

Material deprivation and the Brexit referendum: a spatial multilevel analysis of the interplay between individual and regional deprivation

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In this study, we investigate the relationship between individual and neighbourhood deprivation and the decision to vote for Brexit in the 2016 referendum. Our analysis uses data from the UK Household Longitudinal Study and the English Index of Multiple Deprivation, and employs multilevel models to account for individual-level deprivation, neighbourhood deprivation, and larger-scale regional deprivation. We also examine the interaction between these scales. On average, we find that individual, neighbourhood, and wider area deprivation are associated with a higher likelihood of voting Leave. However, the effect of neighbourhood deprivation is heterogeneous and depends on the broader spatial context: living in deprived neighbourhoods (and to a lesser extent experiencing personal deprivation) has a stronger effect on voting behaviour in more affluent regions. Conversely, the effect of individual and neighbourhood deprivation is close to zero and statistically insignificant in more deprived areas of the country. These results suggest that social comparison processes of in-groups and out-groups operate within larger regional contexts. Our study thus highlights the role of individual and regional deprivation, but also their intersection, in shaping political attitudes and outcomes.

Introduction

The United Kingdom's decision to leave the European Union in 2016 was a significant political event, coinciding with the rise of right-wing populist movements in the European political landscape. On 23 June 2016, the United Kingdom decided that the country should leave the European Union. In total, 72.21 per cent of eligible voters participated in the referendum and 51.89 per cent of participants voted to leave the European Union. In England, the vote was similarly close with 53.40 per cent voting for 'Leave' and 72.90 per cent turnout (Halikiopoulou and Vlandas, 2017).

The prevailing theory behind the Brexit vote suggests that economic insecurity among voters was a key factor, with those who felt left behind due to structural shifts in the labour market more likely to support the Leave campaign (Gidron and Hall, 2017; Inglehart and Norris, 2017; Ausserladscheider, 2019; Carreras, Irepoglu Carreras and Bowler, 2019; Engler and Weisstanner, 2021). This theory suggests that

deprived citizens, both individually and regionally, were more likely to vote Leave. However, while there are several studies investigating this theory at the individual (Halikiopoulou and Vlandas, 2017; Alabrese *et al.*, 2019) and regional (Goodwin and Heath, 2016; Becker, Fetzer and Novy, 2017; Alaimo and Solivetti, 2019; Carreras, Irepoglu Carreras and Bowler, 2019; Nurse and Sykes, 2019) levels, there is little research on the interaction of individual and regional deprivation. This is an important shortcoming given that recent studies have highlighted the role of relative comparisons between groups, such as social classes or regional areas, and the importance of one's relative position within society (Chan *et al.*, 2020; Gidron and Hall, 2020; Green, Hellwig and Fieldhouse, 2022).

In this paper, we aim to fill this gap by examining the association between individual and regional deprivation and voting preferences in the Brexit referendum. Drawing on social comparison theory, we argue that deprived individuals were more likely to vote Leave

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if they lived in affluent areas due to their lower relative status compared to deprived people in poor areas. Hence, we focus on relative deprivation rather than just absolute deprivation to explain individual decisions in the Brexit referendum (Gidron and Hall, 2017; Green, Hellwig and Fieldhouse, 2022). Furthermore, we explore the role of different potential comparisons. First, we test whether the geographical scale matters (Firebaugh and Schroeder, 2009), with the relative status hypothesis holding for larger areas but not necessarily for small neighbourhoods, as they may exert positive externalities. Second, we test whether the comparison of individual or group (neighbourhood) deprivation is more sensitive to the larger geographic context and the hypothesis that close neighbours may be viewed as in-group (Green, Hellwig and Fieldhouse, 2022).

Our empirical analysis is based on a large, representative dataset of 23,258 individuals matched with regional information of the English Index of Multiple Deprivation and the Demographic Census. Based on the place of residence at the LSOA level, we define neighbourhood deprivation and wider area deprivation at different distances (2–75 km) from the place of residence. We apply spatially refined multilevel models of the Brexit vote intention, which account for individual economic deprivation as well as the spatial structure of regional deprivation.

The results show that individually and regionally deprived people were more likely to vote Leave, and that these results are very robust across a range of specifications. Furthermore, the positive effect of individual deprivation and neighbourhood deprivation on the preference to vote Leave depends on the larger spatial context. The effect of individual and neighbourhood deprivation is strongest for people living in richer areas and absent in highly deprived parts of the country. This finding is more pronounced for neighbourhood deprivation than for individual deprivation. Overall, the results support the relative status hypothesis and the idea that close neighbours belong to the in-group while large areas are used as reference for the out-group. This study thus contributes to our understanding of the interplay between individual and neighbourhood deprivation in shaping voting behaviour.

Theory

Individual deprivation

The rise of populism across Europe and elsewhere is often attributed to the concept of the ‘losers of modernization’ (Betz, 1994). This explanation suggests that increased economic competition and restructuring of the economy in post-industrial countries has left a significant portion of the population behind. These individuals may be experiencing economic insecurity, job

loss, or downward social mobility, and are therefore increasingly supportive of radical right views and parties (Goodwin and Heath, 2016). Despite the economic insecurity, individual deprivation may also trigger a cultural backlash among these ‘losers of modernization’. As societies modernise, there is a rapid transformation in cultural values and norms, including aspects such as multiculturalism, liberalism, and social justice. However, those who experience economic marginalisation or do not feel represented in these cultural views may resist the new cultural frameworks and gravitate towards more traditional values and views. This resentment may lead to a backlash that can fuel support for right-wing nationalist, xenophobic, populist, and authoritarian political parties (Goodwin and Heath, 2016; Gidron and Hall, 2017; Inglehart and Norris, 2017; Green, Hellwig and Fieldhouse, 2022). Thus, we would expect higher levels of economic and cultural deprivation at the individual level to be associated with a higher likelihood of voting for Brexit.

Direct H1) Individual-level deprivation increases the likelihood of voting for Brexit.

Nevertheless, previous empirical findings on the correlation between individual-level economic resources and radical right voting are surprisingly mixed. Some studies have reported significant contributions of income, education and class (Alabrese *et al.*, 2019; Carreras, Irepoglu Carreras and Bowler, 2019; Green, Hellwig and Fieldhouse, 2022) to the likelihood of supporting Brexit. However, others find only weak or no relationship between individual economic characteristics and support for the far right. For instance, social class loses its effect on Brexit support (Clarke, Goodwin and Whiteley, 2017) and income loses its significance on right-wing party support in Germany (Hartmann *et al.*, 2022) once several attitudinal measures are included. Similarly, income and unemployment appear to have no additional power in explaining radical right voting once subjective status is taken into account (Gidron and Hall, 2017, 2020; Mutz, 2018; Chan *et al.*, 2020). Overall, the importance of objective economic grievance at the individual level is rather controversial—especially when subjective values are included in the analyses.

