



Explore driving factors of vacant housing in England: taking cases of growing and shrinking urban areas

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SUMMARY: *This article aims to analyze the potential determinants of residential vacancy rates in different urban environments in England, using Blackpool (representative of declining cities) and Liverpool (growth city model) as examples for comparative research. This article uses a multiple linear regression model to conduct correlation analysis on population, socio-economic, housing market, and built environment factors, and evaluates whether the spatial distribution of vacant housing exhibits clustering or dispersion patterns using global and local autocorrelation analysis. Research has found that the increase in the number of small households is negatively correlated with housing vacancy rates, but only significantly in shrinking cities such as Blackpool. Among socio-economic factors, employment in the tertiary industry is only related to job vacancies in declining cities, while unemployment becomes a common catalyst. The impact of median housing prices on vacancy rates in these two types of cities can be ignored. From the perspective of urban form, the density of commercial facilities is the only building environment factor related to vacancy rate, but its impact varies depending on the urban environment. The increase in the number of small households, unemployment rate, employment in the tertiary industry, and density of commercial facilities are key factors affecting residential vacancy rates. To alleviate the problem of vacant housing, policy makers should ensure that housing supply is consistent with changes in population structure, cultivate employment capacity through policies that support relevant industries, especially the tertiary industry, and provide facilities based on the needs of local residents, emphasizing quality rather than quantity.*

KEYWORDS: *British society; Vacant housing; Driving factors; Correlation analysis; Economic growth; Vacancy rate*

1 Introduction

Vacant housing is increasingly becoming a key challenge faced by cities, with profound negative impacts on the housing market, urban ecosystem, social structure, and public welfare [1, 2]. Firstly, as Accordion and Johnson pointed out, its diffusion has led to environmental degradation. The most direct impact is structural degradation, as unmaintained performance deteriorates rapidly. Except for a few buildings, communities with high vacancy rates often face the problem of insufficient investment in public infrastructure, as municipal resources are redirected to more economically dynamic areas. This leads to insufficient infrastructure supply and accelerated degradation in affected areas. In addition, vacant housing exacerbates the inefficiency of urban land, indicating missed opportunities for production development and

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potentially stifling policy driven regeneration efforts. This environmental decline weakens the aesthetic appeal of communities characterized by dilapidated buildings and underutilized spaces [3].

The social impact is equally worrying, especially in terms of safety and community cohesion. Vacant properties, unsafe windows, and lack of monitoring create accessible havens for criminal activities. Their neglected state also provides concealment, allowing illegal activities such as drug trafficking to thrive in areas with poor monitoring. Meanwhile, vacant housing has eroded social trust. For example, in Philadelphia, residents attempting to improve the community through landscaping or window cleaning reported that persistent vacancy masked these efforts, fueled a general sense of helplessness, and weakened community bonds. The housing market is also adversely affected by vacancy, as it lowers the real estate value of surrounding areas [4]. In Columbus, Ohio, a vacant property within a 250-foot radius reduced the value of nearby homes by approximately 3.5%, although properties 500 feet away were largely unaffected. The duration of abandonment further exacerbates this decline: properties that have been vacant for less than a year have caused a 0.034% decrease in neighboring value, while properties abandoned for more than three years have led to a nearly 1% decrease.

In communities with high vacancy rates, both mental and physical public health risks will increase. For example, residents in high vacancy rate areas of New Orleans reported being under long-term stress due to fear of crime, interpersonal distrust, and disparities in access to healthy food, healthcare, and entertainment facilities. Over time, long-term exposure to these stressors is related to the increase in the incidence rate of hypertension, because chronic psychological stress - related to persistent violence and insecurity - can cause physiological damage.

