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# Left behind and left out: Evaluating (dis)connections in the spatially focused migration network of England and Wales

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## Abstract

Previous research has often linked socioeconomic decline and 'left behind' places with out-migration and depopulation. Few analyses have reflected on the role of connectivity in the migratory system, and how this varies across groups and places to produce peripheralisation. Using detailed migration in England and Wales, we examine the level of spatial focusing of migration flows between local authority origins and destinations, using the Gini index. The study extends the established spatial focusing literature to consider the role of age and investigates the phenomenon in 'left behind' places. Our findings show the complexity of the role of migration in the production of left behind places, with implications for population redistribution.

**KEYWORDS**
Gini index, left behind places, migration, peripheralisation, population geographies

## 1 | INTRODUCTION

Peripheralisation is a well-developed concept that describes how complex networks of flows and actors generate a polarising divide between core and peripheral places (Leibert & Golinski, 2017). Similarly, widespread interest in 'left behind places'—stagnating or declining areas—recently emerged, albeit associated with political discontent due to ongoing stagnation (Ford & Goodwin, 2014). In both instances, migration significantly contributes to the growing inequalities (Leibert & Golinski, 2017; Lulle, 2019). Out-migration and depopulation occur when declining regions lose residents to thriving regions, particularly younger migrants who offer a higher economic contribution through taxed employment (Heikkilä & Pikkarainen, 2010). Over time, less prosperous areas may observe human capital and reproductive potential siphoned off to richer areas, further widening the gap between regions.

Migration forms links between places, which are strengthened with increased migration, encouraging movement of information and socioeconomic resources through cumulative through cumulative causation (Massey, 1990). Analysing flows within migration networks furthers understanding of connections, specifically when identifying spatial disparities.

Spatial focusing characterises a migration network by describing the degree to which migration flows across a set of geographic units are uneven or spatially concentrated. Previous studies used the Gini index for this purpose, including Plane and Mulligan (1997), Rogers and Sweeney (1998), and more recently Liu et al. (2015) and Wu and Liu (2022). We employ a similar approach, using detailed estimates of migration flows from the UK's Office of National Statistics (ONS, 2021a). We calculate national-level Gini Indices for all flows, before calculating for flows sending to and from each local authority (LA) in England and Wales. The existing methodology is then extended, by decomposing the Gini index to evaluate the contribution of different age cohorts, given the observed role of age-selective migration.

The UK is used as a case study. The country has entrenched and widening spatial inequalities (Martin et al., 2021; Massey, 1979).

The typology of 'left behind places' incorporates existing inequalities alongside the discontent experienced following economic stagnation (Ford & Goodwin, 2014). Previous analyses of UK migration have compared migration to economic processes, identifying links between immobility, industrial change or economic decline, and discontent (Friedlander & Roshier, 1966; Lee et al., 2018; Rodríguez-Pose, 2018), and matching movement to geographies associated with career development and associated life course transitions (Champion & Gordon, 2021; Thomas, 2019). However, spatial focusing of the migration network has not yet been assessed in a UK context; this is a key contribution of this paper, as this relationship is explored for the first time.

Following a review of existing literature in Section 2, the paper addresses three key themes. First, we provide an overview of internal migration flows for England and Wales in 2019, applying a spatial focusing approach to identify areas of high and low network connectivity. We next consider the extent to which these patterns vary across different age groups through a novel methodological extension of the Gini index. Third and finally, we contextualise observed migration patterns based on existing knowledge of left behind places in England and Wales. Overall, we make a distinctive theoretical and methodological contribution by introducing an alternative application for the spatial focusing approach that explores the relationship between the geographies of migration and peripheralisation. This is important, as whilst the association between the two has been observed previously, our analysis offers further evidence of the complex role of migration networks in generating and maintaining regional inequalities in the UK.

## 2 | BACKGROUND: MIGRATION, PERIPHERALISATION AND THE LEFT BEHIND

This research is situated across the migration, peripheralisation, and spatial inequality literatures. Peripheralisation is a relational, multi-dimensional, multi-scalar, and temporal process that produces core and peripheral areas, outlined by Kühn and Bernt (2013) and Leibert and Golinski (2017). The core is a societal hub; economically attractive, containing resources, jobs and investments, generating in-migration and growth. This process is facilitated by flows that remove resources from peripheral areas, facilitating a spiral of decline. The peripheralisation concept draws from existing theorisations of cumulative causation (Myrdal, 1957) and core-periphery theory (Friedmann, 1973), as market processes reinforce the divide between the wealthier and poorer regions.

The phenomenon of 'left behind places' emerged as an alternative term for periphery, broadening the definition beyond the traditional rural areas to incorporate postindustrial towns. Left behind places have failed to access prosperity when spatial inequalities have widened, prompting disadvantage and immobility or out-migration (Martin et al., 2021), and contributing to political turmoil through the ballot box (Ford & Goodwin, 2014; Rodríguez-Pose, 2018). Left behind places have been classified in various ways, with UK-based examples incorporating measures of economic growth, educational achievement, connectivity, and community resource availability resources (Davenport & Zaranko, 2020; Martin et al., 2021; OCSI, 2019).

Despite being a main dimension of peripheralisation, migration is less explicitly addressed. Out-migration from peripheral areas, particularly the loss of young or high-skilled workers, causes a drain of human capital in the periphery leaving it deprived of talent (Friedlander & Roshier, 1966; Hansen & Aner, 2017; Heikkilä & Pikkarainen, 2010; Lang, 2012; Parr, 1966). Significantly, migration occurs within a system, as every migratory flow has an origin and a destination (Ravenstein, 1885). All together, these flows form a network by socially connecting migrants—and places—through kinship between origins and destinations, allowing flows of information and socioeconomic assistance (Massey, 1990). The connections encourage a cumulative causation process, as the feedbacks along existing flows reduce the costs for future migration. However, whilst place-level impacts of depopulation have been analysed (Kühn et al., 2017), existing research neglects the role of the whole migration network in the processes of regional peripheralisation.

Both migration and peripheralisation are hierarchical systems. As flows move within peripheralisation from the periphery to the core, migration typically occurs up and down a hierarchy of increasingly urban places (Plane et al., 2005; Ravenstein, 1885). Hierarchical movement follows a clear age structure: younger people move up to larger areas, before gradually moving down to less metropolitan areas upon later life stages (Plane et al., 2005). In the UK, this pattern has distinctive geographies. Major regional cities experience net out-migration composed of net in-migration of young workers for faster career progression, who then leave to establish families or upon retirement age, with this 'escalator' process being most extreme in London and the surrounding South East region, notably an area of higher wealth and productivity (Beatty & Fothergill, 2020; Champion & Gordon, 2021; Chen et al., 2020; Fielding, 1992).

Within this network, left behind places are mostly smaller, postindustrial towns that formerly attracted workers in coal, steel, textiles and shipbuilding industries. Post deindustrialisation, existing research suggests their migration connections are mostly local, with a low loss of working age residents but also lower appeal for in-migration (Beatty & Fothergill, 2020; Friedlander & Roshier, 1966; Kalogirou, 2005). This spatial process has economic repercussions, as the concentration of human capital encourages investment that detracts from left behind places (Faggian & McCann, 2008). However, the potential socioeconomic impacts of place (dis)connectivity has been under-analysed.

Existing literatures (Fawcett, 1989; Massey, 1990) emphasise the interdependence of places through the movement of people, including through cultural and personal networks which maintain connections. Spatial focusing of a migratory system describes the structure of these connecting migration flows, specifically the quantity, volume and diversity of flows to origins and destinations (Plane & Mulligan, 1997). If a place exhibits equally distributed flows to and from all destinations or origins, its migration network is

dispersed, whilst spatial focusing occurs when these connections are uneven, concentrated on a small number of origins and destinations. Initially, Plane and Mulligan (1997) demonstrated how the Gini index, traditionally used to evaluate economic inequality, could be decomposed and applied in a migration context, measuring the number of people per origin-destination flow. Their approach demonstrates the inequality of system-level in-migration and out-migration flows and for specific places, with clear upper and lower limits for relative comparison between populations.

Similar studies evaluated alternative indices, variation between different demographic sub-groups, changing levels of focusing over time (Rogers & Raymer, 1998; Rogers & Sweeney, 1998), and more recently linkages between geographical characteristics, temporal changes and socioeconomic development (Liu et al., 2015). In the US, migration networks of different groups have distinct spatial focusing patterns, influencing population change and the spatial concentration of different age groups (Rogers & Raymer, 1998). For our purposes, measuring the contribution of different age cohorts (or other demographic groups) may illuminate dependencies that can make places vulnerable, particularly where peripheralisation is concerned (Leibert & Golinski, 2017). Our decomposition of the Gini index by demographic sub-group re-emphasises the importance of investigating not just *how many* people are moving to where, but also *who* those people are.

