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The Measurement of Intra-Distributional Mobility: An Investigation of District Long-Term Housing Vacancies

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Abstract: It is not unusual for government reports to place spatial inequalities into a league table, highlighting poorly performing jurisdictions in some form of yardstick competition. A case in point is long-term dwelling vacancies. Action on Empty Homes, which works closely with local governments in the UK, provides commentary about poor performance, including recording persistently higher rates in certain regions and mentioning the worst rankings at the local level. How the distribution of vacant dwellings changes is not well explored. How rigid this league is has been a feature of a discussion in the growth literature. A useful dynamic policy measure in this regard is how far the average jurisdiction changes its league position over a given period. A type of convergence proposed here, implied by Sala-i-Martin, features the time for the initial rankings to become discordant with the current order. One could see this sort of measure being used widely, wherever performances are judged relatively as a means of highlighting good practice. Using English data on vacant dwellings, this paper shows that there is a 'long memory' in long-term vacancy rates, both at the local and regional levels. The industrial and housing inheritances of districts in the North of England, evident in the league table in 2004, remain influential after 18 years, even with general population growth. Although the use of incentives to bring dwellings back into use is thought to be successful, it is suggested that the role of the buy-to-let investor may have been overlooked. Changes in the treatment of their rewards appear to coincide with a rise in long-term vacancies.

Keywords: distributional mobility; convergence; long term vacancies; housing theory; local authority districts; buy-to-let investor

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1. Introduction

Action on Empty Homes calls on both the central and local governments of the UK to bear down on poor housing stock management [1]. The implication is that there is more that government should be doing. The most recent initiative from the Department for Levelling Up, Housing and Communities (DLUHC), under the Conservative administration, announced on 11 March 2024 that there is to be a 'crackdown' on long-term empty homes. The initiative, which came into force on 1 April 2024, entails the imposition of a tax premium on such dwellings. This extends a facility that has been available for some time[1].

The imposition is at the discretion of the local Council, which may not use the tools that the central government has crafted in the way that they were intended. It is not unusual for a policy reviewer to report the extremes or possibly the complete league table of performance[2]. Indeed, the means by which elements of the public sector are 'managed' in many economies around the world have come to utilize key performance indicators. League tables of these indicators are a means of injecting yardstick competition among public sector providers [2]. The table ranking can be coupled with market incentives, which provide monetary awards or penalties [2]. The disincentive of a penalty based on a poor league table position could act as an incentive to improve/innovate/provide a better service, much as the threat of a loss might provide in the private sector.

An unrelated area but with similar league table attributes is found in the growth literature [3,4]. Quah ([3] 1368) observes a beta-convergence cross-section regression can

represent only average behavior. Additionally, although there is a narrowing of the distribution in sigma convergence, it says nothing about the stability of the rank order. By monitoring growth in average incomes in the bottom 40% of the income distribution in all countries, the World Bank sought to assess 'shared prosperity'. However, this had flaws [5].

Quah calls for alternative empirics based on studying the dynamics of evolving income distributions, not the representative economy. Indeed, the same shift is called for by the World Bank. The UK's Department for Levelling Up, Housing and Communities (DLUHC) [5,6] is interested in exposing both inequalities and the performance of weaker economies. In the case of [6], it does review mobility, but the method only features the exceptions that shift over more than one decile in the hierarchy. The weakness in the metric is that exceptions do not provide a general measure of mobility. Action on Empty Homes highlights the northwest of England as containing five of the 'top six' local authorities with the highest levels of empty homes in 2019. A gap in the analysis is whether this is a persistent problem of these five (they have positional long memory) or whether the northwest generally contains districts that suffer from empty homes, and even if these five make progress and leapfrog down the league table, another five from the region will take their places. Although neither shines a favorable light on the northwest, the latter scenario indicates something different about the implementation of central government tools at the local level from the former. Policymakers in any field using key performance indicators, such as those collected from public sector entities or countries or regions ranked by some quality-of-life indicator, would benefit from a general measure of the system's mobility rate to benchmark their progress. Also, some notion of whether the system features immobility across some of the hierarchy, such that there is some structural impediment to progress.

This paper sets out to narrow that gap, generating measures of intra-distributional mobility and applying them to data not well explored. Two general measures are reviewed. Batty's rank clock [7] assesses the extent of leapfrogging or change in the rank placing of city populations. It is simple to calculate and interpret and could be applied widely. Boyle and McCarthy's [8] rank-based ordinal index assesses beta-convergence. It is proposed that one could combine their approach to convergence with that of [9], who use an autocorrelation function approach to convergence and long memory. The outcome is a rank-based measure of the 'time to convergence'. The focus is on the decay in concordance between the initial rank and the current one. Two research questions are addressed. First, is the degree of intra-distributional mobility lower in high-vacancy regions? Second, does the degree of intra-distributional mobility that the World Bank or Quah call for enrich the analysis of regional performance at the representative regional level?

This paper is structured as follows. First, with an emphasis on policy initiatives, the English context of long-term vacant dwellings is reviewed. Next, the housing market theory is presented. Section 4, Materials and Method, covers the data used, the measures of rank change, and the notion of convergence using correlation, which is extended to ranks. Inferences about the mobility within subdivisions are drawn and, in the conclusion, the contributions of this paper are outlined. Results using a representative economy approach to convergence and sigma convergence are also discussed. The conclusion considers where the metrics discussed in this paper could embellish what is analyzed.

2. Long-Term Vacancies in England

As of 31 March 2022, there were 25.2 million dwellings in England, an increase of 232,820 from the previous year. There were 676,304 vacant dwellings (assessed six months later). Of these, 248,149 were long-term vacant dwellings. One indicator of the housing 'crisis' is that, concurrently, the Office for National Statistics estimated that there were also 291,610 households assessed as threatened with homelessness. So, the order of magnitude of the number of vacancies corresponds with the annual increase in dwellings or potential homelessness. In their reports from 2016 and 2019, Action on Empty Homes points to two areas of interest. The north of England has a higher rate of long-term vacancies than elsewhere, which it links with older dwellings, lower house prices, people on low incomes,

and more substandard private rented sector. In such areas, housing transactions often occur through auctions rather than conventional sales to investor–landlords. As a result, local housing supply can be dominated by rental properties. London is also unusual in having an 'over-representation' of empty homes in the highest Council tax bands (most valuable).