2 Related research

As shown in Figure 1, urban development can be conceptualized as a cyclical process that includes four theoretical stages: urbanization, suburbanization, de urbanization, and re urbanization, collectively referred to as the urban lifecycle model. In the initial stage of urbanization, industrialization (transition from agricultural economy) drove surplus rural labor to migrate to cities, despite limited income and commuting capacity. Due to insufficient transportation infrastructure, the development of strategic hubs is limited, and towns with abundant raw materials and efficient logistics networks have become the focus of industrial growth [5]. The concentration of this industrial activity has generated a large demand for labor, forming a dense urban core characterized by population inflows, while the population in the surrounding suburbs is declining. Therefore, economic activities and population are concentrated in large cities with industrial advantages, while medium-sized cities lead the production of raw materials and small towns act as intermediaries for agricultural trade, despite the decreasing population.

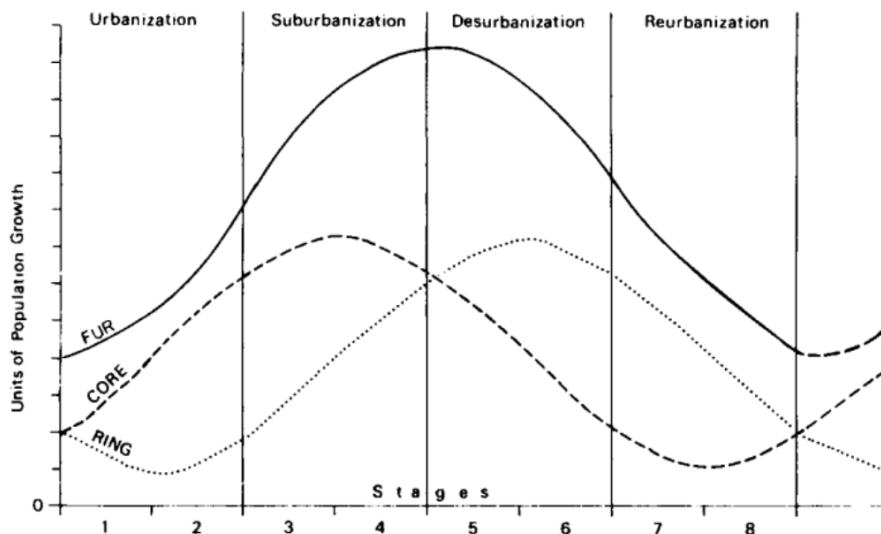


Figure 1: Population changes during the process of urban development

The second stage, suburbanization, marks the evolution of urban dynamics in the industrial era. Although economic restructuring continues to drive urban population growth, improvements in quality, such as expanding employment opportunities and increasing disposable income, enable residents to prioritize housing quality and facilities [6]. The advancement of motorized transportation has further diversified residential patterns, allowing individuals to live in the suburbs while commuting to the city center to work in the tertiary industry. This accessibility of convenient transportation ensures fair access to welfare related infrastructure, including entertainment facilities, retail centers, and medical services, even in vast residential areas. Therefore, the central city and suburbs are functionally integrated, dispersing workplaces and residences over a wider geographical area. Policy driven incentives for suburban development, such as large-scale infrastructure projects, have accelerated this outward migration, resulting in suburban population growth and urban population decline.

The permanent population of central towns may continue to decrease, which could undermine the vitality of the existing urban structure and coincide with the deterioration of social infrastructure. This phenomenon is largely caused by the intensification of traffic congestion [7]. Given that the current road network cannot accommodate the thousands of commuters who rush into the city center every day seeking parking, the accessibility of all workplaces in the city's core area has been affected. Expanding parking facilities in old residential areas (usually located in the city center) and strengthening public transportation services are feasible strategies to enhance the connectivity of the center. However, these measures may inadvertently encourage more residents, especially those in the town, to relocate to the suburbs to avoid traffic congestion and related inconvenience. Meanwhile, offices and other workplaces may be attracted to move to the suburbs, or even beyond city boundaries, to areas with convenient transportation. Therefore, not only will there be a population decline in urban and suburban areas, but rural areas will also experience urbanization, often at the cost of sacrificing natural habitats and fertile farmland. Ultimately, this will lead to a decrease in the overall population of the central city and its surrounding commuter suburbs, due to migration to small and medium-sized cities that provide better employment opportunities, better services, more open spaces, and alleviate the economic and social burden on their original sites [8]. In the fourth stage of reurbanization, even if the population in the suburbs continues to decrease, the population in the core areas may experience relative growth while the overall population level remains stable, ultimately reaching the peak of absolute population growth in both the

core and suburbs. The trend of absolute population recovery in core cities is consistent with the government's efforts to revitalize the image of the city center through measures such as revitalizing existing housing stock, implementing urban renewal projects, and upgrading public infrastructure.