Overall, existing research has demonstrated the overlap between peripheralisation and migration. However, the contribution of the spatial focusing of the migration network has only been briefly discussed, with a suggestion that the structure of flows can have socioeconomic consequences (Liu et al., 2015; Plane & Mulligan, 1997; Rogers & Raymer, 1998). Our research explicitly explores this relationship, using a spatial focusing approach to assess the connectivity and characteristics of the migration network, to evaluate possible association with left behind places and, especially, the potential role of disconnection. This paper offers a unique contribution by analysing the spatial focusing of England and Wales to examine the relationship between peripheralisation and migration. Based on the discussed literature, we hypothesise that there will be a relationship; we predict that left behind places are more likely to have limited population movement, and so have more disconnected, and so more focused, networks, especially for in-migration.

## 3 | METHODS

### 3.1 | Data

We use official detailed estimates for internal migration, which provide the flows between origins and destinations disaggregated by age (defined as of 30 June 2019) and sex[1] at Local Authority (LA) level for England and Wales. This data set contains 1,407,235 records for 2019 (ONS, 2021a). This data forms most population estimation tables for England and Wales and is the most comprehensive data set of origin-destination migration information available. Although the data are available from 2011 until 2020, the 2019 data set was chosen as the most recent whilst being unaffected by the Covid-19 pandemic. LAs are real-world administrative units under the control of a local governing body, with a range of services being provided at district level, making them suitable for analysing left behind places (Davenport & Zaranko, 2020).

The connectivity of the migration network is quite high, with 87% of all potential connections between LAs including at least one migrant. Figure 1 shows the geographies of this network, displaying all origin-destination flows for England and Wales with 100 moves or more in 2019. The figure highlights key areas of movement, for example, LAs containing major cities including London, Bristol, Manchester, Liverpool, Sheffield, and Newcastle. There are 3,393,282 moves recorded in total for the network. 1,162,502 (34%) of these are to neighbouring LAs, and 1,849,907 (55%) are within the same region. The region with the most internal moves is London (13% of all moves nationally), with the fewest observed in the North East of England.

The age distribution of migrants for 2019 is shown in Figure 2, with movers classified into seven cohorts in Table 1, based on Fotheringham et al. (2004). Higher levels of movement are observed for young adults compared to other cohorts, comparable to other studies (Rogers et al., 1978; Shuttleworth et al., 2021). The population share for an age cohort is often dissimilar to the cohort's share of moves; for example, the age 60+ cohort contains 24% of the population, but less than 9% of moves.

### 3.2 | The Gini index for spatial focusing

Spatial focusing is measured using the Gini index, a metric traditionally employed to quantify economic inequality between people within populations, as adapted by Plane and Mulligan (1997). The Gini index measures the inequality of all migration flows in the system, as shown in Equation 1:

$$^{M}G_{(all)} = \frac{\sum_{O}\sum_{D\neq O}\sum_{O'}\sum_{D'\neq O'}|m_{OD} - m_{O'D'}|}{2n(n-1)M} \quad (1)$$

With $m$ being the number of moves between two places and $\{m_{OD}\}$ and $\{m_{O'D'}\}$ capturing the number of individuals moving from origin $O$ (or $O'$) to destination $D$ (or $D'$). The Gini index thus compares the size of every migration flow to every other migration flow, ignoring any diagonal elements $\{m_{OO}\}$. The denominator incorporates the number of migration flows $n$, here the number of LAs included in an ($n$ x $n$) origin-destination matrix, and the number of interregional migrants, $M$. The output falls between 0 and 1. A score nearer 0 indicates that migration flows are equal or dispersed across locations, whilst a score nearer 1 indicates they are uneven, or spatially focused.

Plane and Mulligan (1997) decompose the Gini index to assess the spatial focusing of inward and outward flows. This consists of a

[1]Decimal points are included in this data set, due to the scaling process outlined in the ONS methodology (ONS, 2020). Their methodology also acknowledges the sources of data, and development of estimates to overcome potential biases.

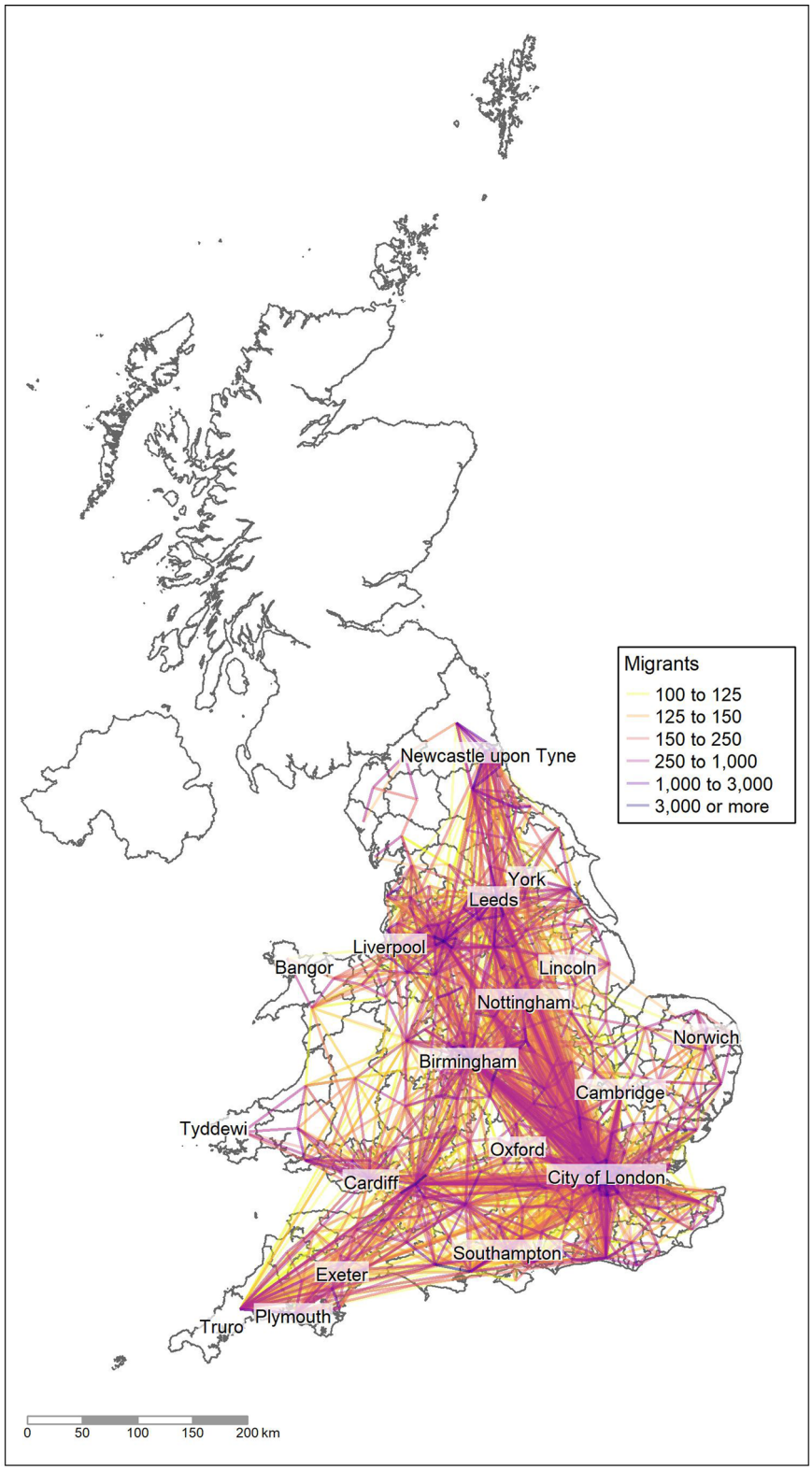


**FIGURE 1** *Migration flows for England and Wales with 100 moves or more (2019).*

rows index that measures the focusing of the destinations of out-migrants (Equation 2), and a columns index that indicates the spatial focusing of in-migrants (Equation 3):

$$ {}^{M}G_{(out)} = \frac{\sum_O \sum_{D \neq O} \sum_{D' \neq O,D} |m_{OD} - m_{OD'}|}{2n(n-1)M} \quad (2) $$

$$ {}^{M}G_{(in)} = \frac{\sum_O \sum_{D \neq O} \sum_{O' \neq O,D} |m_{OD} - m_{O'D}|}{2n(n-1)M} \quad (3) $$

These two equations summarise the entire system (and notably include all migrants, $M$, in their denominator) and are valuable for separating the ingoing or outgoing flows.