Regional deprivation

There are several reasons why regional-level deprivation may influence voting behaviour independently of individual-level deprivation, particularly in the case of Brexit. First, deprived areas are more likely to experience increased competition for resources, such as jobs and public transfers, creating fertile ground for policies that prioritise the interests of in-groups, particularly white natives (Colantone and Stanig, 2018; Autor *et*

al., 2020). Moreover, austerity measures and public spending cuts can contribute to economic grievances and a sense of being left behind and ‘stuck behind’ (Tubadji, Colwill and Webber, 2021). This feeling can be reinforced when an entire region is affected, leading to support for radical right views. However, it is important to note that these effects, like those at the individual level, can be driven by economic as well as cultural factors. Economically deprived areas are likely to experience greater pressure on common goods and infrastructure. The closure of local amenities and services can lead to a ‘disappearance of everyday socio-cultural experiences’, which can create feelings of social isolation and disappointment (Bolet, 2021). Ultimately, these negative emotions can strengthen support for radical right policies. We thus expect to find an independent effect of local deprivation on the likelihood of supporting Brexit.

Direct H2) Neighbourhood-level deprivation increases the likelihood of voting for Brexit.

Direct H3) Area-level deprivation increases the likelihood of voting for Brexit.

Research on the relationship between deprivation and Brexit voting behaviour has shown more consistent results at the aggregate level than at the individual level. Research has found a correlation between average economic conditions, educational success, and support for Brexit in different regions (Goodwin and Heath, 2016; Becker, Fetzer and Novy, 2017; Alaimo and Solivetti, 2019; Nurse and Sykes, 2019). For instance, Tubadji, Colwill and Webber (2021) highlight the negative correlation between culture-related public spending and Brexit vote. However, there appears to be relatively large geographical variation in the relationship between deprivation and Brexit vote (Nurse and Sykes, 2019).

On the other hand, studies examining the effect of contextual conditions using individual-level data have produced mixed results. For example, Colantone and Stanig (2018) find that import shocks and immigration have a significant effect on voting behaviour in regions with increasing Chinese imports. However, other studies have shown that these contextual effects are weak (Abreu and Öner, 2020; Chan *et al.*, 2020), and the association between regional economic pressure and radical right voting weakens substantially when cultural values are taken into account (Chan *et al.*, 2020). In general, studies have suggested that cultural values play a more important role in contextual effects. For instance, Bolet (2021) has shown that people living in areas affected by pub closures were more likely to vote for Brexit. There has been an extensive debate about whether economic or cultural aspects are more

important drivers of radical right support (Clarke, Goodwin and Whiteley, 2017; Chan *et al.*, 2020; Gidron and Hall, 2020). However, as noted elsewhere (Gidron and Hall, 2020) these dimensions are strongly intertwined, and we will aim to operationalise deprivation in a way that incorporates both dimensions, and we will focus on another aspect here: relative deprivation and social comparison.

Relative deprivation

In the theoretical framework of our work, it is important to distinguish between a person’s objective social status and their subjective perception of it, that is their relative deprivation (Chan *et al.*, 2020; Gidron and Hall, 2020; Green, Hellwig and Fieldhouse, 2022; Hartmann *et al.*, 2022). Objective deprivation or being left behind are based on an individual’s actual economic or social position, whereas feelings of deprivation or being left behind can arise from social comparison processes, which refer to comparing one’s own social status to that of others. This concept of relative deprivation suggests that individuals may feel deprived or left behind not necessarily because of their absolute social status, but because of the relative disadvantage they perceive in comparison to others. In this sense, subjective deprivation or feelings of being left behind may play a crucial role in shaping the likelihood of supporting radical right-wing parties (Gidron and Hall, 2017, 2020).

Social comparison theory (Festinger, 1954; Runciman, 1980) suggests that individuals evaluate their own resources and social status by comparison with those of their reference group. The higher the status of the reference group, the lower the perceived relative status of the individual. Previous research has shown that such perception of relative status can result in strong emotional reactions (Firebaugh and Schroeder, 2009; Wolbring, Keuschnigg and Negele, 2013; Clark and D’Ambrosio, 2015). Relative deprivation thus likely triggers feelings such as frustration and social marginalization, which go beyond the effects of objective deprivation alone (Gidron and Hall, 2017, 2020; Green, Hellwig and Fieldhouse, 2022). In addition, social comparison provides a basis for blaming out-groups for one’s own grievances, which can further strengthen support for radical right policies (Green, Hellwig and Fieldhouse, 2022; Hartmann *et al.*, 2022). As a result, subjective feelings of relative deprivation can play an even more important role in driving support for radical right parties than objective levels of deprivation.

Defining the reference group for social comparison is challenging, as it involves identifying a meaningful and empirical definition. Previous research has compared groups such as occupational class or ethnicity (Gidron

and Hall, 2017; Green, Hellwig and Fieldhouse, 2022). While national averages are often used as the reference group for social comparisons (Gidron and Hall, 2020), we believe that this is largely due to data availability, but not necessarily due to theoretical justification. Similar mechanisms of comparison apply, for example, to nations and geographical regions: 'if one part of the country is perceived to be doing well, other areas are doing relatively worse' (Green, Hellwig and Fieldhouse, 2022: p. 325). Living in a relatively poor area while seeing other areas of the country flourishing is particularly likely to generate feelings of frustration and resentment (Cramer, 2016). We suggest that individuals compare their own material resources with the average resources of those around them to derive their relative status. Nevertheless, different mechanisms of comparison may operate at different geographical scales and their intersections.

Spatial scale hypothesis

Firebaugh and Schroeder (2009) propose the geographical scale hypothesis in their study on neighbourhood effects of happiness: 'individuals are happier when they live among the poor, as long as the poor reside at a distance' (Firebaugh and Schroeder, 2009: p. 825f). According to this spatial scale hypothesis, a geographical neighbourhood or area can have two distinct effects: (i) it can be used as a reference group for social comparison, and (ii) it can provide public goods. Living in an affluent neighbourhood can lower individual relative status, increase frustration, and foster radical right voting behaviour. However, living in an affluent neighbourhood may also come with good public amenities such as kindergartens, public transport, pubs, and schools, which may offset the negative effects due to status comparison (see also Bolet, 2021).

The likelihood of these processes varies according to geographical scale. Living in a larger affluent area likely contributes to social comparison but does not necessarily indicate good local amenities. Individual deprivation is therefore worse if the larger area is more affluent. In contrast, if a smaller local neighbourhood is affluent, this likely comes with good quality and provision of local infrastructure and amenities. Being deprived in an affluent local neighbourhood may be worse because of social comparison, but better because even deprived individuals benefit from public goods, reducing the sense of being left behind. We thus expect a negative interaction between individual deprivation and larger area deprivation. However, the interaction between individual deprivation and local neighbourhood deprivation can work in both directions.

Interaction H4a) The effect of individual level deprivation on voting behaviour is stronger in affluent areas of the country, as they are used for relative status comparison.