The Housing Act 2004 enabled authorities to issue an empty dwelling management order (EDMO) on long-term empty properties to ensure it was used for housing. These were hardly applied. From April 2013, authorities were empowered to remove the empty properties' discount or set a Council tax increase of 100% on those that had been empty for over 12 months. Between 2012 and 2015, the Empty Homes Programme, worth GBP 216 million, brought 9000 long-term empty homes back into use. It is believed that its ending explains a subsequent rise in vacancies [10]. For the Council, above the loss of tax revenue, it would face complaints from neighbors about joint maintenance costs (what happens if there is a water leak?), squatters, vandals, and anti-social behavior, as well as the general depreciation of property in quality and taxable value[3].

3. House Price Theory and Vacancies

An asset price model relates the price of the dwelling to its rental stream and the cost of capital. As rental yields are expected to have a greater locational value in the future, properties in growing areas will have favorable rent expectations, which are built into the decisions to build and buy. Productivity (income) and the population of the urban economy determine long-term house price growth [11]. Mortgage lenders will reinforce the decisions of buyers in growing cities. The distribution of house prices is an excellent predictor of future population growth [12]. In particular, growth is quite rare in cities with large fractions of their housing stock valued below the cost of new construction [12].

Wheaton [13] applied the concept of the natural rate of unemployment to the U.S. housing market: there is a natural vacancy rate. Imperfections in the matching process would lead to vacancies being a permanent feature, and the length of that vacant period and the proportion of vacancies in the housing stock provide insight into the state of the market. Wheaton [13] depicts an inverse relationship between vacancies and house prices, consistent with a demand or price cycle. His work, though, is based on the U.S. housing market, and he defines a vacancy as the difference between the number of households and dwellings. The purchaser, upon taking ownership, is assumed to hold two properties and has to dispose of their surplus one, which is vacant and requires selling time. Price, in this context, mediates the transfer of the surplus home to the new buyer, so it represents the cost to the latter rather than the seller.

Holding two properties in the UK housing market system is uncommon. Most buyer–seller exchanges entail serial ownership. A second-hand dwelling for sale is commonly occupied during the selling period. Selling time in this one-property model, therefore, does not have the same opportunity costs as holding one surplus to requirements. Vacancies in the UK system also have imperfections that are associated with normal life events, such as inheritance, probate, or owners moving into long-term care plus purchasing an uninhabitable dwelling with the intention of renovation, and tenancies ending without replacement tenants [1]. The change in the vacancy rate can be used as a measure of housing market activity. However, a rise in long-term vacancies would provide a clearer indicator of housing distress in the UK system.

Malpezzi [14] shows that U.S. real mortgage rates declined from the early 1980s, which the asset price model predicts would elevate prices. He shows that price and the flow of mortgage lending moved together. The financial crisis of 2008 led to house prices plummeting, but the value of mortgages 'fell off a cliff'. In an uncertain environment, more risk-averse lenders, as in the post-crisis era, made qualifying for a loan rather than its price a binding constraint [14]. Lenders became risk-averse about all but the safest borrowers and robust dwellings. This elevated long-term vacancy to an excessive level, suggesting a structural over-supply of dwellings [15]. Zabel [16] finds empirical evidence for the combination of rising prices and falling vacancies in the U.S. There is a relatively strong decline in new housing

construction in response to a rise in vacancies and little reaction when vacancies fall. The rising prices–falling vacancies trend is not universally found. Hoekstra and Vakili-Zad [17] believe the Spanish paradox (rising prices and vacancies) in the pre-crisis era is linked with strong tenant legal protection and the rather poor image that Spanish tenants have. Many owners of vacant dwellings are reluctant to act as landlords. Rising house prices may result in dwellings being retained for investment reasons and being kept vacant.

Over the decade to 2021, the UK Census shows that there was a 6.6% rise in population[4], but this was focused on the regions adjacent to London. The north experienced a rate of growth half that of England's. Basic economic theory starts with a downward-sloping demand curve and an upward-sloping supply curve, with shifts in these curves resulting in changes in the equilibrium price and quantity of a good. Because housing is immobile and durable, a negative population shift is not reflected in the quantity of local housing units. Glaeser and Gyourko [12] posit that under these conditions, new construction is not viable, and the supply curve is theorized to be vertical. The supply curve becomes horizontal once the dwelling price/rent falls below the cost of maintenance, and it becomes a non-viable consumption good. Here, dwellings are withdrawn from the market [15].

A locale subject to the deconcentration of jobs and population [12,18] would find the housing market is adversely affected, characterized by lower rental returns. Action on Empty Homes [1] finds a primary cause of relatively high levels of long-term empty homes is that owners are unable to fund repairs/ improve homes to occupy, sell, or rent (p. 17). These are concentrated in particular neighborhoods with pre-1913 dwellings. Moreover, there is a concomitant higher level of antisocial behavior and criminal damage that makes the dwelling unattractive. Such 'sick' properties, not appealing in terms of their locational characteristics, are hard to return to use.

Action on Empty Homes also points to the size of the privately rented sector in these poorer neighborhoods. The rise of the buy-to-let landlord (BTL) played a key role at the lower-quality end of the housing market. Pryce and Sprigings [19] find that BTL purchasers participate in the same segment of the UK housing market as first-time buyers, sucking lower-cost dwellings out of the owner-occupation market and renting them back to those who would have bought them. The Treasury's [20] more positive view highlights the supply of new housing, the upgrading of existing rented accommodation, and adding lubrication to the housing market. Jones and Mostafa [21] argue that over the 20 years to 2016, there was a revival of the private sector landlord sector and an increase in the supply of rental properties in the UK market, with a large portion funded by BTL mortgages. This group bought up properties, some distressed, improving the quality and releasing them back onto the market as rented dwellings. They find the peak year of the BTL landlord's internal rate of return to be 2013.