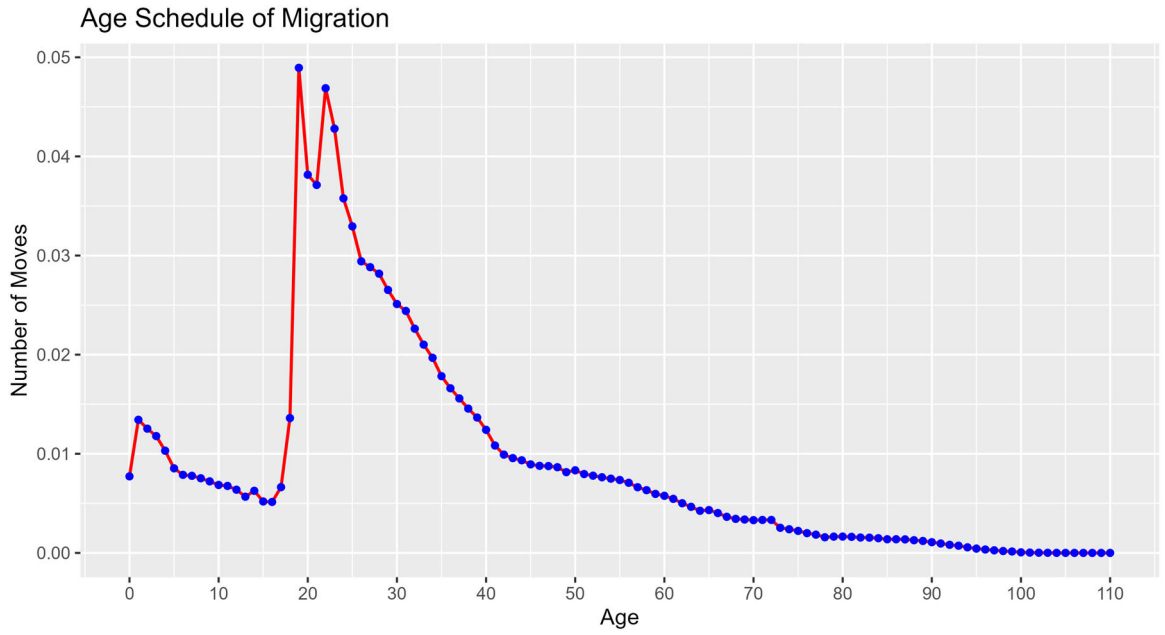


**FIGURE 2** *Age schedule diagram, migration estimates for* England and Wales (2019).

**TABLE 1** Population data by age group, 2019

| Cohort | Population size (%) | Number of moves (%) |
|---|---|---|
| 0 – 15 years | 11,380,514 (19.15%) | 449,057.82 (13.23%) |
| 16 – 19 years | 2,604,333 (4.38%) | 252,725.03 (7.45%) |
| 20 – 24 years | 3,690,265 (6.21%) | 682,642.7 (20.12%) |
| 25 – 29 years | 4,009,669 (6.75%) | 493,665.35 (14.55%) |
| 30 – 44 years | 11,503,323 (19.35%) | 825,811.26 (24.34%) |
| 45 – 59 years | 11,930,956 (20.07%) | 391,372.22 (11.53%) |
| 60 + years | 14,320,780 (24.09%) | 298,007.18 (8.78%) |

For each individual LA, the in- and out-migration field indices can be decomposed further to reflect the level of focusing of the incoming and outgoing flows for a specific place. For each individual LA, *o* or *d*, the following equations are used, using the total outgoing migrants, *L*, or total incoming migrants, *I*, within the denominator to allow for large differences in population sizes:

$$G_{(Out)} = \frac{\sum_{D \neq o} \sum_{D' \neq o} |m_{oD} - m_{oD'}|}{2n(n-1)L} \quad (4)$$

$$G_{(In)} = \frac{\sum_{O \neq d} \sum_{O' \neq d} |m_{Od} - m_{O'd}|}{2n(n-1)I} \quad (5)$$

## 3.3 | Decomposition by age group

Equations (1–5) measure spatial focusing for the total population. This measures how evenly balanced all flows are in the network, as well as for individual LAs and specifically only outgoing or incoming flows. We extend the above calculations by evaluating the relative impact of different age cohorts through a decomposition of the Gini index, based on derivations in an economic context by Sharrocks (1982), Lerman and Yitzhaki (1985) and Stark et al. (1986). Decomposing the Index in this way permits the measurement of different properties of the migration network (Figure 3). So far, this approach has captured the entire network using the full Gini index (A), and decomposition by flows (B), which separates incoming and outgoing flows. We decompose the Gini index by sub-group (C), which allows the networks of specific population groups to be explored. This can incorporate all network flows, as is done with the standard Gini index, or separate incoming and outgoing flows.

The index is decomposed into the following parts:

$$G = \sum_{a=1}^{A} S_a G_a R_a \quad (6)$$

In Equation (6), a indexes a subgroup, for example age cohort, of migrants, such that $m_{OD} = \sum_{a=1}^{A} m_{ODa}$. $S_a$ is the share of subgroup *a* in the total migration *M*, with a larger value indicating that a higher proportion of migrants in the system fall within this sub-group. $G_a$ is the Gini coefficient for the migration network of component *a* only, calculated using either Equations (4 or 5) with a high score indicating uneven flows. $R_a$ is the Gini correlation of migration of sub-group *a* with the distribution of all migrants, *M*, where $F(M)$ and $F(m_a)$ are the cumulative distributions of total migration and sub group migration (Stark et al., 1986).

$$R_a = \frac{\mathrm{Cov}\{m_a, F(M)\}}{\mathrm{Cov}\{m, F(m_a)\}} \quad (7)$$

$R_a$ is a value between −1 and 1, measuring 0 if $y_a$ and $y$ are independent. As$|R_a|$ approaches 1, $m_a$ becomes more correlated to

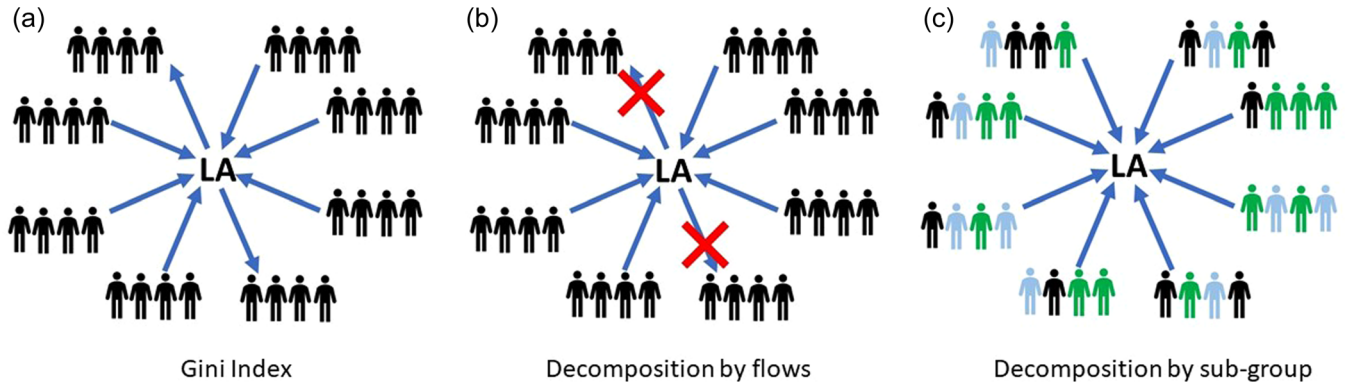


**FIGURE 3** *Types of decomposition.*

**TABLE 2** Gini index 2011–2020

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Gini | 0.805 | 0.807 | 0.810 | 0.810 | 0.813 | 0.815 | 0.810 | 0.809 | 0.810 | 0.811 |

the total number of migrants, *M*, indicating that LAs that have focused fields for the measured cohort are likely to have focused fields for all cohorts.

Consequently, this equation decomposes the migration flows into three metrics for each sub-group component: the share of all migration, the inequality across all origin-destination flows, and the correlation of flow magnitude for each group compared to the magnitude for all migrants. Therefore, we can compare spatially the extent to which different sub-groups contribute to the level of spatial focusing to and from LAs. Due to the complexity of interpreting results for 339 LAs, and given that all components sum to the national Gini index, the impact of each age group on the spatial focusing of each LA is reported as the Focusing Contribution ($C_a$) of the Gini index (Equation 8), which indicates the level of contribution of component a to the focusing of the flows measured.

$$\mathrm{Ca} = \frac{S_a G_a R_a}{G_{All}} \tag{8}$$

## 4 | RESULTS

### 4.1 | Is the migration network of England and Wales spatially focused?

The Gini index for all migration flows (Equation 1) was calculated for each year between 2011 and 2020, presented in Table 2. The Gini index for each year is higher than 0.8. Whilst migration flows are not expected to be equal (Plane & Mulligan, 1997), with upper and lower limits of 0 and 1, a score of 0.8 indicates that the migration system of England and Wales is highly focused, and migration flows in the network are uneven. As this is consistent over time, we focus on the pre-pandemic 2019 data for the remainder of the study.