Interaction H4b) The effect of individual level deprivation on voting behaviour may be stronger or weaker in affluent local neighbourhoods, as they can be used for comparison but also provide desirable common amenities.

Group comparison

In addition to the reference group, it is also important to consider who people compare themselves to. So far, we have assumed that people tend to compare their own situation with that of someone else. However, Green, Hellwig and Fieldhouse (2022) argue that it is not necessarily the individual economic situation that is used to judge the success of current policies but rather the situation of one's in-group (e.g. one's own class or neighbourhood). Previous work has shown that people judge policies not only by their own economic grievances but also by the grievances of people they observe in their immediate environment, such as their friends and neighbours (Ansolabehere, Meredith and Snowberg, 2014). According to this economic voting model, people will vote for populist parties if they perceive their own in-group to be economically disadvantaged.

Relative comparisons further amplify this effect, as individuals may compare the economic situation of their own in-group with that of an out-group (Green, Hellwig and Fieldhouse, 2022), a comparison that is often emphasised in populist policies (Adler and Ansell, 2020). Given that people lack accurate information about the whole economy, we argue that they use the situation of the larger geographical area to form beliefs about the situation of the out-group. Therefore, we expect deprivation in small neighbourhoods to be worse when the larger area is prosperous.

Interaction H5) The effect of neighbourhood deprivation (in-group) on voting behaviour is stronger in more affluent larger areas (out-group), as the direct neighbours are seen as in-group while larger areas are used as out-group for comparison.

In summary, we expect both individual and neighbourhood deprivation to increase the probability of voting for Leave (direct effect). We expect the effects of individual and neighbourhood deprivation to be stronger in more affluent larger areas of the country due to social comparison (interaction). Given that immediate neighbours can be used for social comparison of relative status but can also be seen as in-group or contribute to public goods, we are not clear about the interplay between individual deprivation and the immediate neighbourhood (interaction).

Note that we are not a priori clear about the appropriate spatial scale for measuring larger areas for comparison. One possible explanation for the differences

in results of previous studies using multilevel data is the geographical scale of the regional context. While some studies assumed effects at the larger regional level of government district (Bolet, 2021), electoral districts (Abreu and Öner, 2020) or even counties (Colantone and Stanig, 2018), others specified small-scale neighbourhood effects (Chan *et al.*, 2020). Similarly, Weber (2015) highlights how conclusions about perceived group threat can differ depending on the spatial scale used to measure the outgroup. In this study, we will thus take an explorative approach by considering multiple distances to measure area deprivation. The distribution of average commuting distances in England and Wales has a mean of 15 km (see Supplementary Figure S2), indicating that many people daily observe areas within 10–20 km to their home. Intuitively, based on these commuting patterns, we would expect something between 10 km and 20 km to be a promising distance to form the reference group or outgroup.

Data, variables, and statistical model

Data

Our analysis of the association between deprivation and voters' decision in the Brexit referendum builds on a matched dataset of individual and regional data. At the individual level, we draw on information from wave 8 of the UK Household Longitudinal Study (UKHLS, 2016–2018). We use the restricted access version, which includes the respondents' geographical location (University of Essex, Institute for Social and Economic Research, 2020). For each UKHLS respondent, we matched information from the fine-grained regional level of Lower-layer Super Output Areas (LSOA). LSOAs contain on average around 1,400 individuals (600 households). We therefore interpret them as neighbourhoods.

Regional level data for LSOAs are taken from the 2015 English Index of Multiple Deprivation (Smith *et al.*, 2015) and the 2011 Census (Office for National Statistics *et al.*, 2017). For reasons of comparability, we restricted the data to respondents living in England only. We further restricted the sample to respondents who were either born in the United Kingdom or who have British citizenship. In total, our final matched dataset includes 23,258 English UKHLS respondents living in 10,214 LSOAs. From a statistical point of view, this can be considered an ideal setup for multilevel analyses, as it provides for a large number of observations at the higher (LSOA neighbourhood) level and a still sufficient number at the lower (individual) level (Maas and Hox, 2004).

Variables

The dependent variable is the revealed intention to vote 'Leave' in the 2016 Brexit referendum among

participants in the UKHLS study (Y_{ij}). The precise wording of the interview question was 'Should the United Kingdom remain a member of the European Union or leave the European Union?', and respondents' answers were recorded on a binary scale.

Our main independent variables are measured at the individual and regional levels. All individual level variables are constructed from UKHLS data. First, we rely on an individual material deprivation index (ranging from 0 to 1), which is defined as the normalised weighted sum of consumer goods that people say they cannot afford (X_{ij}). The weights are calculated by the proportion of people who have the respective good (Knies, 2022). In this study, we combined the normalised scales for material deprivation, children's material deprivation and pensioner's material deprivation, as families with children and pensioners were asked about a different set of goods. More details on the index can be found in Supplementary Material A. Higher values on the index indicate more individual deprivation.

Second, we use the 2015 English Index of Multiple Deprivation (IMD) at the LSOA level to capture the level of small-scale regional (roughly neighbourhood) deprivation (Z_i). The IMD is a measure of deprivation that includes several sub-domains, such as income, employment, health, education, crime, housing, and living environment. In our main analysis we rely on the (standardised) score of multiple deprivation, but Supplement D shows results for deprivation ranks. In order to account for the spatial structure of regional deprivation, we have also constructed spatial lags of the IMD, defined as the average value of the index within a radius of d kilometres around each LSOA (Z_i^{lag}). We interpret this variable as a measure of large-scale area deprivation while varying d between {adjacent, 2 km, 5 km, 10 km, 20 km, 35 km, 50 km, 75 km}. Note that both indices—individual and area deprivation—have a very skewed distribution (see Supplementary Figure S1).

In addition, we have constructed a number of individual and regional control variables for our statistical models. As we are interested in the effect of deprivation, we control for potentially confounding variables. On the individual level, we control for current unemployment, household equivalence income (percentile intervals), highest educational attainment, age (5-year categories), gender, migration background, ethnicity, marital status, and year-month of interview (V_{ij}). All models contain two dummies which indicate if an observation was eligible for children or the pensioners deprivation module. We report additional results without controlling for the economic conditions. Our regional-level controls are population density (inhabitants per square kilometres), percent population aged 18–29, percent population aged 65 and above, percent foreign nationals living in each neighbourhood, and

change in average house prices¹ between the 2016 and 2006 (W_j). We intend to capture other processes that may lead to deprivation and populist vote intentions such as population ageing, group threat processes, and increases in costs of living and resulting economic hardship (e.g. Adler and Ansell, 2020; Chan *et al.*, 2020; Bolet, 2021). Again, we calculated spatially lagged means of these variables for the larger area (W_j^{lag}).²

Statistical model

We model the intention to vote ‘Leave’ with a spatially refined multi-level model. More precisely, we specify a Hierarchical Linear Model (HLM) with random intercepts and random slopes (Raudenbush and Bryk, 2002; Snijders and Bosker, 2012). The random intercepts for voters’ intention are assumed to depend on deprivation of the neighbourhood. In addition, we specify random slopes for the effect of individual deprivation. The random slopes are allowed to vary by neighbourhood deprivation. Hence, we specify a cross-level interaction effect of individual and regional deprivation. This model allows us to test the relative status hypothesis, which predicts a stronger positive association between individual deprivation and support for Brexit in more affluent regions. The spatial refinement of the model is that we include spatially lagged averages of regional deprivation in the wider area (see Rüttenauer, 2022 for a discussion of the advantage of the approach over other spatial modelling strategies). This allows us to test the geographic scale hypothesis and compare interactions with individual and neighbourhood deprivation.