The returns are linked to the tax regime. In April 2016, a 3% Stamp Duty surcharge was imposed on buy-to-let properties. Also, there was a phased reduction in mortgage interest tax relief. The number of loans for such a house purchase reduced from 117,500 in 2015 to 73,400 in 2018 [22]. Private landlords have sold more homes than they have bought since, which has a significant impact on the number of rented dwellings[5].

Suzuki and Asami [23] also draw on labor market theory, proposing that one could conceptualize dwellings as either inside or outside the market. Drawing on work by [24], long-term vacancies are likely to be 'outside' or not participate in the market because there is little or no demand. Once the dwellings' prices fall below the cost of maintenance, they become a non-viable consumption good. Couch and Cocks [24] consider the demolition of the least popular housing stock and its replacement with housing that more closely meets contemporary demand as the most successful policy in tackling housing vacancy in Liverpool.

Bringing a dwelling back to health in a market with significant and persistent insufficient demand would alter the rank order of local vacancies but not alter the regional divide. It could just displace problems to neighboring districts.

4. Materials and Methods

There are different sources of housing vacancy data [25]. The set used here is taken from the UK's Department for Levelling Up, Housing and Communities (DLUHC) Reports on dwellings of the Local Authority District of England (Live Table 615). The annual data that come out each October are available from 2004. The data are based on dwellings that are reported as empty (i.e., unoccupied and unfurnished) for the purposes of Council tax, and so may be subject to a discount, charged a premium, or fall into an exempt category. It is not a second home.

Wyatt [26] argues that the English District Council tax-based data can produce statistical information on vacancies at various geographical scales, revealing the nature of empty dwellings at the local level. Council data present two categories of empty dwellings that are unoccupied and substantially unfurnished: vacant and long-term vacant. The latter are long-term if empty for six months or more. This is considered the minimum threshold for local authorities to enforce action to bring the dwelling back into use [26]. Local Councils utilize these data for policy purposes, as does Action on Empty Homes for analysis.

The number of dwellings is supplied by the UK's DLUHC, published in Table 125. The long-term vacancy rate is the number of long-term vacant properties as a proportion of all existing properties. This is multiplied by 100 to generate long-term vacancies per 100 dwellings (LTVR) (so it could be viewed as a percentage). Excluding the Isles of Scilly, which have intermittent data, this covers annual data across 308 districts. Where there are missing data, the most recent value is used. This affects the data set in 2004 and 2023 more than any other year. The latter year has quite a few 'dropouts', so it is omitted from the study.

Three approaches are taken to analyze the nature of change. There is an outline of Batty's clock, which can reveal the extent of movement across the distribution. Second, Kendall Tau is introduced, which can reveal the extent of discordance between the rank order in the base year of 2004 and subsequent periods. This draws on [8]. Third, spatial autocorrelation is used to consider the claim that there is a geographical bias in long-term vacancies and whether this persists. This can be seen as a version of [9].

4.1. Shuffling and Batty's Clock

Assume N districts divided into k subsamples with n_i districts in each. $N = \sum_{i=1}^{k} n_i$. The entire sample is placed in rank order of some measure of inequality with rank score R. Let the mean sum of ranks assigned to segment i $\overline{R}_i$, which is defined in a Kruskal–Wallis test as $\frac{1}{n_i}\sum_{j=1}^{n_i} R_{ij}$, $i = 1, \ldots, k$. This is the equivalent of the representative economy of i. If the mean rank is calculated for t periods, convergence in this pairwise scenario would exist when the mean-rank order changes $\overline{R}_{it} > \overline{R}_{gt}$, $\overline{R}_{it+1} < \overline{R}_{gt+1}$. There is 'leapfrogging' in the mean rank between segment i and g, or there is time incongruence in the mean rank.

At the level of the distribution, intra-distributional mobility can be measured in rank score changes. Focusing on segment i alone, differences in rank score R between time t and $t + p$ are defined as $R_{it+p} - R_{it} = d_{ip}$. The mean absolute leapfrogging rate for segment i is $\frac{1}{n_i}\sum_{i=1}^{n_i}|d_{ip}|$), which is the metric used in Batty's [7] 'clock' paper. This will vary with n_i. To standardize the leapfrogging rate, this can be divided by n_i again so that a percentage can be generated, proffering the change, weighted by the potential number of rank places $\frac{1}{n_i^2}\sum_{i=1}^{n_i}|d_{ip}| \times 100$. If there is no change, the value is zero. If there is an inversion of the order, the other extreme is 50%.

The net segment shuffling, $\frac{1}{n_i}\sum_{i=1}^{n_i} d_{ip}$, is zero when assessed over the entire sample but can be combined with absolute change on a segment basis to generate a ratio $\left(\sum_{i=1}^{n_i} d_{ip}\right) / \sum_{i=1}^{n_i}|d_{ip}|$, which offers a direction of change. A percentage of 100 indicates all change is in the same direction, whereas zero indicates the mean rank is unaltered.

A third gross shuffling rate entails assessing the rank change attributable to segment i districts as they move across the national sample over the p periods. In Sala-i-Martin's [6] discussion of convergence, he asks how long it takes one 'team' to climb the league. The

gross change rate covers a group of 'teams'. The change in rank of this 'team' across the full league is $R_{ijt+p} - R_{ijt} = d_{ijp}$. The team at issue could leapfrog both segment and non-segment rivals. A single team's mobility does not provide insight into the fluidity of the rank order in general. The shuffle rate for the nation would be defined as $\frac{1}{N^2}\sum_{i=1}^{k}\sum_{j=1}^{n_i}|d_{ijp}|$. Districts in segment i may be less mobile than districts elsewhere, consistent with some persistent inequality. The measure used to capture the rate of shuffling of districts in segment i within the national sample is $\frac{1}{Nn_i}\sum_{j=1}^{n_i}|d_{ijp}|$.