However, the various stages of the urban lifecycle model have been criticized for oversimplifying the complexity of urban development, mainly focusing on population change as the primary evaluation criterion. In addition to demographic factors, factors such as economic growth patterns and spatial distribution of social activities also have a significant impact on the trajectory of urban development. For example, Salvati and Zamboni's study on urban expansion in 174 metropolitan areas from 1950 to 2000 showed that urban growth is not necessarily correlated with population growth. On the contrary, it is more closely related to economic driving factors that are less affected by population changes, indicating that the stage of urban development is the result of complex interactions between population and economic factors. Secondly, this particular model has been criticized for its geographical breadth of research, as it mainly focuses on the urban development patterns of Western European countries before the 1990s. However, the dynamics of urban evolution may vary significantly in different urban environments, making it difficult to summarize them into a universal framework [9]. For example, Turok and Mykhnenko's research examined the urban development trajectories of European cities from 1960 to 2005. Their research findings highlight significant differences between Eastern and Western European cities and attribute these differences to different political and economic backgrounds. Specifically, Western European cities exhibited a growth pattern from the 1960s to 2002, followed by a slight decline and a slow recovery after 2000, influenced by deindustrialization and economic restructuring since the 1970s. On the contrary, Eastern European cities experienced rapid expansion under communist rule, followed by a sharp contraction after 1990. Thirdly, as indicated by the seamless and continuous four stage urban lifecycle model, the trajectory of urban development does not always follow a unilateral linear development with predictable outcomes. Athens is a suitable example, where urban development presents a non-linear trend characterized by alternating stages of population growth and decline. In addition, since World War II, the stages of this model have overlapped and coexisted simultaneously in various metropolitan areas, coinciding with the parallel processes of urbanization and suburbanization, and the trend of deurbanization and reurbanization is not very obvious.

Vacant housing is an inherent aspect of dynamic urban development. In the process of urbanization, due to population migration towards urban centers, there may be vacant housing in suburban or rural areas, leading to an oversupply of housing and an increase in vacancy rates in these areas, especially in cities that have experienced rapid urbanization in recent years [10]. For example, China's rapid urbanization has led to a large outflow of population from rural areas, leaving behind a large number of vacant homes, while the development of new housing in rural suburbs has stimulated demand driven urban-rural transformation. In addition to higher vacancy rates in rural areas, small towns surrounding economically active metropolises often have higher levels of vacant housing. In addition, during the period of suburbanization and deurbanization characterized by a decline in urban population, urban centers that experience significant population decline due to reduced demand are more prone to housing vacancies. In the stage of reurbanization, although the population in the city center may start to grow again, reducing the vacancies left by the previous stages, this recovery is not only due to increased demand similar to the urbanization process. On the contrary, the main catalyst for this trend may lie in the improvement of the quality of existing urban housing, rather than just the increase in demand brought about by population growth. In the fourth stage of reurbanization, the prevalence of vacant housing may decrease, especially in downtown areas. The case of Leipzig,

Germany illustrates this point, where re urbanization is driven by residents' conscious preferences for the inner city, where housing is revitalized to meet individual needs and thus reduce housing vacancies in the inner city.

3 Overview of the research area and research methods

3.1 Study areas: Blackpool and Liverpool

In this study, Blackpool and Liverpool were designated as key research areas (see Figure 2). Blackpool is a local administrative district located in the heart of the western edge of England, about 43 kilometers north of Liverpool. As shown in Figure 3, the population of the town in 2021 was 141000, a decrease of about 0.8% from 142100 residents in 2011. This population trend has made Blackpool one of the five local authorities in the northwest region experiencing a decrease in population. Blackpool can be said to be an area with limited development prospects [11]. In the past decade, the town has faced the challenge of an aging population, with the proportion of people aged 65 and above increasing from 19.1% to 20.7%. At the same time, the employment level has declined, with employment opportunities for residents aged 16 and above decreasing by 1.5%.