On the individual level, we specify the intention of voter i in LSOA neighbourhood j as a linear function of individual deprivation X_{ij} and a vector of individual-level control variables V_{ij} , such that

$$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + V_{ij}' \delta + \epsilon_{ij} \quad (1)$$

At the regional level, we specify random intercepts and random slopes for individual deprivation that vary with neighbourhood deprivation, Z_j , and spatial lags, Z_j^{lag} (area deprivation). The random intercepts further depend on regional socio-demographic control variables W_j . The LSOA neighbourhood-level model thus is given by

$$\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + \gamma_{02} Z_j^{lag} + W_j' \theta + W_j^{lag}' \lambda + \nu_{0j} \quad (2)$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} Z_j + \gamma_{12} Z_j^{lag} + \nu_{1j} \quad (3)$$

Taken together (inserting Equations 2 and 3 in Equation 1), we thus arrive at a Spatially Lagged Cross-Sectional Hierarchical Linear Model (SLX-HLM). This model is given by

$$\begin{aligned} Y_{ij} = & \gamma_{00} + \gamma_{01} Z_j + \gamma_{02} Z_j^{lag} + \gamma_{10} X_{ij} + \\ & \gamma_{11} Z_j X_{ij} + \gamma_{12} Z_j^{lag} X_{ij} + \\ & W_j' \theta + W_j^{lag}' \lambda + V_{ij}' \delta + \nu_{0j} + \nu_{1j} X_{ij} + \epsilon_{ij} \end{aligned} \quad (4)$$

Our analysis consists of three steps. First, we provide descriptive information for our main variables and for the spatial clustering of our data. Second, we present regression results of a baseline SLX-HLM model without cross-level interactions to estimate average individual and regional-level contextual effects of deprivation. Third, we estimate our full model (according to Equation 4) to test for potential cross-level interactions between individual deprivation and regional deprivation at the neighbourhood and area level. In our main analysis, we will rely on linear probability models throughout. However, results of non-linear models are presented in Supplementary Material E.

Results

Descriptive evidence

Figure 1 shows the spatial distribution of deprivation and the official Electoral Commission results of the Leave vote share. First, we see strong clusters of deprivation around urban cores, for example around Birmingham, Liverpool, or Manchester. Second, deprivation is highly spatially autocorrelated, with a Moran’s I of 0.63. Third, there is a slight tendency for those regions with higher levels of deprivation to have a higher likelihood of voting to leave the EU, for example in the coastal part of the East Midlands, or in South Yorkshire. Finally, the correlation between deprivation and Leave vote share at LSOA level is weak ($r = 0.04$), but becomes slightly stronger when we exclude London.

As descriptive statistics (Supplementary Table S1) show, our dependent variable (the UKHLS survey measure of the intention to vote ‘Leave’) differs from the actual votes in the Brexit referendum. The share of people intending to vote for Brexit in our English UKHLS analytical sample is 44 per cent, while the official vote share for England was 53 per cent. Hence, it should be kept in mind that there is a discrepancy between the reported intention to vote and actual votes (as shown in the left map of Figure 1).

Baseline model

Estimates of our basic SLX-HLM model without cross-level interactions are plotted in Figure 2. The graph shows the coefficients and 95 per cent confidence intervals for our main independent variables. For reasons of simplicity, we use 20 km as the geographical

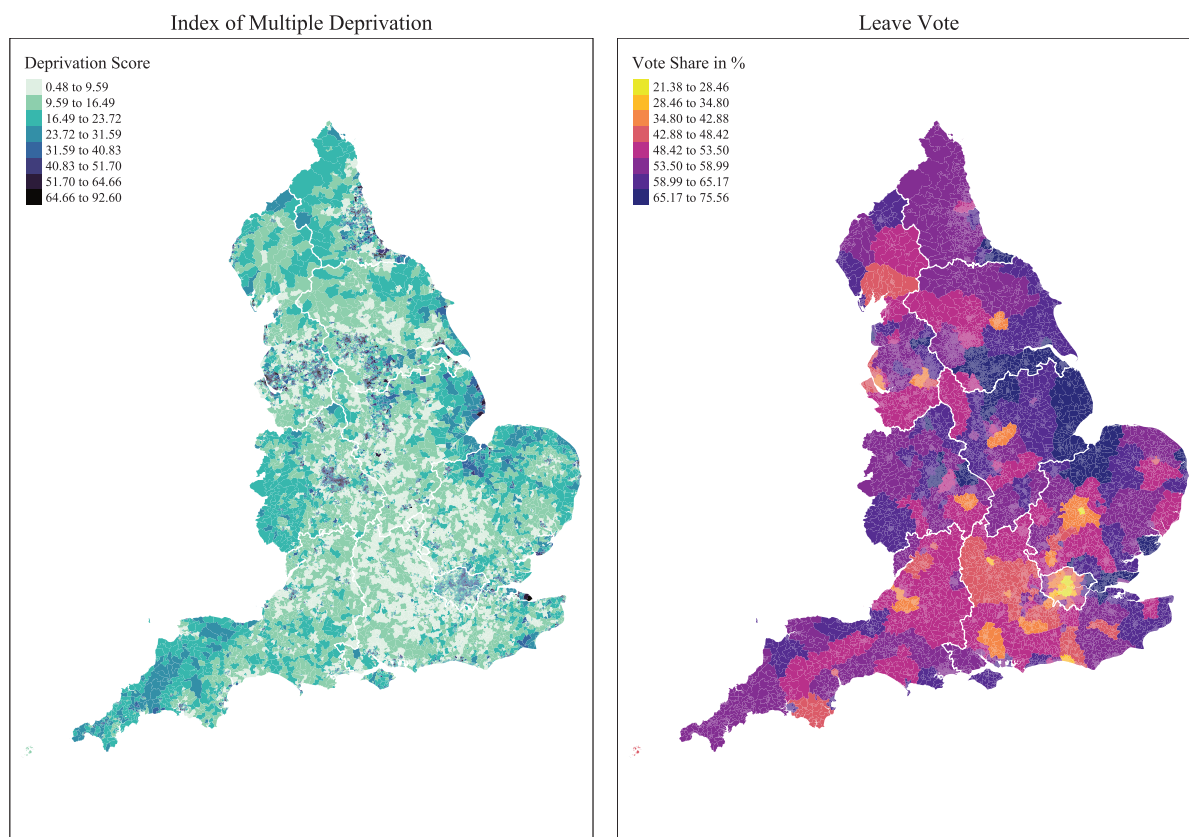


Figure 1 Index of multiple deprivation on the LSOA level (left panel) and official leave vote share on the Local Authority District level (right panel).

bandwidth for the broader area. The substantive conclusions, however, remain similar for other comparable distances (see [Supplementary Figure S2](#)).