The Gini indices for incoming and outgoing flows are calculated for individual LAs. High out-migration index scores indicates flows of migrants leaving the LA are uneven, or concentrated on fewer destinations. High in-migration scores imply the LA receives migrants from relatively few origins. Every LA in England and Wales displays high spatial focusing across both in-migration and out-migration networks, with all scores higher than 0.4, indicating that migrants are not sent or received to and from other LAs equally.

As in previous studies (Plane & Mulligan, 1997; Rogers & Raymer, 1998), the Gini indices are z-standardised, then plotted in a migration field diagram to categorise LAs (see Figure 4). The positive correlation of 0.743 between the in-migration and out-migration indices, suggests locations receiving from more origins are likely to send migrants to more destinations. The LAs within the red box have both indices within ±1 so are characterised as 'normal' within the context of this specific migration network. The 44% of LAs that fall outside of the box are 'redistributors' of population (Plane & Mulligan, 1997; Rogers & Raymer, 1998). LAs that lie above the black diagonal line are described as 'outwards redistributors', meaning they send migrants to more LAs than they receive migrants from. LAs below the black diagonal line experience the opposite as 'inward redistributors'. The LAs that fall outside the 'normal' category are spread across the four categories explained in Figure 5.

Figure 6 shows the geographies of the categories. In the bivariate map (Figure 6c), higher in-migration index score is represented as green (vertical axis), whilst higher out-migration index score is purple (horizontal axis). Navy areas have focused fields for both measures, whilst white areas have dispersed fields for both measures. The map shows focused in-migration towards the more prosperous South East region surrounding London, although less within London itself. In comparison, northern, coastal and Welsh local authorities display more focused out-migration. These observations suggest the LAs

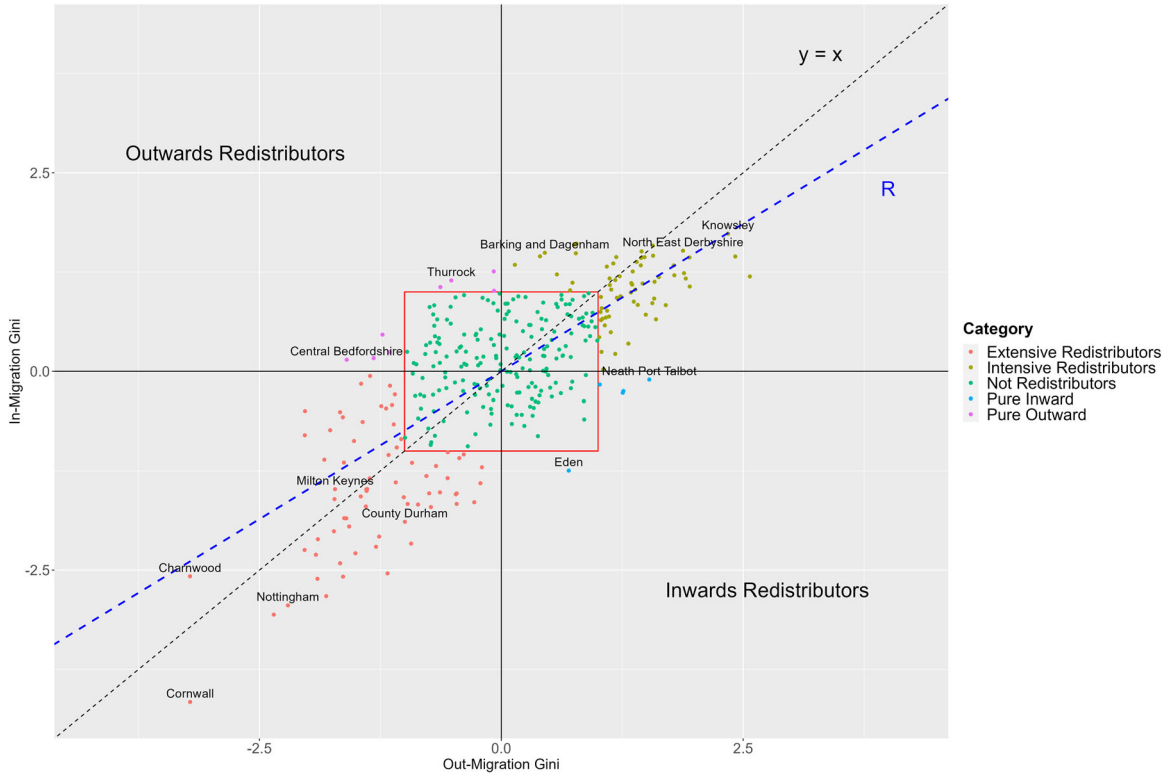


**FIGURE 4** *Migration field diagram, England and Wales 2019.*

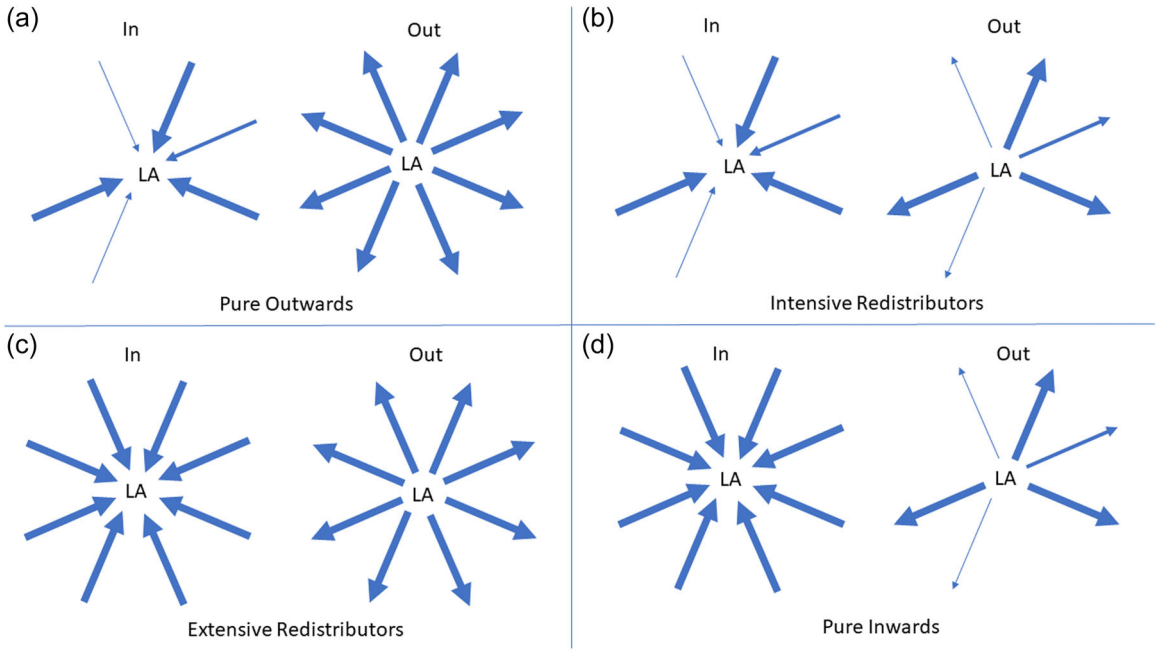


**FIGURE 5** *A visualisation of the categories used in the Migration Field Diagram.*

surrounding London are sending migrants to more LAs than they receive them from, notably more than other areas of the country. This correlates with the national escalator effect, whereby people move into London, then gradually migrate outwards over time (Champion & Gordon, 2021). The geographical pattern reinforces the theory that dispersed out-migration combined with focused in-migration is associated with more developed areas, as South Eastern LAs are stereotypically wealthier and more suburban (Liu et al., 2015).