Figures 2 and 3 show that Liverpool is one of the most populous cities in England, located in the west of northwest England. In 2021, its population reached 486100, an increase of about 4% from 466400 in 2011. Despite experiencing an aging population in recent years, Liverpool's situation seems less severe compared to Blackpool, with the proportion of people aged 65 and over increasing from 14.1% to 15.1%. In terms of employment, the proportion of employed individuals aged 16 and above has increased from 47.1% in 2011 to 48.2% in 2021, indicating a broader development prospect.



Figure 2: Location of Blackpool and Liverpool

In this study, Blackpool and Liverpool were intentionally chosen to represent two different urban environmental scenarios - urban shrinkage and urban growth - with the aim of exploring the unique driving forces behind vacant housing in each scenario [12]. On the one hand,

Blackpool is an example of urban shrinkage, characterized by a decrease in population and economic activity, which is reflected in reduced employment opportunities. On the contrary, Liverpool has been chosen as a model of urban growth due to its significant increase in population and economic vitality. On the other hand, both urban areas have high vacancy rates. Specifically, in 2021, there were 7650 vacant homes in Blackpool, while Liverpool had 19615 vacant homes. In this situation, both cities faced a widespread problem of vacant housing in 2021, with vacancy rates (calculated as the proportion of vacant housing units to total housing) exceeding the English average (6.1%), with Blackpool reaching 10.5% and Liverpool reaching 8.6%, as shown in Figure 4.