4.2. Shuffling and Convergence

Caggiano and Leonida's [9] approach to convergence and memory entails assessing a given signal with itself at various subsequent points in time. Stationary data can have an exponential decay in their autocorrelation function (ACF), or it just drops to zero after a certain time lag, indicating that the signal, or shock, has been 'forgotten.' The time to forget is the time to convergence. Non-stationary data show almost no decay, so the signal is remembered. In between, 'long-memory' shows a power-like slow decay in the correlogram. Abadir and Talmain [27] conclude that if an economy is composed of non-homogeneous and interdependent sectors, the aggregate process displays non-linear and long-memory symptoms in the ACF. This should apply to elements of a national series where a regional imbalance persists.

By analog, a rank-based autocorrelogram can reveal the dynamics of the LTVR order and the length of memory. Kendall's Tau is a measure of association defined as the probability of concordance minus the probability of discordance. It is a non-parametric measure designed for ordinal data. Concordance between variables XY can thus be defined. If x_{1t} and y_{1t} are both lower or higher than x_{2t} and y_{2t}, then we have a concordant pair or an agreement. However, if $x_{1t} > x_{3t}$ and $y_{1t} < y_{3t}$, then we have a discordant pair or a disagreement. Kendall's coefficient is calculated by counting the agreements and disagreements. Assuming no ties and N values in both X and Y, the sum of these two is $N(N-1) \div 2$. Concordance in X over time can be defined in a corresponding way. If x_{1t} and x_{2t} are lower or higher than x_{1t-1} and x_{2t-1}, then we have concordance or agreement. However, if $x_{3t} > x_{3t-1}$ and $x_{4t} < x_{4t-1}$, then we have a discordant pair or a disagreement [28]. The concordance can be tracked over time. Tau over p periods is defined as

$$T_N(p) = \frac{2S_{Np}}{N(N-1)},$$

where S_p is the sum of all the concordant time matched pairs between time $t + p$ and the base period. A standard deviation for such a statistic is $\sqrt{\frac{4}{9N}}$. One could estimate a statistic for each lag. When plotted against p, it is an autocorrelogram. Rather than a 'signal', a distributional approach has the simplicity of asserting that there is an imprint of the original order in the future one. Tau provides a measure of the strength of dependence between two variables, with a range of $-1 < T < 1$.

With no decay in Tau, there is a perfectly stratified system, which would imply the order remains unchanged, so the signal [initial order] is remembered perfectly, which is the default position found in [8]: all economies are stacked in order at time 0, and there is no subsequent shuffling or leapfrogging. In this context, the antithesis of rank preservation is when the rank order of the distribution is 'forgotten'. Thus, convergence [in distributional mobility] is found when the original rank order [in vacancy rates] is 'not associated' with a later one. This would be in keeping with [29] (p. 146), who observe that the precise definition of convergence is where the long-run distribution is independent of initial conditions and a globally converged neo-classical system subject to random shocks only [30].

The upshot is that where $T_N(p) = 0$, p is the time to convergence. Where $0 < T_N(p) < 1$, a degree of rank preservation over p periods of time is found, and a long rank memory exists, implying restricted mobility. There could be amnesia or reverting to the original rank akin to error correction. This presents combinations of convergence and non-convergence,

depending on aggregation. This can be contrasted with segment time profiles. However, there is no reason to expect the segments to duplicate the national picture.

4.3. Spatial Autocorrelation

A spatiotemporal relationship (i.e., spatial change over time) can show how a high vacancy rate in one district correlates with vacancies in neighboring districts in future years [31]. Moran's *I*, a global measure of spatial association, involves correlating a variable with the spatial weighted average of itself so that it can provide an indication of (dis)similar values across space. Spatial autocorrelation over p periods can be defined as $I_p = \frac{z'_{t+p} W z_t}{z'_{t+p} z_t}$, where $z_i = x_i - \overline{x}$, and x is the vacancy rate [32]. The local measure, Local Indicators of Spatial Association (LISA), makes up the components of Moran's *I*. A LISA can be defined as $I_p^i = z_{t+p} \sum_j w_{ij} z_t$. LISA maps offer 2 × 2 types of association: high–high (HH) or hot spots, low–high (LH), high–low (HL), and low–low (LL) or cold spots. HH implies districts with high vacancy rates in the initial period are colocated with high-vacancy-rate districts p periods later. In other words, the local history matters. LH and HL reflect outliers that are at odds with the locations nearby p periods ago. If the spatial structure is forgotten over time, current vacancy rates are not spatially associated with earlier neighboring ones. The spatial association could be a source of concordance over time.

The measured association depends on the type of weights matrix. A queen matrix can capture association contiguous spaces, where w_{ij} = 1 for a neighbor and 0 for a non-neighbor, and w_{ii} = 0. An alternative, nearest-neighbors matrix was also considered. Both were estimated, but only the former is displayed. The difference between them with a low number of neighbors is slight.

5. Results

5.1. The National Housing Picture

The peak year for the overall average vacancy rate is 2008 at 3.45%. Of this, long-term vacancies made up 42% in 2008, down from 45% in 2004. London had the lowest average vacancy rate in 2008 of all the English regions. Dividing long-term vacancies by all vacancies from Live Table 615 reveals that 43% of vacancies were long-term in 2004. This was below the English average of 42%. The southeast has the lowest LTVR. The northwest (not northeast) had the highest average vacancy rate in 2008 (4.7%), when 49% were long-term vacancies. In 2017, London had by far the lowest vacancy rate (1.77%), and 32% of those were long-term. The northwest's corresponding values are 3.2% and 38%. Both the extreme regional cases experienced a decline in vacancies and long-term vacancies after the financial crisis.

As displayed in Figure 1, the LTVR was 1.45% in 2008, slightly below the peak of 2004. It declined and had a low value in 2017. For context, Figure 1 also displays the time series of real prices and the Experimental Index of Private Housing Rental Prices, deflated by the CPIH. Real rents generally decline, whereas a price cycle has peaks in 2007 and 2021, with a trough around 2013. The returns to property do not appear in line with the LTVR.