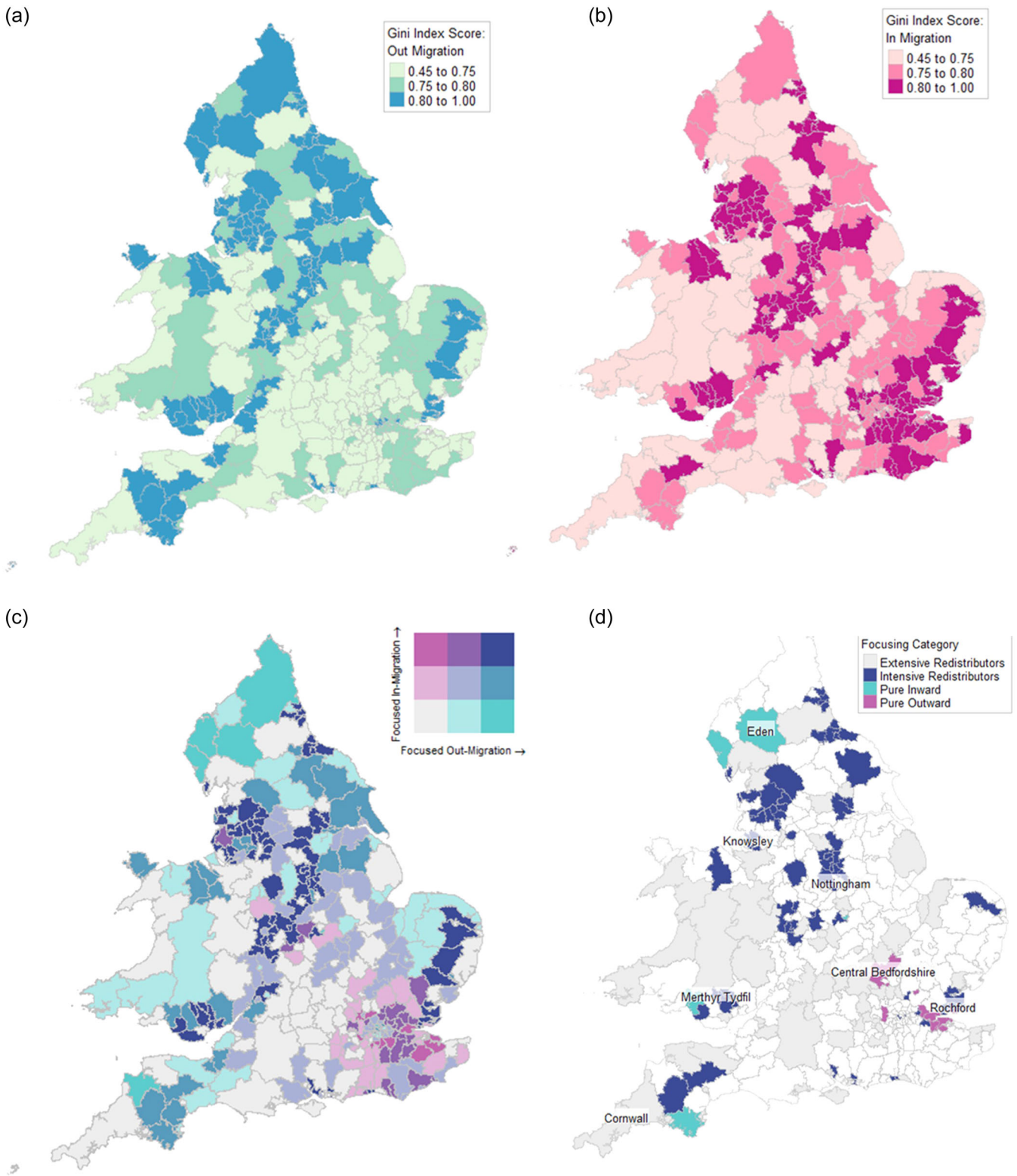


**FIGURE 6** *The spatial distribution of the Gini Indices for in-migration, out-migration, and both*. Figure 6a: Gini index Score for out-migration by LA. Figure 6b: Gini index Score for in-migration by LA. Figure 6c: Bivariate Map of in-migration and out-migration Gini Indices. Figure 6d: Geography of categories outlined in Migration Field Diagram (Figure 5).

The four categories of focusing identified in Figure 4 were investigated further to identify overlap with existing classifications of left behind places.

The intensive redistributors with the highest levels of spatial focusing for both inwards and outwards migration are dark blue in the bivariate map and observed in the top right of Figure 4. These are mostly located in the North West and on the South East Coast. Some LAs within this category are classically peripheral locations in both a UK and international context, with higher rurality and deprivation. The LAs below the black diagonal line with more focused out-migration flows than in-migration flows include Knowsley, Merthyr Tydfil and Isles of Scilly, which have all previously been classified as left behind (Davenport & Zaranko, 2020). This is similar for some LAs with more focused in-migration flows than out-migration flows, for example Barking and Dagenham, but this grouping also includes slightly wealthier LAs, such as Rochford. These LAs tend to be positioned towards the East or South-East of England nearer the region of London, incorporating wealthy suburban LAs alongside left-behind coastal LAs, and so may form part of their migration system. The geographies and known characteristics of intensive redistributors suggest left behind LAs are more likely to have more focused out-migration than in-migration, whilst highlighting how location potentially connects an LA to the migration network.

In comparison, the grey extensive redistributors positioned in the bottom left of Figure 4, exhibit lower-than average scores across both indices; both migration fields are relatively dispersed and so have extensive interaction within the migration system,. Most extensive redistributors have more dispersed in-migration flows than out-migration flows, however the LAs have contrasting characteristics, including northern city regions such as Nottingham and York, alongside southern, rural LAs of Isle of Wight and Cornwall. The extensive redistributor LAs are not consistently included in left behind classifications (Davenport & Zaranko, 2020; Martin et al., 2021), potentially because dispersed migration fields generate higher connectivity for socioeconomic flows. However, the inconsistency of category suggests uncertainty about the relationship between left behind places and spatial focusing.

The role of direction identified across the intensive redistributors can be investigated through the pure redistributors. Pure inwards redistributors have significantly focused out-migration but fairly dispersed in-migration, positioned in the bottom right of Figure 4, green on the Figures 6c, 6d. These are mainly located towards the North, and in Wales and eastern coastal areas. Out of the five significant purely inward redistributors, three have been classified as left behind in at least one classification (Davenport & Zaranko, 2020; Martin et al., 2021). Notably, Eden is the least left behind of the group and has the most dispersed out-migration. This reinforces the pattern observed for the intensive redistributors, with dispersed in-migration compared to their focused out-migration, which are less economically developed.

Alternatively, the pink outward redistributors (Figure 6d) exhibit more focused migration inwards compared to quite dispersed out-migration, receiving from few origins but sending to many destinations. These, including Thurrock and Central Bedfordshire, are notably less 'left behind' than purely inward redistributors. However they are not 'thriving' LAs, classed in contradictory ways across different methodologies (Davenport & Zaranko, 2020; Martin et al., 2021). The geographical distribution is a key feature of purely outward redistributors. They are mainly located in the South East, surrounding London, with locations including wealthy suburban and struggling coastal LAs. Whilst not all are thriving areas, their physical proximity to the major city of London may encourage integration to the migration system, particularly if commuters can benefit from proximity to the capital alongside lower residential costs in less prosperous LAs, leading to all avoiding being left behind in a national context.

Analysis of each category indicates levels of spatial focusing do not neatly align with classifications of left behind places. Despite the geographies of the Gini indices being comparable to known socioeconomic patterns, individual categories contain both left behind and wealthier LAs. This analysis highlights an initial concern when assessing left behind places; it is possible that the categories do not neatly align because the category of 'left behind' is so complex. Left behind is associated with economic and politics as well as demographic characteristics such as migration. To address this complexity, we investigated case studies to evaluate how spatial focusing overlaps with attributes of left behind places.

Knowsley and Central Bedfordshire were studied. Knowsley is located within Liverpool City Region, and fits the expectations of a left behind place. The primary industry is manufacturing, accounting for 17.6% of jobs (ONS, 2021b). It is located within the commuter zone for Liverpool City Region, and it is one of the most deprived LAs nationally with 65% of the area's Lower Super Output Areas (LSOA) in the bottom 20% of the Index of Multiple Deprivation, and 38% in the bottom 5% (Noble et al., 2019). In comparison, Central Bedfordshire has a diverse economy, with the largest employment providers being retail (18.3%) and education (10.6%). The median salary of £36k is higher than Knowsley's £30k. Significantly, Central Bedfordshire utilises connections with London, Oxford, and Cambridge, encouraging a thriving knowledge-based economy that supports a higher standard of living. Both populations grew in 2019, but growth of Central Bedfordshire was higher than the national average, including the 5th highest net migration nationally, whilst Knowsley was ranked 98th.

We investigated how their circumstances may affect migration connections. Figure 7a shows the migration networks of Knowsley, an intensive redistributor with focused in-migration and out-migration. A key characteristic of this network is the limited number of connections. Knowsley sends and receives 72% of migrants to and from neighbouring LAs, and nearly 85% in the North West region, with the major city of Liverpool being a notable neighbour. This level of disconnection fits our hypothesis for the expected association between spatial focusing and left behind places.

In comparison, Figure 7b displays the network of Central Bedfordshire, a pure outwards redistributor with more focused in- migration than out-migration, and one of the wealthiest LAs in the country.