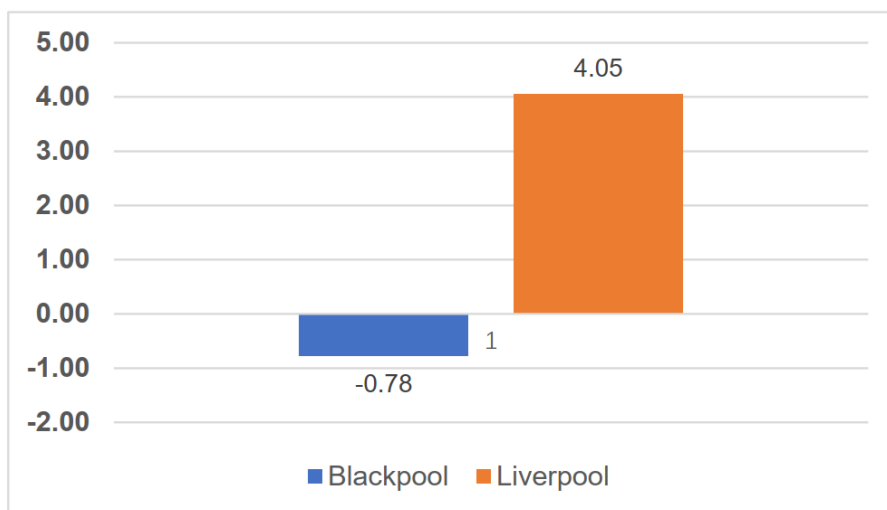


Figure 3: Growth in population in Blackpool and Liverpool from

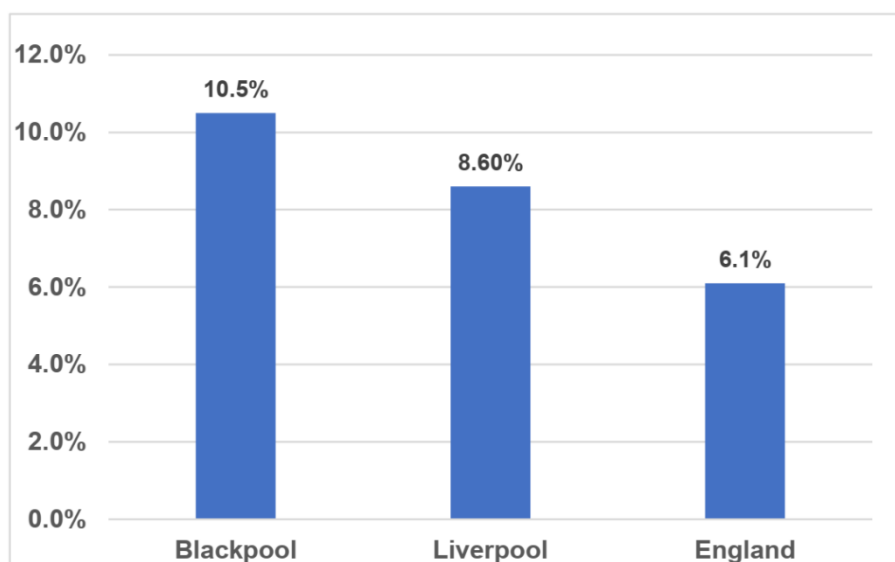


Figure 4: Comparison of vacant housing rate in Blackpool, Liverpool and England

3.2 Data collection and procedure

In this study, all datasets were collected at the level of mid-level super output regions (MSOAs), a geographic classification that includes 2000 to 6000 households and 5000 to 15000 people. Specifically, Liverpool's local authorities include 60 MSOs, while Blackpool has 19 MSOs. The data used in this study is secondary and comes from various platforms [13].

For the dependent variable, the number of vacant homes and related housing categories at the MSOA level in Blackpool and Liverpool in 2021 were collected. This dataset represents the latest information available for analysis. In this case, vacant housing units are defined as residences that are truly uninhabited, have no fixed occupants, show no signs of being used as secondary housing, and do not have temporary residents.

The independent variables are divided into population, socio-economic, housing market, and built environment factors (see Table 1 for details). Population factors include population growth over the past five years (from 2016 to 2021), the number of small families (consisting of one to three people), and large families (exceeding three people). Socio economic data includes the number of individuals aged 16 and above employed in the tertiary industry (including energy supply, construction, trade, transportation, accommodation and catering services, information and communication, financial activities, real estate, professional services, administrative support, education, and human health), as well as unemployment data. In addition, the median housing price for 2022 is selected to examine the dynamics of the housing market. The population and socio-economic data are sourced from the 2021 census data provided by NOMIS. The median housing price data representing factors in the housing market comes from the National Bureau of Statistics (ONS, 2023d).

For building environment factors, public facilities (including schools, hospitals, and bus stations) and commercial institutions (such as shops and restaurants) are identified as Points of Interest (POI) on OpenStreetMap (OSM) and then imported into ArcGIS Pro for processing to determine their total number at the MSOA level. In addition, by extracting commercial, residential, and industrial land from OSM and integrating these different land uses into ArcGIS Pro to calculate MSOA level statistical data, the scope of land development can be determined. The calculation of road density is the ratio of road length (in meters) to area (in square meters) at the MSOA level. The road network data was obtained from the UK Ordnance Survey (2024) and imported into ArcGIS Pro for geographic level statistical analysis.

Table 1: Summary of dependent and independent variables

Dependent variable	
The total count of unoccupied residential units	
Independent variable	
Demographical factors	The population surged during the five-year period from 2016 to 2021.
	The number of compact households consisting of one to three residents.
	Form a larger family consisting of three or more people.
Socio-economic factors	Individuals employed in the tertiary industry.
	Unemployment figure.
Housing market factor	Median house prices.
Built-environmental factors	The aggregate count of publicly accessible amenities.
	The number of commercial facilities.
	Urbanized zones encompassing commercial, residential, and industrial land parcels.
	Road density (m/m ²).