Figure 2 shows net additional dwellings per 1000 existing dwellings (additions rate) and transactions per 100 dwellings (sales rate) had a dramatic decline following the 2008 crisis. Sales peaked at 5.8% of the housing stock in 2007. The corresponding value in 2009 was 60% lower, consistent with the cliff problem highlighted by [14] and discussed by [33]. The addition of dwellings (mostly new builds) peaked in 2008 in the pre-crisis era, at just under 1% of the existing stock annually. It reached a low of 0.56% in 2013 but rose just over 1% in 2019. Inconsistent with [34], the time profile of LTVR improves when other markers indicate market distress worsens.

The affordability of the lower-quality dwellings, as captured by the house price–earnings ratio at the lower quartile (HPER), is not dissimilar to the real price in its variation. The pre-crisis era entails high vacancy rates during the house price bubble period when property was most unaffordable, which is consistent with [17]. Overall, long-term vacancies

were at a high when price and unaffordability were high, and during the early post-financial crisis, they fell when other measures of activity contracted. This is also a paradox.

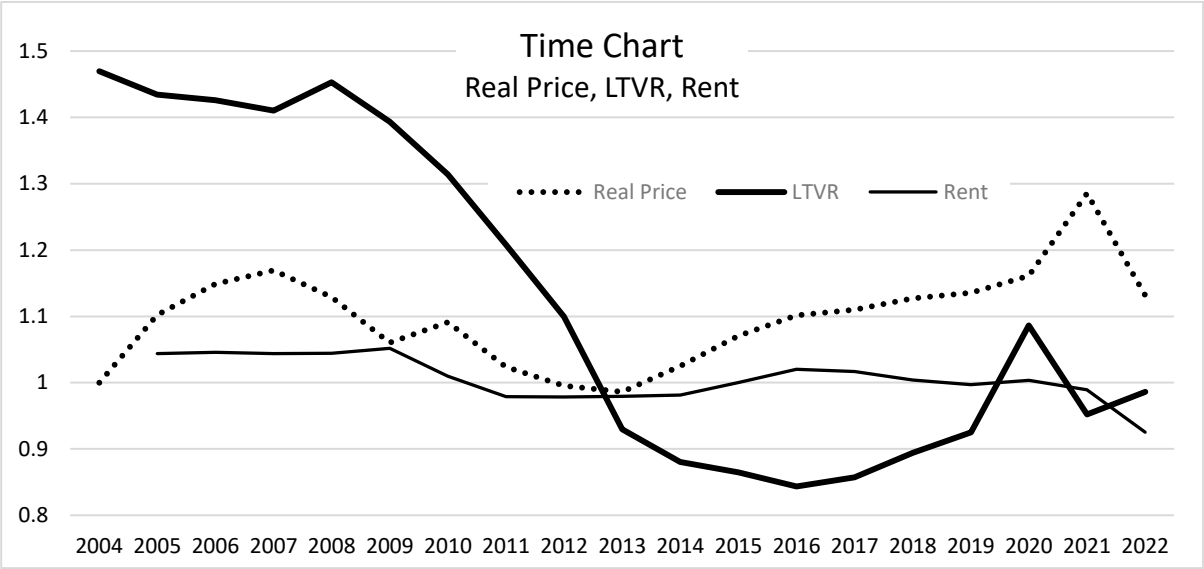


Figure 1. Vacancy rates and house cost indices.

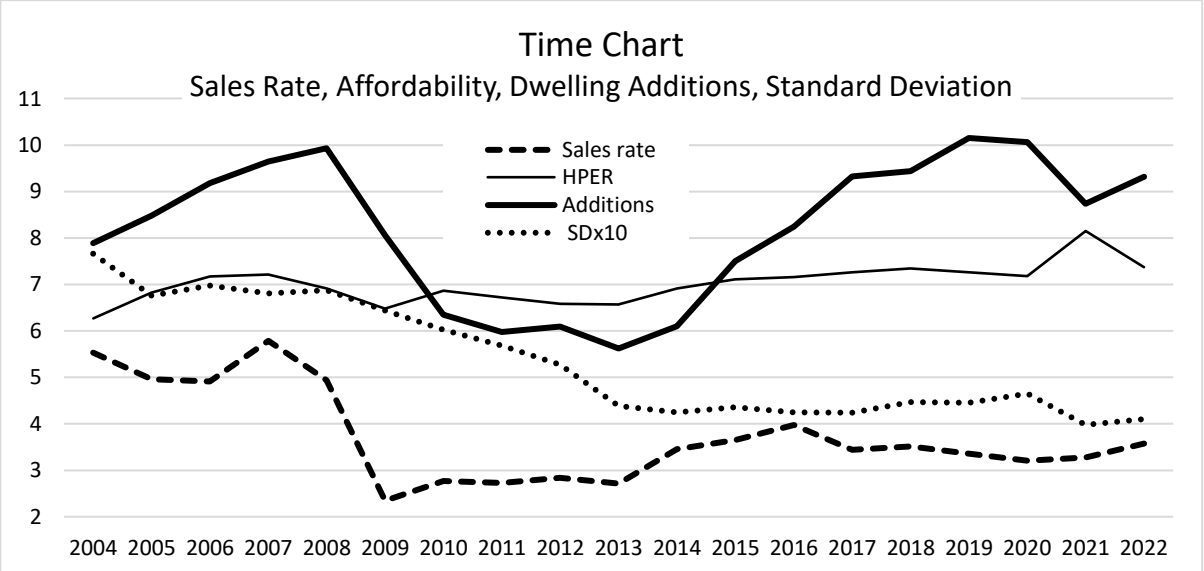


Figure 2. Other national housing indices.

The standard deviation is a standard metric for analyzing sigma convergence. The profile in Figure 2 indicates that there was sigma convergence in LTVRs up to around 2012, followed by stability in the spread until COVID-19.

5.2. Shuffling Metrics

Table 1 reports mean ranks and gross and net changes. At the national level, on average, a district leapfrogged 68.4 rank places over 2004–2022. When seen in the context of 308 districts, this represents a gross mobility rate of 22.3%. It appears that shuffling was greater when gauged to 2019, before the pandemic, yet there is a clear churn in the rank order.