For individual deprivation, we find that a one standard deviation increase in the deprivation index is, on average, associated with a 1.8 percentage point higher probability of voting 'Leave'. Note that this effect is larger—at 3.0 percentage points—when we omit other economic control variables (compare columns 1, 2, and 3 of [Supplementary Table S2](#)). In addition to this individual effect, the results show an independent regional-level effect of deprivation, which is of comparable magnitude. According to the baseline model, voters are more likely to prefer to leave the EU if they live in more deprived neighbourhoods and in more deprived areas of the country. Our spatially lagged model suggests that contextual effects at the small neighbourhood level and at larger-scale area level are of similar magnitude, with slightly larger effects of the local neighbourhood (2.2 percentage points at the LSOA level, and 2.0 percentage points at the 20 km area level). Bearing in mind that these are net of individual income and employment status, these deprivation effects appear to be moderately strong.

These results confirm previous empirical evidence of significant individual and regional effects of deprivation. We find strong evidence of a genuine contextual effects of deprivation, even after netting out the effects of a full set of individual and regional-level control variables. Taken together, the average effects of deprivation at all three levels are substantial, and they additionally hold for deprivation ranks and with non-linear models (see [Supplement Material](#)). We interpret this as support of the *economic insecurity hypothesis*. Being materially deprived (*H1*), living in materially deprived local neighbourhoods (*H2*), and living in more deprived areas of the country (*H3*) are on average associated with a higher likelihood of supporting Brexit.

Beyond our main research focus, the results of the baseline model also support previous findings from related research strands. For instance, the proportion of foreigners in the immediate neighbourhood reduces the probability of voting for Leave, while more foreign residents in the wider area are by trend associated with a larger probability of populist voting intentions—the context effect is particularly strong at 5 and 10 km (see [Supplementary Figure S2](#)). This finding is in line with

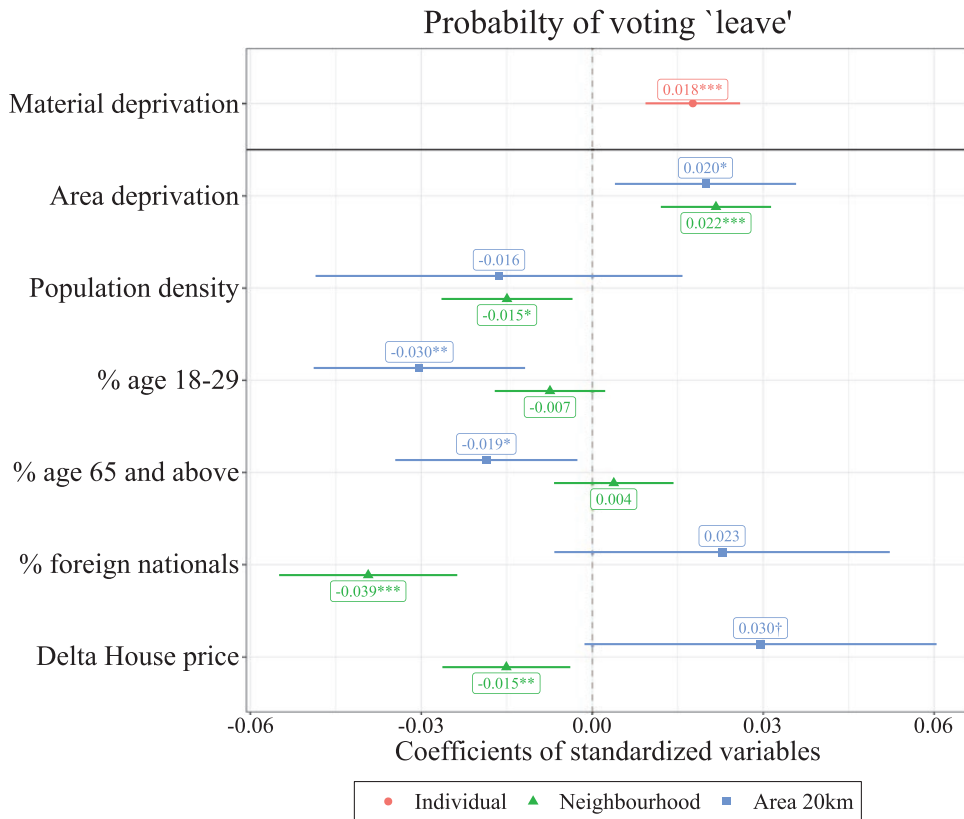


Figure 2 Regression results from Baseline SLX-HLM model. Notes: The model includes further individual-level control variables (estimates not shown here): age (5-year bins), sex (1 = woman), migration background (1 = yes), ethnicity, highest education, marital status, unemployment (1 = yes), household equivalence income (in GBP), interview month, deprivation battery eligibility. All continuous covariates are standardized (divided by their standard deviations and centred around the sample mean).

the well-known contact hypothesis at the small neighbourhood level and the group threat hypothesis at the larger area level. Similarly, increasing house prices in the immediate neighbourhood reduce the likelihood of right-wing populist voting, while increases in the region as a whole have a positive effect on the likelihood of Leave intentions. These examples show that contextual effects operate in different ways at different geographical scales.

Full model with cross-level interactions

So far, we have shown that—*on average*—individual, neighbourhood and area deprivation have independent effects on the likelihood of supporting Brexit. However, a key contribution of this paper is to investigate the intersection and interplay between the different levels of material deprivation. We first test whether the effect of individual deprivation depends on the geographical context. According to the social comparison theory, we would expect individual deprivation to be particularly influential in affluent regions of the country, as it signals

a low relative status (*H4a*). However, the geographical scale hypothesis suggests that this relative status effect mainly applies to larger areas, as affluent local neighbourhoods will also exert some positive externalities to compensate individual deprivation (*H4b*). To test these hypotheses, **Figure 3** shows the estimated marginal effects of individual deprivation by varying neighbourhood deprivation (left graph) and area deprivation (right graph), as predicted by our SLX-HLM model with cross-level interactions. We initially focus on 20 km as our area definition, but we will further extend this to other measures of the larger area.

There is no evidence of a heterogeneous effect of individual deprivation across different values of local neighbourhood deprivation. Individual deprivation increases the likelihood of voting 'Leave', and this effect is similar across deprived and non-deprived LSOA neighbourhoods. The model predicts an increase in the probability of around 2.1 percentage points for every one standard deviation increase in the individual deprivation index, irrespective of the local context.