3.3 Correlation analysis of multiple linear regression

Autocorrelation is an important indicator that reflects the correlation between a certain geographical phenomenon or attribute value on a regional unit and the same phenomenon or attribute value on neighboring regional units, used to measure the spatial clustering degree of a

certain element [14]. The Moran's index is commonly used to quantify this clustering attribute. There are two types of autocorrelation: global spatial autocorrelation and local spatial autocorrelation. The calculation formula for global Moran's I is:

$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n \omega_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^n \sum_{j=1}^n \omega_{ij} \sum_{i=1}^n (X_i - \bar{X})^2} \quad (1)$$

where, X_i and X_j respectively represent the observation values corresponding to the i -th and j -th entities in the defined spatial context; n represents the total number of spatial entities observed within the designated research area; \bar{X} represents the average observation value of all entities; ω_{ij} corresponds to a spatially weighted matrix that depicts the adjacency relationship between the i -th and j -th entities in space.

In the case where $I > 0$ represents positive spatial correlation, it means that the studied entity exhibits spatial clustering. On the contrary, when $I < 0$ represents negative spatial correlation, it indicates that entities are spatially dispersed. If the result is $I = 0$, it indicates that the calculation does not meet the statistical significance standard, which means that the entity is randomly distributed in space.

The Local Spatial Association Index (LISA) focuses on examining the spatial interdependence between specific units and their adjacent units. The calculation expression of the local Moran I statistic is as follows, and the definition of each variable is consistent with the previous description.

$$I = \frac{\sum_{j=1, j \neq i}^n \omega_{ij} (X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^n (X_i - \bar{X})^2} \quad (2)$$

In this study, we employed global and local autocorrelation analysis to evaluate whether the spatial distribution of vacant housing exhibited clustering or dispersion patterns, and quantified the degree of these patterns.

Using ArcGIS 10.7, we measured the connection length from a single residential area to its adjacent streets, which we designated as l_i . In addition, we determined the cumulative length of all connections from the residential area to the street network, denoted as L . Then, we calculated $f_i = l_i/L$, which represents the weighted impact of the surrounding land use intensity on the residential community vacancy index, using the following formula:

$$X = \frac{x_1 f_1 + x_2 f_2 + \dots + x_n f_n}{n} \quad (3)$$

where, X is used to represent the dynamic energy or vitality of a specific area within a defined range. x_n corresponds to the street vitality index of adjacent road sections, while f_n represents the proportional weight of the connection length with the corresponding road section. f_i refers to any weighting factor that satisfies the condition $\sum f_i = 1$. l_i represents the length of the connection between the relevant roads and residential areas. L represents the total length of all connections between residential communities and street networks.

In residential communities that are not directly adjacent to any roads, the above formula is

applicable for calculating the regional vitality index by considering surrounding plots with direct road adjacency. This process continues to iterate until the community is directly linked to a plot with a regional vitality index. The connection length between the community and each individual plot is measured as k_i and included in l_i , while the total connection length between the community and plots with regional vitality index is measured as K and represented as L . Then, the regional vitality index t_i of the plot is used as x_i , indirectly obtaining the regional vitality index of the residential community.

This study used SPSS 26.0 to evaluate the correlation between community vitality and vacancy rate using Pearson correlation coefficient. This method aims to investigate the factors that affect the vacancy rate of residential communities.

4 Empirical analyses

4.1 Spatial clusters of vacant housing

Figure 5 depicts the geographical clustering pattern of vacant homes in Blackpool and Liverpool. In Blackpool, areas displaying hotspot clusters (indicated in deep red) represent areas with abnormally high concentration of vacant homes, while areas marked in orange clusters represent a medium density distribution of such properties. These clusters mainly appear in the western coastal area of Blackpool. On the contrary, the remaining vacant housing in Blackpool is relatively evenly distributed and lacks any obvious spatial clustering [15]. In addition, there are no obvious areas of scarce vacant housing in Blackpool. In Liverpool, the urban core located in the north reflects a similar clustering phenomenon, displaying a density of vacant housing ranging from abnormally high to moderately high (represented by dark red, light red, and orange). At the same time, the northeast and southwest edges of Liverpool have been identified as suburbs, and it has been observed that the density of vacant housing is low (marked in medium blue) and moderately low (indicated in light blue).