Empty Homes [1] highlights three broad territories as groups of standard regions: North (Northeast, Yorkshire Humberside, and Northwest), Midlands (West Midlands and East Midlands), and South (East of England, Southwest, and Southwest). London is separated here as well so that four 'regions' of England are analyzed. Districts in the North

have the highest 'levels' of long-term vacant homes, followed by the Midlands and South over time by mean rank. Importantly, regional value seems heavily stratified. The North dropped from 218.7 by 1.9 places over 18 years. This is a net change among the 72 districts. On average, a district shifted 59.6 places (19.6%), which suggests less mobility than the English average. By contrast, the net gross ratio (−3.2%) suggests the order shuffled, but the mean rank is almost unchanged. If the terminal year of analysis was 2013, the relative picture would have been worse.

Table 1. Rank Level and Shuffling Rates. Gross Δ = gross change Gross Δ% = gross shuffling rate Net/Gross%= Net shuffling rate.

	All	**North**	**Midlands**	**South**	**London**	**All**	**North**	**Midlands**	**South**	**London**
Level						Net Change				
2004		218.7	167.8	112.2	164.9					
2013		240.7	179.9	112.8	90.7		22.0	12.1	0.6	−74.2
2019		230.1	171.0	118.7	106.8		11.3	3.2	6.5	−58.1
2022		216.8	171.1	115.2	150.3		−1.9	3.3	2.9	−14.7
Gross Δ						Gross Δ%				
2013	62.5	54.7	58.8	60.3	95.6	20.3	17.8	19.1	19.6	31.0
2019	68.9	55.8	71.3	68.3	95.4	22.4	18.1	23.2	22.2	31.0
2022	68.4	59.6	62.3	70.1	92.9	22.2	19.3	20.2	22.8	30.2
						Net/Gross%				
							40.1	20.6	1.0	−77.7
							20.3	4.5	9.5	−60.9
							−3.2	5.2	4.2	−15.8
Segment Only										
Gross Δ						Gross Δ%				
2013		15.7	14.9	31.3	9.7		21.8	22.9	22.7	29.4
2019		15.8	17.3	36.1	9.5		21.9	26.7	26.2	28.8
2022		16.9	15.1	36.3	9.2		23.5	23.2	26.3	27.9

The gross shuffling rate for Midlands districts of 62.3 places did not change the segment's overall national position (+3.3 places). The South also has a similar net change (of 2.8 places), which keeps its average rank floating around 115, despite a gross change of 70 places. The gross change rate is around the national average of 23%.

London boroughs have a much wider time variation than the other groups. The average has a U-shape to the time profile. It drops 15 places to a mean rank of 150.3, around the median, having been as low as 79 in 2012. The average change over the 18 years (93 places) is three times the number of boroughs.

Change within segments is also reported in Table 1. The gross average change in the northern segment is 16.9 places, or 23.5% of the 72 districts. Having standardized the shuffling rate, one can compare this with that of the Midlands, which has a similar value, the South (26.3), and London (27.7), both of which are larger. Note that they are all greater than the national value (22.2).

Figure 3 displays the standardized gross change rates of within-region movement against p, the time lag. The time profile among the northern districts indicates that change over the first nine periods (to 2013) increases with the lag relatively quickly. After that, there is much less change in the rate. The standardized shuffling rate among the northern districts over the 18 years is 23.5%. The average gross change in those districts among the full distribution is 68.4 places. This means that northern districts are leapfrogging districts from other regions. The gross change rate in the context of 308 districts is 19.3%. If the nation had a similar distribution of vacancies to the northern region, the average gross change would be over 72 places (13 greater). The same adjustment value would apply to the Midlands, with districts in the south shifting 81 places (11 more). London's districts are more mobile across the national distribution than others, inflating the average change.

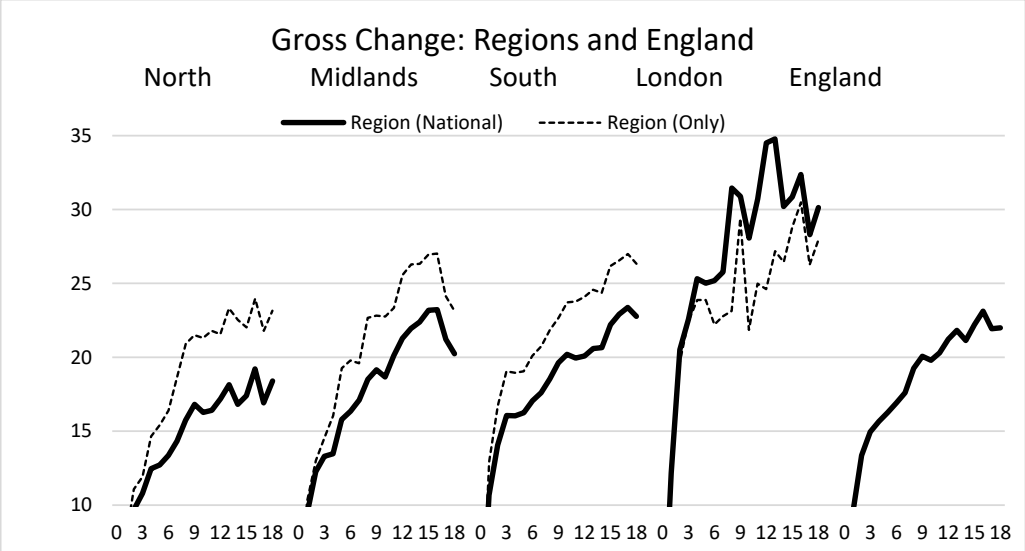


Figure 3. Gross change: regions and England.

5.3. ACF Inferences

The time plot for the national ACF is displayed in Figure 4, with the value measured against p. As Kendall's Tau is different from zero ($[T_N(18)] = 0.345$), it is concluded that the full set of districts failed to converge. That is, there is likely to be a long memory in rank positions. The corresponding correlations at lag 18 for the four segments, 0.296, 0.337, 0.212, and 0.159, are all below the national figure. The confidence intervals for London and the Midlands indicate values dropped to zero at some lags, implying the original vacancy hierarchy is forgotten. That said, there is not always a decline. There is slight evidence of districts reverting to a more similar order to 2004, which is seen in the national Tau values with a rise in concordance at the end associated with the lockdown period. There is no obvious change in the national time profile around lag 9 (associated with 2013) or 2016, when policy changes affecting vacancies or landlords could have altered the trend.