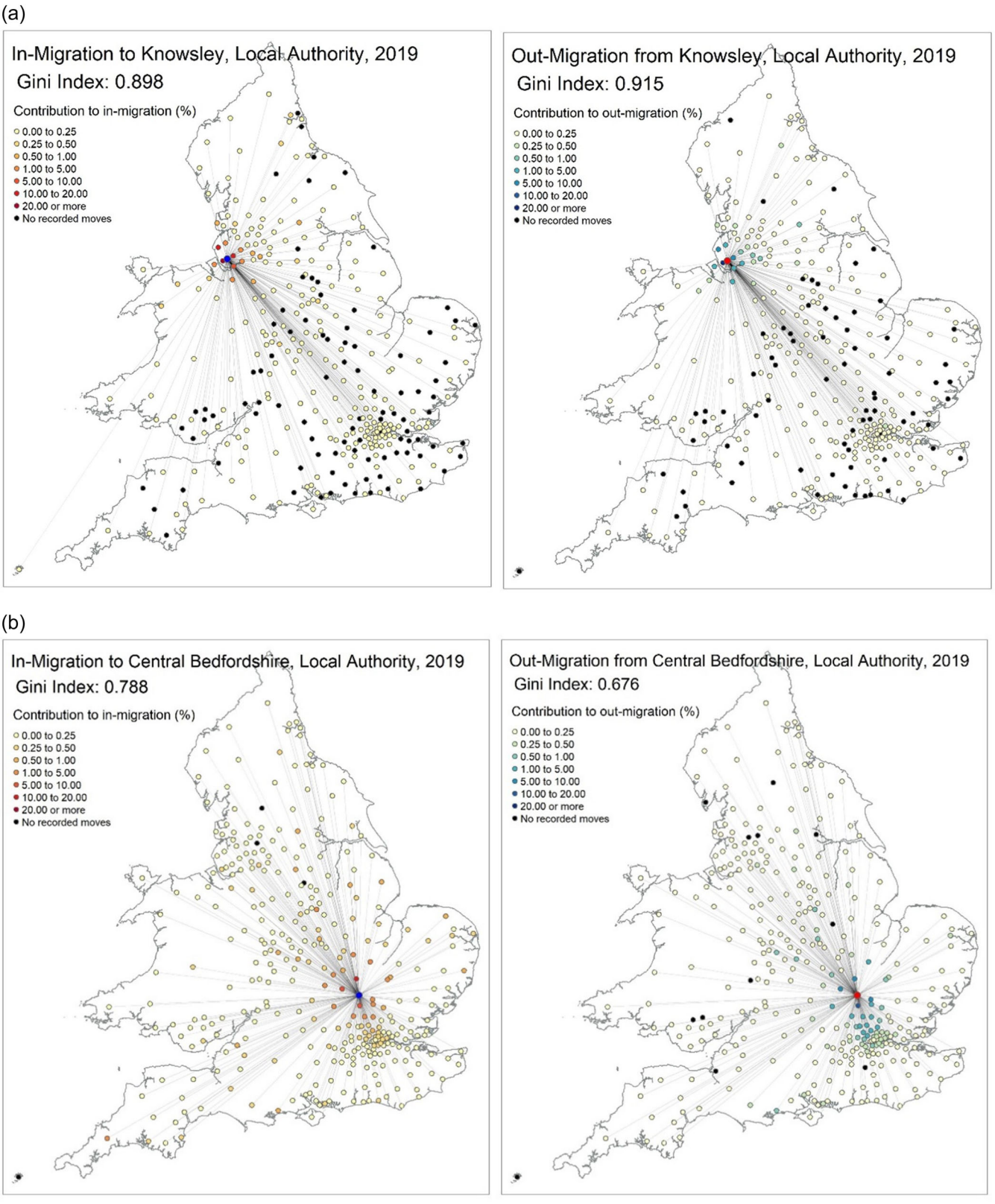


**FIGURE 7 (A)** Migration network of Knowsley, a LA in North West England. (b) Migration network of Central Bedfordshire, a LA in South East England.

Visually comparing these networks highlights the role of geography and network connections in shaping left behind places. Both LAs both depend on their neighbours which are neighbouring major urban areas; however, a key difference is Central Bedfordshire's proximity to London. As a thriving metropolitan centre and global city, London has a greater impact on Central Bedfordshire's network than Liverpool for Knowsley, offering more opportunities for nearby residents. Central Bedfordshire's in-migration network is less focused than for Knowsley because it acts as a stepping stone to and from residence and employment within the capital. Additionally, it also thrives as a pure outwards redistributor with an even wider out-migration network because it has connections to rural LAs, with a network reaching into Cornwall in the South and Northumberland in the North. Overall, Central Bedfordshire is an LA within the escalator process, consequently highlighting the role of location and migration direction in shaping the spatial focusing of an LA.

To understand left behind places in the UK and internationally, analysis of spatial focusing highlights how a place fits within a wider system. Social associations occur between locations, fitting within a national structure of movement that contributes to peripheralization of certain places. Our case studies demonstrate how relative levels of spatial focusing could link to known geographies of socioeconomic characteristics that shape left behind places, specifically the national emphasis on London and the South East, with proximity to London associated with higher opportunities for prosperity (Fielding, 1992).

However, developing the analysis beyond the basic Gini index could further understanding of the relationship between spatial focusing and left behind places. Whilst the contrasting LAs in Figure 7 are categorised with relative Gini index scores, the actual values are similar, reflecting a fundamental feature of the data set nationally. As all raw Gini index scores are higher than 0.4, indicating all LAs exhibit spatial focusing across their migration networks, it is difficult to conclusively correlate the limited variation with external factors. Both national Gini Indices exhibited very low correlation with income, house price, and employment rate. However, there is positive correlation of over 0.4 between the in-migration Gini index and the number of universities within the LA. Features such as this, alongside the observed importance of location highlighted by the case studies and geographies that match the escalator effect indicate potential motivations for movement influenced by specific sub-populations, specifically older or younger age cohorts. Consequently, analysing the total population may over-simplify the relationship between spatial focusing and left behind places. On that basis, the movement of specific age groups will be examined next.

## 4.2 | 4b. How does the level of spatial focusing vary by age?

Migration flows are disaggregated into seven age cohorts to investigate whether there is any difference in the geographies of spatial focusing across the age groups, and whether these differences influence the overall migration fields. When the Gini index is calculated for each cohort within each LA, only 104 of the 339 LAs are in the same focusing category for all cohorts, including Knowsley. This means most LAs show different levels of focusing across different age cohorts. For example, LAs containing universities, including Nottingham, have extremely dispersed migration fields for both in and out-migration for the 20–24 years category. Meanwhile, highly rural LAs, such as Cornwall, exhibit increasingly dispersed in-migration fields for higher age cohorts, correlating with the increased movement for retirement-aged citizens to rural areas.

These deviations are potentially masked within overall migration fields. Consequently, the Gini index is decomposed by age cohort to assess each cohort's contribution to the level of focusing of the migration network. The calculated Migration Share ($S_a$), Gini coefficient ($G_a$) and Gini correlation ($R_a$) of each age component, and their product, $C_a$, are shown in Table 3, with $C_a$ being the overall contribution of cohort $a$ to the level of focusing of the assessed network. All age groups have spatially focused migration networks. Gini coefficients and Gini correlations are consistently higher than 0.8, indicating consistently uneven migration flows, and levels of focusing for each cohort are comparable to levels for the whole population. These two factors suggest the measure of a group's contribution to focusing is mainly dominated by its contribution to the overall volume of migration ($S_a$).

We calculated relative measures, so variation is highlighted regardless of the group's $S_a$ score. (Lerman & Yitzhaki, 1985). The relative contribution is $C_a$ as a proportion of $S_a$, which shows that the movement of 0–15 year olds has the highest contribution to focusing relative to its share of migration. The relative marginal effect shows the effect on spatial focusing if there was a marginal increase in the share of that group, indicating that increasing the movement of 30–44 year olds would cause the largest increase to population-level focusing. However, the key finding of the decomposition is how small the relative values are: at national level, each group offers minimal contribution to spatial focusing, because all cohorts exhibit levels of spatial focusing.

Despite variation in the decomposition at national level, our extension has potential when analysing smaller geographies. Figure 8 shows the spatial distribution of $C_a$ for the 20–24, 30–45 and 60+ cohorts. The $C_a$ value reveals the extent to which each age group contributes towards the overall spatial focusing for each LA. If a cohort has a higher focusing share, the level of focusing for the LA's migration field is more influenced by that cohort's redistribution.

The Age 20–24 cohort shows limited focusing contribution, $C_a$, to both in-migration and out-migration Gini indices in the South East, increasing towards the North West, incorporating rural peripheral areas of western Wales and the South West, alongside northern cities such as Manchester and Liverpool. The green LAs on the eastern and southern coasts indicate a higher $C_a$ for this cohort for outwards flows than inwards flows. In these areas, the movement of the age 20–24 cohort is more responsible for concentration of out-migration flows, although with limited impact on the number of LAs migrants are received from. The spatial patterns change for the older cohorts.