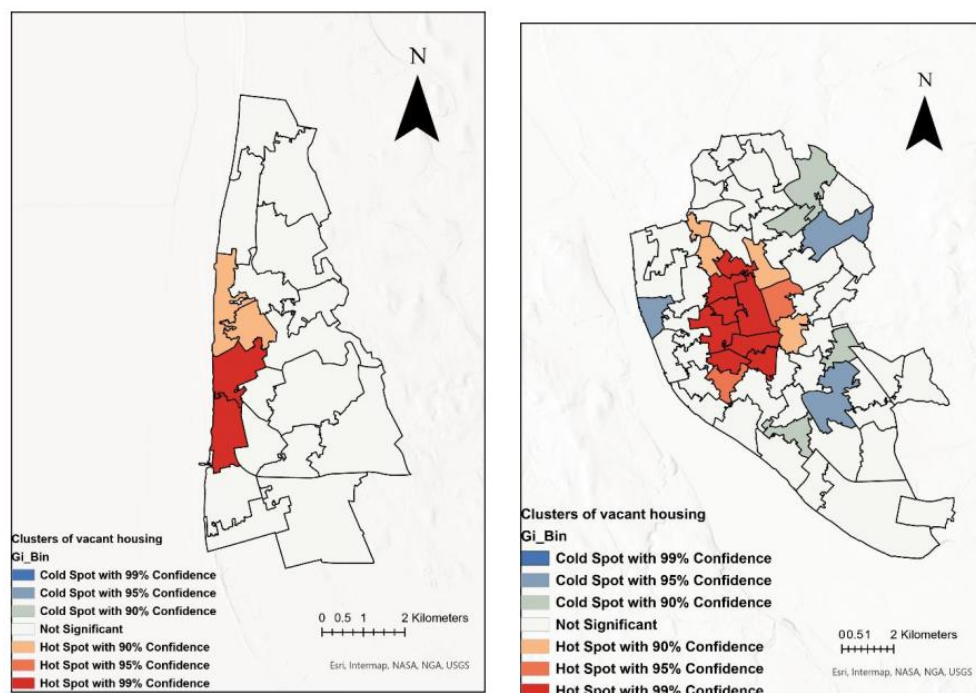


Figure 7: Spatial clustering of vacant housing at MsOA level

It is evident that both regions have a significant accumulation of vacant residential properties in their central and adjacent areas. This pattern may be intricately linked to the dynamics of suburbanization and anti-urbanization, which collectively lead to a sustained decline in population in downtown areas.

4.2 Quantitative results

Table 5 shows the results of multiple linear regression analysis. For both of these examined regions, the R-squared values exceeded 0.5, indicating that the regression model performed quite well. In addition, the variance inflation factor (VIF) of each independent variable is below 10, indicating relatively low multicollinearity between variables [16].

In the context of Blackpool, a shrinking urban area, the significance levels of several variables are below 0.05. These variables include the number of smaller households (consisting of one to three people), the number of people employed in the tertiary industry, the number of unemployed, and the number of commercial facilities. These findings suggest that these independent variables may affect the prevalence of vacant housing in Blackpool. It is worth noting that the significance levels of unemployment rate and commercial facilities are below 0.01, highlighting that these two variables may have a more significant impact on the number of vacant residential properties. Among the important factors, only the number of smaller households showed a negative coefficient of -0.245, indicating a potential negative correlation with the number of vacant housing units. On the contrary, the coefficients of employment in the tertiary industry, unemployment rate, and commercial facilities are 0.418, 2.298, and 4.517, respectively, all of which are positive values. This indicates that as these factors increase, the number of vacant homes in shrinking urban areas such as Blackpool also increases accordingly, and vice versa.

For variables with a significance level above 0.05, including population growth, number of large families (more than three people), median housing prices, number of public facilities, developed land area, and road density, their impact on the occurrence of vacant housing seems to be minimal.