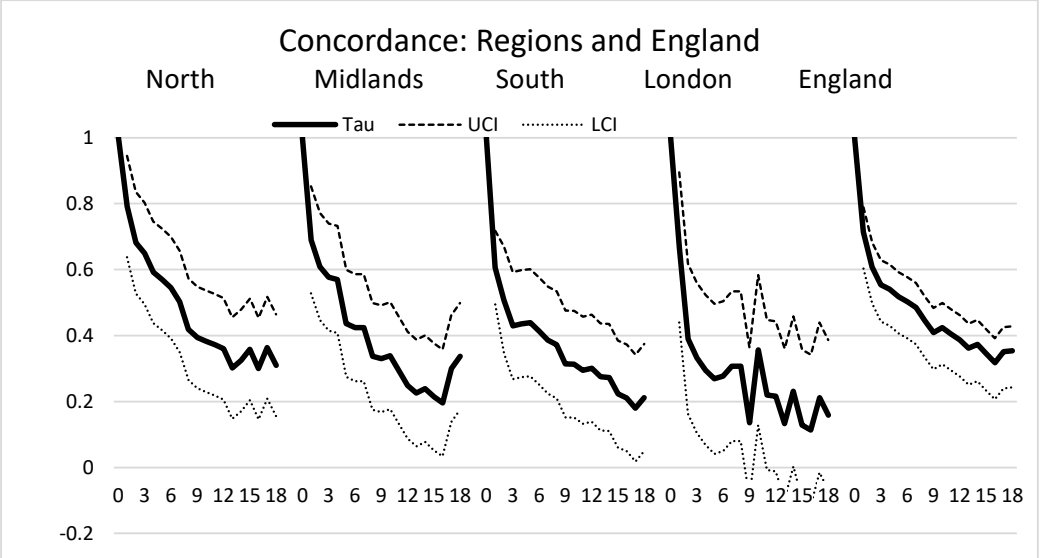


Figure 4. Concordance values: regions and England.

An observation from the Tau profiles in Figure 4 and gross change in Figure 3 is that one reflects the other. This is to be expected as the gross change formula has similarities with Spearman's rho, another rank correlation measure.

5.4. Spatial Autocorrelation

The spatial context is analyzed in a series of LISA maps in Figure 5. The map for the base year (2004) shows an LL among Southeast/West districts, with much smaller HH spots in the Newcastle, Manchester, and Liverpool areas. Moran's *I* is 0.283, the midpoint value of the 19 years and when the LTVR is at a high. The peak year, 2013, has a correlation of 0.35, whereas the values in 2019 and 2022 (0.252 and 0.236) are lower than those in 2004. The maps imply the north has an increasing concentration of high vacancy rates, highlighted by the extended HH cluster. These results indicate that a district with a high vacancy rate in 2004 has neighbors that, in future years, will have high vacancy rates. This includes both rural and urban districts.

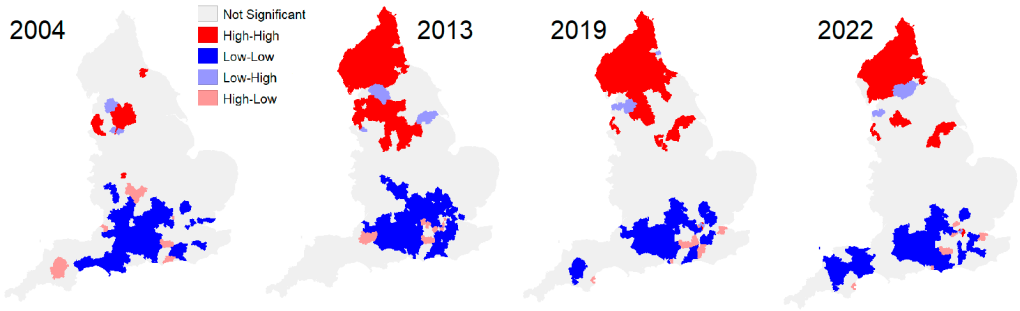


Figure 5. LISA maps.

6. Discussion

One feature of the data at the national level is that vacancies are at a peak in the pre-crisis era when prices were at a high point and affordability at a low point. This is not consistent with the expectation that vacancies are a sign of distress. Although this combination aligns with the Spanish paradox, a better explanation concerns the relative decline in the north of England. A deconcentration of jobs in cities in the north [18] and a shift of demand for dwellings to the south could explain the Spanish paradox in the British context.

The impact on the national housing market, as captured by price and turnover immediately after the financial crisis, is biased towards transactions, which exhibit a dramatic drop. Unexpectedly, the vacancy rate appears to parallel the drop when work elsewhere projects that it should rise [15,16].

The decline in the headline LTVR is likely to have distributional aspects. The distribution narrows as the level of vacancies falls. The narrowing of the distribution implies that there is the equivalent of sigma convergence. A narrowing implies high [low] rate regions experience a relatively rapid fall [rise] in the proportion of vacancies.

The spatial autocorrelation results support a regional imbalance thesis: districts with a high [low] rate in 2004 are likely to be co-located with districts that, in future years, have a relatively high [low] rate. The larger hot spot of higher vacancies in 2013 than in 2004 is consistent with a general shift in the demand for dwellings to the south and the greater northern mean-rank value reported in Table 1.

As asserted earlier, it would be useful to consider intra-distributional aspects. At the regional or representative level, mean ranks of the north, Midlands, and south changed little over the 18 years. This implies a stratified system, perhaps consistent with Empty Homes' view that there is a greater problem of long-term vacancies in the north of England than elsewhere and ties in with the decline in attractiveness of northern cities proposition. It also aligns with the LISA maps in Figure 5.