**TABLE 3** National Gini decomposition by age: 2019

| Cohort | Share of migrants ($S_a$, %) | Gini correlation coefficient ($R_a$) | Gini index ($G_a$) | Focusing contribution ($C_a$, %) | Relative contribution ($C_a/S_a$) | Relative marginal effect ($C_a - S_a$) |
|---|---|---|---|---|---|---|
| 0–15 | 13.2 | 0.899 | 0.943 | 13.9 | 1.053 | 0.007 |
| 16–19 | 7.4 | 0.881 | 0.885 | 7.2 | 0.973 | −0.002 |
| 20–24 | 20.1 | 0.835 | 0.943 | 19.5 | 0.970 | −0.006 |
| 25–29 | 14.5 | 0.855 | 0.953 | 14.6 | 1.007 | 0.001 |
| 30–44 | 24.3 | 0.865 | 0.970 | 25.2 | 1.037 | 0.009 |
| 45–59 | 11.5 | 0.860 | 0.928 | 11.4 | 0.991 | −0.001 |
| 60+ | 8.8 | 0.868 | 0.873 | 8.2 | 0.932 | −0.006 |

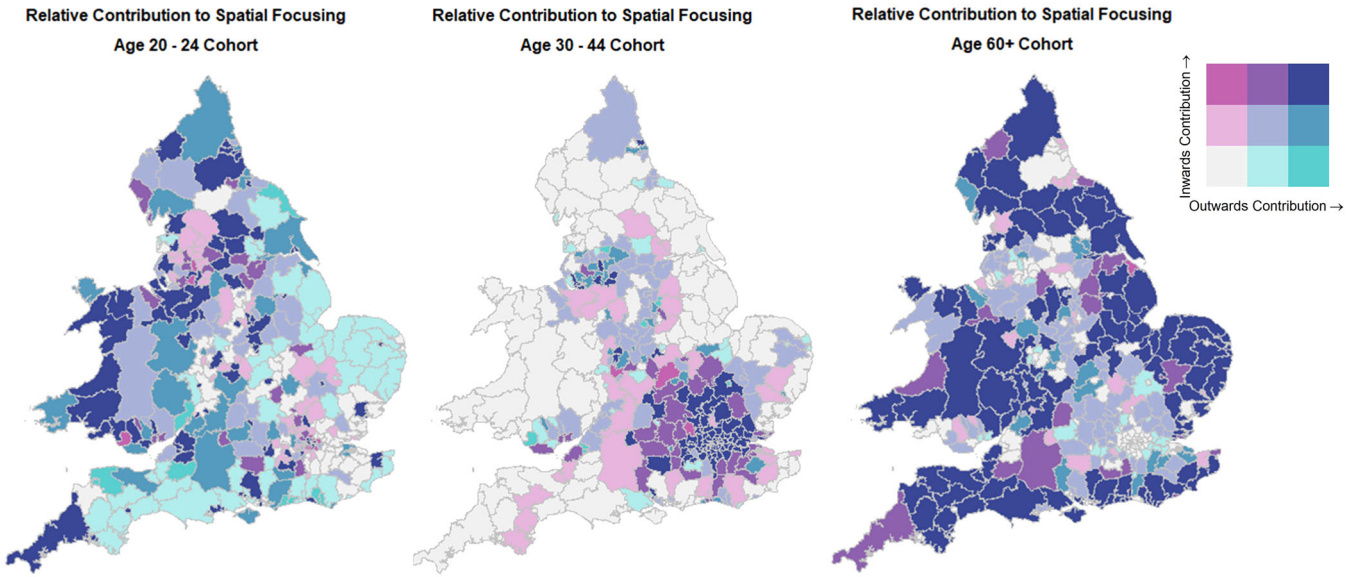


**FIGURE 8** Distribution of $C_a$, Ages 20–24 years, 30–44 years and 60+ for England and Wales, 2019.

For the Age 30–44 cohort, very high $C_a$ scores are measured for LAs in and around London, suggesting the cohort contributes more to spatial focusing near in this area compared to the rest of the country, possibly due to movement to and from London. This is important as, for these LAs, the cohort is arriving from and moving to fewer LAs. As this is potentially the family planning stage of life, focused migration suggests some, frequently less urban, LAs are more attractive than others to raise a child. Outside the capital, the contribution decreases for outwards flows but stays high for incoming flows. The rest of the country has a relatively low contribution to focusing for this cohort. These patterns are reversed for the Age 60+ cohort.

Analysis of the decomposition of the Gini index re-emphasises the contrast of South East England compared to the rest of the country. The spatial variations mirror the migration geographies, and consequential prosperity, whereby South East England attracts young people who move to access upward social mobility, then disperse later in their careers to 'cash in' their assets in wealthier rural areas (Fielding, 1992, p. 4). The LAs outside this region contribute more to out-migration focusing for the 20–24 cohort, potentially reflecting the attraction of university cities. For the 30–45 cohort, the migration premium slows (Champion & Gordon, 2021); disproportionate redistribution implies that those who 'step off' the escalator only forge connections to specific locations, which will benefit from the talent they receive. In comparison, the lower contribution from migrants aged 60+ reflects the dispersal process of this age group; it is indiscriminate, with the dispersed migration pattern downsizing for retirement in rural areas (Plane & Jurjevich, 2009). To understand left behind places, the geographies of focusing matter; the places with reduced focusing for mobile working people are more likely to be able to engage in the redistribution of the workforce. However, these geographies do not explicitly match left behind categorisations; instead, they emphasise the regional contrast between the South East and the rest of the country that reduce the likelihood of its LAs to be left behind, but this contrast is so extreme it overshadows the more localised differences between places left behind and not.

**TABLE 4** Decomposition for selected local authorities: In-migration

| Local authority | Cohort | Share of migrants | Gini index | Gini correlation | Focusing contribution | Relative effect |
|---|---|---|---|---|---|---|
| Knowsley<br>Gini:0.898<br>Intensive (Inwards) Redistributor | 0–15 | 0.201 | 0.951 | 0.976 | 0.207 | 0.006 |
| | 16–19 | 0.035 | 0.966 | 0.938 | 0.035 | 0.000 |
| | 20–24 | 0.125 | 0.921 | 0.941 | 0.120 | −0.005 |
| | 25–29 | 0.156 | 0.920 | 0.957 | 0.153 | −0.003 |
| | 30–44 | 0.278 | 0.926 | 0.978 | 0.280 | 0.002 |
| | 45–59 | 0.128 | 0.941 | 0.951 | 0.128 | 0.000 |
| | 60+ | 0.078 | 0.953 | 0.926 | 0.076 | −0.002 |
| Central Bedfordshire<br>Gini 0.788<br>Pure (Inwards) Redistributor | 0–15 | 0.169 | 0.886 | 0.961 | 0.182 | 0.013 |
| | 16–19 | 0.023 | 0.908 | 0.906 | 0.024 | 0.001 |
| | 20–24 | 0.150 | 0.763 | 0.899 | 0.130 | −0.020 |
| | 25–29 | 0.143 | 0.799 | 0.963 | 0.139 | −0.004 |
| | 30–44 | 0.293 | 0.840 | 0.976 | 0.305 | 0.012 |
| | 45–59 | 0.135 | 0.844 | 0.953 | 0.137 | 0.002 |
| | 60 + | 0.088 | 0.833 | 0.879 | 0.082 | −0.006 |

**TABLE 5** Decomposition for selected local authorities: Out-migration

| Local authority | Cohort | Share of migrants | Gini index | Gini correlation | Focusing contribution | Relative effect |
|---|---|---|---|---|---|---|
| Knowsley<br>Gini:0.915 | 0–15 | 0.215 | 0.968 | 0.982 | 0.223 | 0.008 |
| | 16–19 | 0.062 | 0.940 | 0.941 | 0.060 | −0.002 |
| | 20–24 | 0.115 | 0.905 | 0.946 | 0.107 | −0.008 |
| | 25–29 | 0.132 | 0.928 | 0.967 | 0.129 | −0.003 |
| | 30–44 | 0.264 | 0.948 | 0.981 | 0.269 | 0.005 |
| | 45–59 | 0.136 | 0.948 | 0.957 | 0.135 | −0.001 |
| | 60+ | 0.077 | 0.966 | 0.949 | 0.077 | 0.000 |
| Central Bedfordshire<br>Gini: 0.788 | 0–15 | 0.155 | 0.780 | 0.891 | 0.159 | 0.004 |
| | 16–19 | 0.084 | 0.832 | 0.833 | 0.086 | 0.002 |
| | 20–24 | 0.119 | 0.752 | 0.891 | 0.118 | −0.001 |
| | 25–29 | 0.134 | 0.763 | 0.900 | 0.136 | 0.002 |
| | 30–44 | 0.240 | 0.726 | 0.946 | 0.244 | 0.004 |
| | 45–59 | 0.147 | 0.734 | 0.890 | 0.142 | −0.005 |
| | 60+ | 0.121 | 0.760 | 0.844 | 0.115 | −0.006 |

To understand the nuances of left behind places, the decomposition of LAs is examined more closely in Tables 4 and 5. We return to the examples of Knowsley and Central Bedfordshire, as LAs with contrasting location and left behind status. These LAs have similar age compositions; Central Bedfordshire has a median age of 41.1, 23% of households have children, and 17.9% of the population aged 65 or over, whilst Knowsley has a median age of 39.5, 22% of households have children and 17.3% are aged 65 or over (ONS, 2021b). However, their levels of focusing differ. Knowsley is consistently an extremely focused network, with $G_a$ scores higher than 0.9 across the age cohorts for both in- and out-migration. There is little influence of age on the level of focusing on the migration network for this LA; migration occurs to and from a small variety of other locations across the entire population. In comparison, Central

Bedfordshire consistently shows lower $G_a$ scores for out-migration compared to in-migration, reflecting that the marginally increased connectivity for dispersal of people occurs across the ages. A key difference between the two is the higher contribution of out-migration of the 60+ cohort in Central Bedfordshire; this is more dispersed, indicating the broad movement of people out of the area.