However, the effect of individual deprivation does in fact vary depending on how deprived the area is. According to our results, a higher individual deprivation index (by one standard deviation) is associated with a 5.7 percentage point increase in the likelihood of a person voting ‘Leave’ if that person lives in the most affluent region of England. It seems that this situation of low relative status creates particularly strong feelings of being ‘left behind’. On the other hand, there is no discernible effect of individual deprivation in areas with higher levels of area deprivation. The effect of individual deprivation is close to zero for voters living in areas slightly above the average deprivation score, and the model even predicts a negative (though statistically insignificant) effect for people from the most deprived areas. Note, however, that the interaction term falls just short of the 5 per cent threshold for statistical significance ($p = 0.074$).

In [Figure 4](#) we re-run the same model for different definitions of a larger area, ranging from directly adjacent units to a bandwidth of 75 km. In terms of trend, these graphs follow a pattern similar to the idea of social comparison and relative status, but also to the geographical scale thesis. Individual deprivation has a more detrimental effect the more affluent the larger area, for example within 20, 35, or 50 km. However,

the interaction is weak for closer neighbourhoods, as the negative comparison effect may be offset by positive neighbourhood externalities. The interaction effect also disappears when we go beyond 50 km. This may be too far to be relevant for individual status comparisons. Overall, we tend to interpret these results as support for relative status comparison (*H4a*), especially for larger areas (*H4b*). However, this must be interpreted with caution given the large statistical uncertainty around the estimated interaction effect. Additional models using deprivation ranks and non-linear models ([Supplementary Figures S5 and S8](#)) show a similar pattern, but (like our main results) fail to show a significant interaction at most distances.

Finally, we want to test if the effect of local neighbourhood deprivation on Brexit voting depends on the larger spatial context. As argued by [Green, Hellwig and Fieldhouse, \(2022\)](#), the relative economic grievance of an entire group—such as one’s neighbours—may be more important for feelings of despair and political dissatisfaction than the individual situation alone. [Figure 5](#) shows the interaction between local neighbourhood deprivation and deprivation at the larger area.

The results provide a clear pattern that supports the notion of relative status comparisons between in-groups and out-groups. Living in a deprived

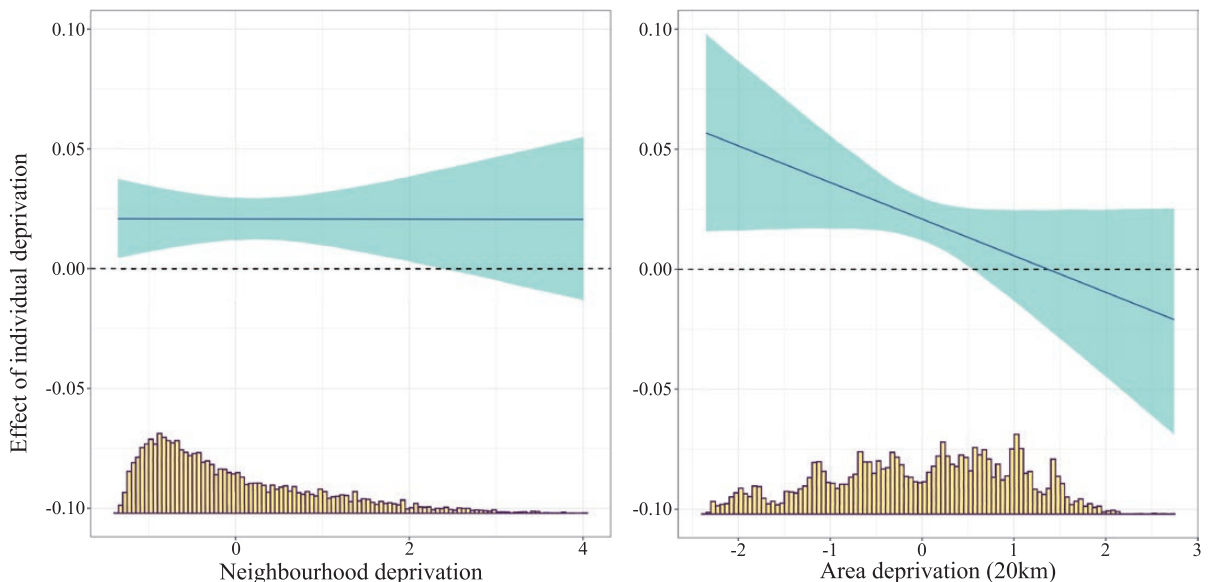


Figure 3 Cross-level interactions from SLX-HLM model. Notes: The model includes further individual-level sociodemographic and economic control variables (estimates not shown here): age (5-year bins), sex (1 = woman), migration background (1 = yes), ethnicity, highest education, marital status, unemployment (1 = yes), household equivalence income (in GBP), interview month, deprivation battery eligibility. The model includes further regional-level control variables (included at neighbourhood level (LSOA) and at area level, spatial lagged mean value for LSOAs within 20 km distance of respondents’ place of residence): Population density, median age of the population, percentage share of foreign nationals, change in housing prices 2016–2006, and interaction terms of individual material deprivation with all LSOA-level neighbourhood variables. All continuous covariates are standardized (divided by their standard deviations and centred around the sample mean).