The average district leaps 68 places over the 18 years, which corresponds with the number of districts in the north and Midlands and twice the number in London. Separating the districts into regions, the average change within the north and Midlands is almost identical, at around 23%. There are more rank movements within the south and London. All four have a gross change rate above England's. In the context of the full distribution, districts in the north are generally less mobile than those elsewhere, but the difference

with the Midlands is small. As a group, the higher vacancy regions exhibit fluidity in the distributions, but there is stratification between groups.

Rank-based convergence is defined in terms of the similarity of the base and current rank orders. Kendall's Tau for the full distribution declines with the early lags, but the gradients weaken after around 2012. The time plot does not converge on zero, suggesting there is a long memory in rank positions. Performing the same procedure but separating the districts into regions, there is a similarity in the rate of decline of concordance within the north, Midlands, and south, as well as with England as a whole. London exhibits greater discordance, with some values at higher lags being not different from zero. The persistently relatively high vacancy rate among the northern districts implies that the national distribution is, to some extent, segmented. Abadir and Talmain's [27] non-homogeneity thesis is consistent with a long memory in vacancy rates at the national level.

One might consider how events, or introducing or canceling a vacant housing policy, might have an impact on the shuffling. Lag 16 in Figure 4 is associated with a sharp change. This is linked to lockdown, when house trading was thin. The north's and London's mean ranks of 2013 are out of line with those of 2004 and 2022. It could be that the Empty Homes Programme, as well as empowering authorities to remove the empty properties' discount, could have driven London's vacancy rates down quickly. The north's 'catch-up' post-2013 could also be due in part to the Empty Homes Programme. However, the continuation of the relative performance could also be due to improved financial returns. Returns to the landlord were higher in the north than elsewhere over the period 2019–2022, whereas, in London, they were weak [35].

7. Conclusions

This paper set out to consider simple metrics that can be used by policy analysts when considering relative performance. Intra-distributional mobility, or lack of it, is a constant theme in government reports.

The tools reviewed are applied to long-term empty dwellings in England. From a central government perspective, the metrics of average vacancy rate and standard deviation are moving in the right direction, post 2008, with a declining national average when it would be expected to rise and a narrowing of the spread, with what would be described in the growth literature as sigma convergence. The relative picture is mixed. Empty Homes' comments about the five districts of the northwest highlighted in the introduction point to a spatial concentration of problems in the northwest but do not consider its persistence.

It was noted in the introduction that league tables are used to drive competition among public sector providers. One might argue that Empty Homes is providing the sort of analysis one might find in other fields of public policy, so it could be an example of where metrics are needed. Although the northwest is not analyzed specifically, the corresponding commentary looked at mean ranks. Here, there is a persistence in the north > Midlands > south hierarchy. However, average gross change across the distribution implies notable intra-distributional mobility and league table changes. This points to a rather fluid as opposed to the rigid hierarchy implied at the regional level. Highlighting northern district councils as poor performers is unfair. To square the two inferences using ranking metrics, there is a high degree of positional displacement within all regional groups. The persistence of the north as having the highest average rate is a result of the districts that have improved their LTVRs relatively well being offset by the less successful jurisdictions, resulting in a stable hierarchy at the regional level. This is found in the south and the Midlands as well. It is not clear that a persistently high vacancy rate is not associated with low levels of shuffling.

In terms proposed by [23], long-term vacancies, as measured by the data analyzed here and by Empty Homes, are best viewed as 'outside' the housing market. They were most common when house prices and unaffordability were high. During the early post-financial crisis, they fell when other measures of housing market activity contracted [15,16]. This does not correspond well with market activity in other countries, as highlighted by others, e.g., [13,23].

Using local tax as a means of addressing poor housing stock management implies that the owners who are not inclined to use their dwelling to house someone can pass the property on to someone who is. Finding a buyer is more challenging in areas of weak demand and periods of low activity. So, a falling vacancy rate when sales of dwellings in the owner–occupier market collapsed is difficult to explain. If the buy-to-let landlord, who is less reliant on outside finance [36], was a key agent in nursing sick properties back to health, and the incentives for the small landlord are now modest, the early success from 2004–2012 in reducing vacancy rates is unlikely to be repeated.

Although the data may not correspond with other reports internationally, concerns raised by Empty Homes are echoed elsewhere. The US lost more than 20% of its low-cost renting stock between 2011 and 2017 [37], and the proportion that remains that is over 50 years old is 43%, up from 35% in 2007. The decline in small landlords is not unique to the UK either, e.g., [36,37]. The small investor–landlord may play a key role in managing vacancy rates. The impact of the BTL landlord on the housing market in the UK in this regard needs more work. This applies elsewhere.

The World Bank's new measure, the Prosperity Gap, captures how far societies are from USD 25 per person per day [5]. One might view this as a measure that tracks a variant of beta convergence but skews the data toward poor countries. Although this will favor the closing of the larger gaps, it does not analyze distributional change directly. Global intra-distributional mobility via gross shuffling and the autocorrelation function approach to convergence and long memory could offer insight into how growth is shared. One could compare the gross mobility rates among poor and rich regions. If potential economic growth is more limited because they possess lower productive capacity, poorer households should have lower average mobility rates, securing a relatively smaller share of general growth.

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Data Availability Statement: Certain research materials and data referenced in this paper are accessible online and through various public sources. Most importantly Table 615 available at- https://www.gov.uk/government/statistical-data-sets/live-tables-on-dwelling-stock-including-vacants.

Conflicts of Interest: The authors declare no conflicts of interest.

Notes

1 https://commonslibrary.parliament.uk/research-briefings/sn03012/ (accessed on 6 April 2024).

2 For example, https://www.centralbedfordshire.gov.uk/migrated_images/empty-homes-strategy_tcm3-24109.pdf (accessed on 9 October 2024).

3 https://www.centralbedfordshire.gov.uk/migrated_images/empty-homes-strategy_tcm3-24109.pdf (accessed on 9 October 2024).

4 https://www.ons.gov.uk/census (accessed on 2 October 2024).

5 https://www.cbre.co.uk/insights/articles/why-are-landlords-leaving-the-rental-market (accessed on 12 October 2024) & https://www.hamptons.co.uk/articles/buy-to-let-purchases-fall-to-record-low#/ (accessed on 12 October 2024).

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