Despite the similarity in population contribution, an important difference between the two LAs is that Knowsley mostly interacts with neighbouring LAs across the cohorts. For 20–24 year olds, the neighbouring LA Liverpool sends 39% of movers, and receives 32%—the next highest LA is St Helens, with less than 7% for both directions. This is even higher for 25–29 year olds, with 48% and 42% each direction respectively. In comparison, Central Bedfordshire does not have a flow containing more than 15% of movers. This highlights the left behind nature of Knowsley as an LA; the previously observed disconnection within the wider network is observed across the age cohorts, leaving it dependent on a singular flow. Consequently, the criteria of left behind influences the migration network differently to how we proposed; it localises it across the age groups, making the LA socially isolated.

Decomposing the Gini index indicates the extent to which a populating group contributes to the level of connectivity of a location, which can be compared to socioeconomic factors. Alongside the geographical patterns within Figure 8, focusing contributions ($C_a$) correlate differently with assessed socioeconomic variables, depending on the evaluated age cohort. For example, the $C_a$ of age 20–24 and age 25–29 cohorts display positive correlations with unemployment rate, university count and average house prices, the strongest of which being university count, for both in-migration and out-migration. In comparison, these metrics correlate negatively with $C_a$ for the cohorts under 20 and over 30 years old. These correlations suggest LAs with higher values for these socioeconomic metrics are more likely to exhibit uneven migration networks for younger cohorts. The observation that focusing contributions have weaker correlations with relevant socioeconomic variables contradicts expectations, as disconnection is perceived to have a key role in the formation of left behind places. This indicates that the relationship between the phenomena is unclear.

However, as was noted in the national analysis, the focusing contribution is heavily influenced by the proportion of migrants from each cohort moving in and out of the area, which is replicated in the small relative effect shown throughout Tables 4 and 5. This is a limitation of the UK context, due to the highly focused nature of the network. That said, a spatial focussing approach provides insight into the role of migration for left behind places, for example highlighting the isolation of Knowsley.

## 5 | FURTHER DISCUSSION AND CONCLUSIONS

The investigation into peripheralisation and the evolution of left behind places is an area of research of growing importance as the political implications of historical neglect continue. This study contributes to this body of research from a migration perspective, a frequently overlooked but highly important feature of peripheralisation. This paper addresses how places fit in the national migration network of England and Wales, building on prior literature that demonstrated the effectiveness of using the Gini index (Plane & Mulligan, 1997). The study extended the methodology by decomposing the Gini index and assessing the contribution of different age groups to this redistribution. It sought to address the hypothesis that Left Behind Places would exhibit spatial focusing in their migration networks.

The migration network of England and Wales is highly spatially focused. This means that all LAs do not send or receive migrants evenly to or from origins and destinations, as certain connections are stronger than others. By analysing the level of inequality across the migration flows of this network, we identified the South East of England as having LAs that do not receive migrants from many origins but send them to a variety of destinations. Contrastingly, North West England has fewer connections for both inwards and outwards migration. This inequality in movement has social implications, as it influences social connection across the country. Indeed, the high volume of movement towards the South East of the country has been observed in previous studies, particularly when migration is disaggregated by age (Champion & Gordon, 2021). This high inequality in migration may be related to the high level of spatial inequality in the UK compared to other European countries.

Decomposing the Gini index revealed variations in the level of focusing at LA level which can be associated with the known movements of different age cohorts. This was evaluated by expanding the methodology to decompose the Gini index by population sub-groups, which identified the role of age 20–24 years and 60+ years cohorts in shaping the migration network. The propensity to migrate differs across the life course, with these differences also being spatially centred around the renowned 'escalator' region of the South East. The demographic implications include uneven movement of human capital, where some places in the network are more likely to send and receive early-career workers than others, benefitting from their contribution to economic growth. However, the level of spatial focusing remained high across LAs and age cohorts, limiting the available conclusions from this data set.

Across metrics measuring the level of spatial focusing and decomposition by age, attempts to understand the relationship between spatial focusing and left behind places reveal it to be complex. As peripheralisation has been linked to demographic processes (Leibert & Golinski, 2017), we hypothesised that disconnected LAs would be more likely to be 'left behind'. This is visible in the context of certain LAs, for example Knowsley is a left behind place with very constrained migration fields. However, nationally, neither in or out-migration Gini indices display strong correlations with measures used in existing studies (Davenport & Zaranko, 2020; Martin et al., 2021); disconnected does not automatically equate to disadvantaged. Conversely, the visual correlation between the level of spatial focusing and known trends of inequality reinforce previous observations of human capital being attracted to opportunities in

metropolitan areas (Faggian & McCann, 2008), and the eventual dispersal for 'empty-nesters' (Plane & Jurjevich, 2009). Consequently, a key contribution of this study is the emphasis on the complexity of what it means to be 'left behind'; it is not easily categorised, hence analysis requires a variety of measures, and additional factors need to be considered within future work.

Firstly, disconnection in migration networks occurs for contradictory reasons. The expected reason is a lack of capability to move, measured as lack of movement from the left behind areas. However, an alternative reason is lack of aspiration or need to move. Migration is a two-way connection dependent on push and pull factors (Plane & Rogerson, 1994); a lack of movement and consequential disconnection may be due to limited desire to move based on an individual's existing quality of life. Indeed, movement across the urban hierarchy slows as local wages rise due to shortages, limiting the effect of prior migration to reduce costs of movement (Massey et al., 1993). However, this data and methodology focuses specifically on the mobility of people. Those that are immobile are not included and it is not possible to declare *why* they are immobile. On the same theme, we are unable to address why people move; whilst we can make assumptions based on the age cohort of the mover, the justifications for moving, such as house prices and employment structure, that shape left behind places could be investigated further, to identify causation beyond correlation.

Additionally, identifying left behind places is complex because of the variety of measures and understandings of 'left behind'. It is a slippery term. The results of different metrics vary, as is seen by the production of different classifications, so the relationship between socioeconomic decline and the structure of the migration network is not straightforward. Disconnection is a key factor in isolation and awareness of broader society, and the accessibility of other populations, even within the country. Redistribution of migrants also contributes to the sharing of ideas and knowledge. Furthermore, measuring the spatial focusing of a network highlights a weakness in an LA that may otherwise have not been acknowledged. However, as the age decomposition shows, disconnection may take many forms and left behind places cannot be defined through just one of them. The complexity of the definition also highlights the national specificity of the study; 'left behind' in the UK is embedded in politics and postindustrial history (Ford & Goodwin, 2014). The application of the methodology to contextualise left behind places in Europe or the US could provide alternative insights.

Overall, the findings of this study are important because they highlight vulnerability; LAs with focused migration fields are at greater risk of being affected by economic events within the regions they are connected to (Plane & Mulligan, 1997; Rogers & Raymer, 1998). Our methodology extends this analysis by assessing the known link of age and economic contribution to reflect how this vulnerability may be understood further. Future work may develop the methodology, such as examining an alternative case study with more variety in its level of focusing, analysing focusing at a smaller administrative scale, or measuring the impact of alternative subgroups in the population. To connect the level of spatial focusing to left behind places, future work may consider the role of distance in migration as this is commonly incorporated in other migration analyses and has been associated with individual's aspirations to move for opportunity. Finally, this work is situated within a specific time frame; temporal analysis could assess whether the Covid-19 pandemic has impacted individual-level decisions for migrating, or the overall system. As everyday life changes, the migration network may change with it, potentially having more significant consequences on the categorisation of left behind places.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that supported this research are openly available through Office for National Statistics (ONS), with details found in the reference list. Code to reproduce analysis is available on Github (https://github.com/RSanderson96/Migration_Analysis).

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