of deprivation. Leeds shows improvement on just one indicator (schools) while Birmingham, Bristol and Manchester show improvements on just two – different combinations in each case.

Conclusions and discussion

This paper takes the literature on the suburbanisation of poverty in a new direction, moving beyond documenting the process to examine some of the potential consequences for low-income groups. It does not do this by reference to the general qualities of ‘the suburbs’ since it is clear that the rise of low income groups in outer urban areas occurs in only a subset of these locations. Instead it seeks to identify the neighbourhoods which are housing an increasing share of those in poverty and then to explore some of their qualities, comparing them with neighbourhoods where the share of poverty is declining and with those not witnessing any change. The paper can also be seen as an extension of the gentrification literature, shifting the gaze away from the neighbourhoods from which low income groups are being displaced to the locations where they are increasingly making their home.

The main contribution of this paper, therefore, is to demonstrate an approach to understanding the welfare impacts of poverty suburbanisation by focussing on two aspects of residential amenity: levels of air pollution and quality of schools. These are chosen partly on grounds of data availability but also because they are important influences on welfare and opportunity which we hypothesised could be affected by urban location. For these two dimensions, our results show that amenity is indeed related to urban location but also that the impacts of suburbanisation are quite varied as summarised above. The gains in relation to improved

air quality more apparent than those related to school quality but both vary between cities.

We are not concluding on the basis of this limited study that suburbanisation – and by implication gentrification – is a process to be welcomed or a goal to be pursued by policy either in the UK or more widely. Much more work is needed to explore the many and varied dimensions of welfare impacted by these changes, and we would expect many of these to be negative rather than positive. A particular priority would be an assessment of the impacts on access to public transport services since these play such an important role for low income households in relation to accessing employment and other opportunities. More suburban locations are likely to be much less well served by these networks, so that low income households in these places are confronted with difficult decisions over whether to incur the costs of maintaining a car or not (Mattioli 2017). Other approaches altogether may be necessary to understand the subjective experience of suburbanisation or its impacts on social networks, for example.

In developing a theory for the impacts of suburbanisation in relation to our outcomes, we identify two quite different distributive mechanisms which are at work. Future studies need to theorise how impacts may vary for other services or amenities and how they may vary between national contexts. Influences in the latter case are many and varied. In relation to air pollution, for example, the strength of any urban gradient will be shaped by the mix of fuel types for vehicles and the balance between public and private transport, all subject to a range of policy influences. In relation to education and local public services more generally, the urban gradient will be shaped by the funding systems for local services. All of these overlay the complex set of factors which lie behind the suburbanisation of poverty, including a wide range of social and housing policies in each country. The suburbanisation of poverty is likely to be at least as variegated in its forms and impacts as gentrification.

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Appendix

FIGURE A1

PM₁₀ by distance decile for each city

Notes: distance deciles: 1 = closest to city centre; 10 = furthest from city centre. 'X' indicates mean. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on DEFRA website

FIGURE A2

NO₂ by distance decile for each city

Notes: distance deciles: 1 = closest to city centre; 10 = furthest from city centre. 'X' indicates mean. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on DEFRA website

FIGURE A3

Percentage of 15-year old pupils achieving 5+ GCSEs/GNCQs at A*-C by distance decile for each city

Notes: distance deciles: 1 = closest to city centre; 10 = furthest from city centre. 'X' indicates mean. Box indicates quartile range and horizontal bar within box indicates median

Source: own study based on data from *Compare school performance website*