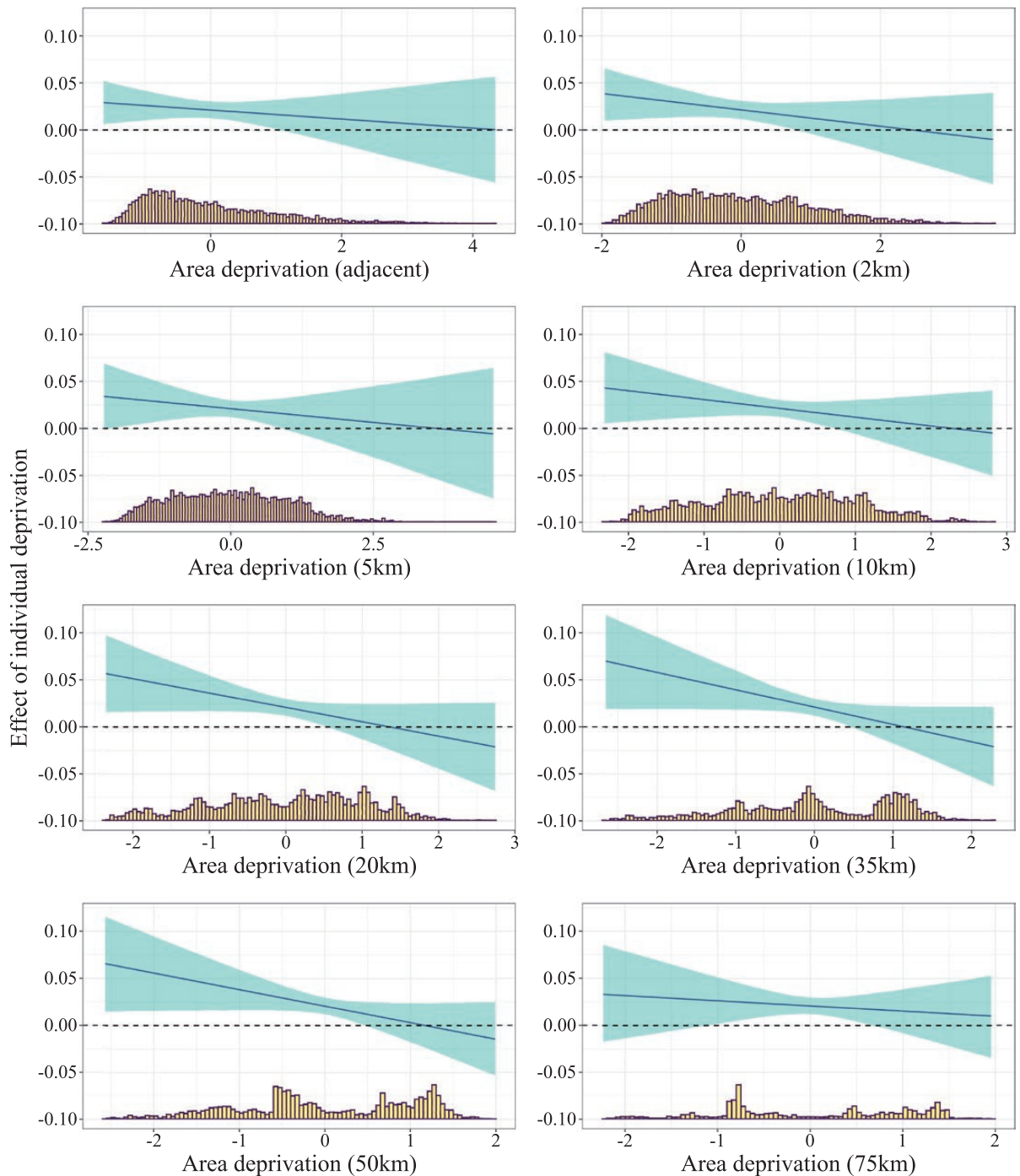


Figure 4 Cross-level interactions from SLX-HLM models, interaction of individual and regional deprivation at varying geographical scale. Notes: The models include further individual-level sociodemographic and economic control variables (estimates not shown here): age (5-year bins), sex (1 = woman), migration background (1 = yes), ethnicity, highest education, marital status, unemployment (1 = yes), household equivalence income (in GBP), interview month, deprivation battery eligibility. The models include further regional-level control variables (included at neighbourhood level (LSOA) and at area level, spatial lagged mean value for LSOAs within varying (adjacent, 2, 5, 10, 20, 35, 50, or 75 km) distance of respondents' place of residence): Population density, median age of the population, percentage share of foreign nationals, change in housing prices 2016–2006. The models control finally for interaction effects of individual material deprivation with all LSOA-level neighbourhood variables. All continuous covariates are standardized (divided by their standard deviations and centred around the sample mean).

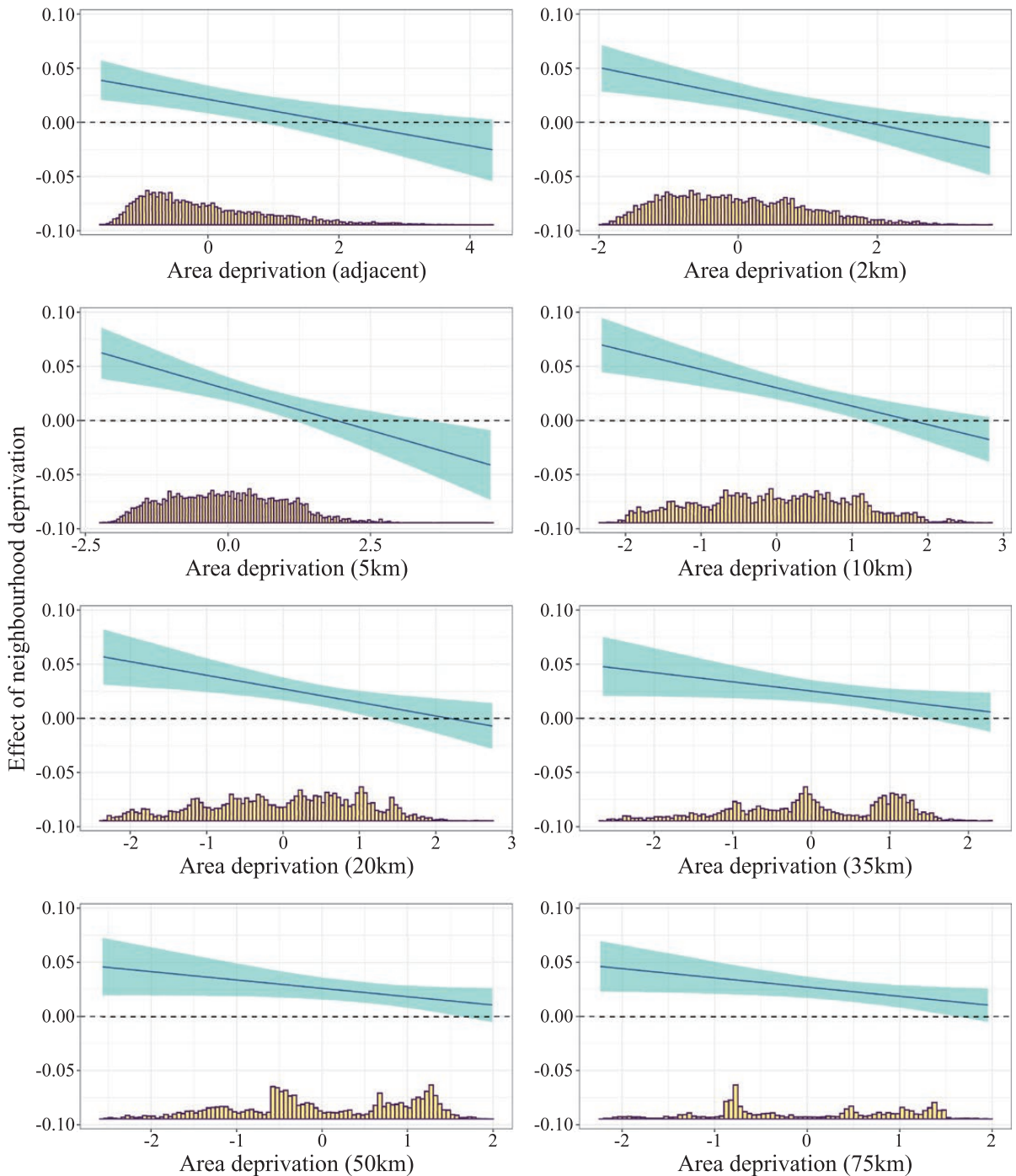


Figure 5 Second-level interactions from SLX-HLM models, interaction of local and larger area deprivation at varying geographical scale. Notes: The models include further individual-level sociodemographic and economic control variables (estimates not shown here): age (5-year bins), sex (1 = woman), migration background (1 = yes), ethnicity, highest education, marital status, unemployment (1 = yes), household equivalence income (in GBP), interview month, deprivation battery eligibility. The models include further regional-level control variables (included at neighbourhood level (LSOA) and at area level, spatial lagged mean value for LSOAs within varying (adjacent, 2, 5, 10, 20, 35, 50, or 75 km) distance of respondents' place of residence): Population density, median age of the population, percentage share of foreign nationals, change in housing prices 2016–2006. The models control finally for interaction effects of individual material deprivation with all LSOA-level neighbourhood variables. All continuous covariates are standardized (divided by their standard deviations and centred around the sample mean).

neighbourhood increases support for Brexit, particularly when that deprived neighbourhood is located within a more affluent larger area. Taking 10 km as an example, a one standard deviation increase in neighbourhood deprivation is associated with a 7 percentage point increase in Brexit support if that neighbourhood is located in the most affluent part of England. In contrast, the effect of neighbourhood deprivation is close to zero if that neighbourhood is located in a wider area that is one standard deviation above the average deprivation. Comparing the results across different bandwidths, this in-group/out-group comparison appears to be quite localised, with the strongest interaction values when comparing the local neighbourhood with the situation within 5 or 10 km. All of these interactions are also highly significant, and we observe identical results in non-linear models (Supplementary Figure S9). The uncertainty is somewhat greater for deprivation ranks, but the substantive results follow the same pattern (Supplementary Figure S6). Furthermore, the interplay between local deprivation and area deprivation becomes much weaker from 35 km onwards. This is consistent with the distribution of average commuting distances (Supplementary Figure S2) and fits perfectly with the idea of relative group-based social comparison (*H5*).

Conclusions

Since the 2016 Brexit referendum, several studies have examined how individual and regional deprivation influence right-wing populist voting decisions. In our study, we merged individual-level data on intentions to vote for 'Leave' in the Brexit referendum with information on deprivation at the individual, neighbourhood, and area levels. We improved on previous studies by considering the interaction between deprivation at different levels, allowing us to explore two separate mechanisms of social comparison. By analysing deprivation at multiple levels, we were able to gain deeper insights into the factors that shape voting behaviour.

On average, individual, neighbourhood, and area deprivation independently increase the likelihood of supporting Brexit, with similar effect magnitudes. The impact of focal neighbourhoods is slightly stronger than that of individual or larger area deprivation. We observe results that tend to support individual social comparison theory, as the effect of individual deprivation is notably stronger in more affluent regions. Conversely, individual deprivation loses its independent influence in highly deprived areas: individually deprived individuals are not more likely to support leaving the EU compared to their less deprived counterparts. However, this findings does not reach statistical significance at the 5 per cent level. Yet, we find strong

support for group-based comparisons, where the negative impact of local neighbourhood deprivation is more pronounced in more affluent regions. In more deprived larger areas, by contrast, the characteristics of the local neighbourhoods have only negligible effects.

Our study provides weak support for both social comparison theory and the geographic scale hypothesis (Firebaugh and Schroeder, 2009). We find that people in the wider area seem to have a greater impact on relative status perceptions than immediate neighbours. Wealthy neighbours may have a positive spillover effect by contributing to good infrastructure and amenities that benefit the poor. Another explanation for our findings is the group-based comparison theory (Green, Hellwig and Fieldhouse, 2022). We consistently find consistent support for the idea that people compare the deprivation of their peers (in this case, neighbours) to the broader area as reference or out-group. If one's own group has a low relative status, this can lead to feelings of despair and dissatisfaction with current policies, which may steer individuals towards right-wing voting intentions. Our findings are in line with the argument that close neighbours contribute to in-group evaluations, while larger areas are seen as out-groups and used for relative status comparisons.

Our study highlights the need to consider the role of reference groups and geographical scales, as well as their interaction, when examining the mechanisms of social comparison. The impact of a given measure may vary at different spatial scales and be influenced by other factors at varying levels. Our study has illustrated this phenomenon in the context of material deprivation. However, similar arguments can be made for other spatial characteristics, such as the proportion of immigrants, where the contact hypothesis and group threat may have different effects at different scales. Thus, research on populism in general may benefit from a greater focus on understanding the interplay between different spatial mechanisms.

Our analyses also have some limitations. First, and most importantly, our analysis does not provide evidence on causal effects of deprivation. Although the results suggest strong and robust statistical associations, our main independent variables may be endogenous. An important task for future research clearly is to analyse matched panel data at the individual and regional level in order to control for stable unobserved differences between voters that may confound the effect of deprivation, e.g. a similar design as used by the study of Kaufmann (2017) on context effects of immigrant inflows on changes in anti-immigration attitudes and individual votes for UKIP. Second, our dataset is limited to English voters and neighbourhoods. Thus, we cannot generalize the results to the UK referendum as a whole. Third, we analysed intention to vote rather

than actual voting behaviour. Although there is likely to be a close relationship with actual voting, it should be borne in mind that deprivation may have affected turnout somewhat differently on the day of the referendum. Fourth, our focus in this paper was on the effect of deprivation. We did not address the precise mechanisms along the causal chain from deprivation to populist votes, that is we cannot answer the question of how deprivation leads increased Brexit support. We theoretically follow the hypothesis that subjective feelings of being stuck behind as a group, relative to an out-group, plays an important role. Further research along these lines may shed light on the validity of cultural arguments.

Notes

1. Based on the median house prices data provided by the Office of National Statistics. The data is publicly available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/medianpricepaidbylowerlayerssuper-outputareahpsdataset46>.
2. Descriptive sample statistics for all variables are shown in [Supplementary Table S1](#). Note that we also kept extreme (negative) income values. However, our strategy of binning income into percentile intervals reduces the influence of the outliers while simultaneously controlling for potential non-linearities. Moreover, we standardized all continuous variables by one standard deviation.

Supplementary Data

Supplementary data are available at *ESR* online.

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Data Availability

The Understanding Society and Harmonised BHPS Special Licence Access data (12th Edition) is not publicly available because of privacy restrictions, but access can be acquired via the UK Data Service (SN: 7248, <https://doi.org/10.5255/UKDA-SN-7248-12>) after application. The 2015 English Index of Multiple Deprivation in online available at <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015>, and the 2011 Census data is online available at https://www.nomisweb.co.uk/sources/census_2011. R 4.2.2 was used for data analysis, and code

for replication will be made available at <https://github.com/ruettenuer/brexit-deprivation>.

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