Table 2: Results of multiple linear regression analysis

Independent variables	Shrinking urban areas (Blackpool)			Growing urban areas (Liverpool)		
	Coef	Sig	VIF	Coef	Sig	VIF
The number of populations increased	0.271	0.2145	2.6473	-0.0225	0.3334	1.9040
The number of households(one three persons)	-0.2456	≤0.056	2.3251	0.0284	0.4575	1.1769
The number of households (above three persons)	-1.5665	0.0628	4.0432	0.0963	0.3876	1.3746
Populations employed in tertiary industry	0.4184	<0.053	7.2005	0.0142	0.7912	1.9296
The number of unemployment	2.2985	0.0122	4.8514	1.3771	<0.013	2.5947
Median housing price	0.0026	0.4721	5.1756	0.0003	0.4631	2.3864
The number of public facilities	-16.358	0.3131	2.6216	-0.8324	0.9283	1.2333
The number of commercial facilities	4.5172	≤0.0134	2.3237	-1.4625	<0.056	1.9425
Developed area	-0.3181	0.6641	2.6443	-0.0226	0.3335	1.3202
Road density(m/m ²)	11064.4514	0.0731	2.6572	9120.0207	0.0563	1.4444
R ²	0.8685			0.6035		

In the expanding urban area of Liverpool, only the significant levels of unemployment and the number of commercial facilities is below 0.05, indicating that these factors may be key factors leading to the widespread existence of vacant housing. It is worth noting that the significance level of the unemployment rate is even lower, dropping below 0.01, highlighting its potential stronger impact on the number of vacant homes. The coefficients of unemployment rate and business convenience for these two influencing variables are 1.377 and -1.462, respectively. This suggests that the unemployment rate may be positively correlated with vacant housing - an increase in unemployment rate may correspond to an increase in vacant housing. On the contrary, the increase in commercial facilities may lead to a decrease in vacant housing in developing urban areas such as Liverpool. For the remaining independent variables, including population growth, number of households (regardless of size), employment in the tertiary industry, median housing prices, number of public facilities, developed land area, and road density, their impact on the number of vacant homes seems negligible as their significance level exceeds 0.05.

4.3 Analysis of Driving Factors

(1) Demographic factors. According to the results of regression analysis, population growth over the past five years does not seem to have a significant impact on the number of vacant homes in Blackpool and Liverpool. This result seems inconsistent with previous studies that have identified demographic changes as the main driving factor for housing vacancy, particularly emphasizing how population decline leads to housing oversupply [17]. However, this study only examined the impact of population growth on housing vacancy rates over the past five years, indicating that housing supply may take longer to adapt to short-term new housing demand, a phenomenon similar to the results of a previous study conducted in Columbus. Current research also suggests that recent population changes have no significant impact on housing vacancies, which applies to urban areas that are constantly shrinking and expanding.

Regarding population composition, the impact of household numbers on housing vacancy rates varies in Blackpool and Liverpool, representing both shrinking and growing urban areas respectively, although the impact of large families (over three people) on housing vacancy in these two regions is minimal. For smaller families (consisting of one to three people), this result is in stark contrast to previous studies that have shown that an increase in small core families may increase housing vacancy rates due to population aging and low fertility rates [18]. However, in this study, it was found that there is an inverse relationship between small households and housing vacancy rates - an increase in small households may reduce the number of vacant units, especially in shrinking urban areas such as Blackpool. This trend may stem from establishing joint property ownership through marriage and parental relationships, in which case the period between establishing a partnership and having the first child is an opportunity to transition to owning housing. In this case, buying a house and cohabiting may come before getting married as a step towards stability, thereby reducing housing vacancies. On the contrary, in developing urban areas such as Liverpool, the expansion of the higher education sector may attract a higher proportion of short-term residents, such as students seeking temporary accommodation or recent graduates. Therefore, these smaller families may not have a significant impact on housing vacancies in areas with migrant populations.

In addition to smaller families, this study also evaluated the impact of larger families on housing vacancies. Both Blackpool and Liverpool have shown that regardless of whether the city area shrinks or expands, large families have no significant impact on housing vacancy rates, which may be due to a lack of corresponding housing types in the market to accommodate large families. For example, compared to apartments, detached houses may be more suitable for

providing additional bedrooms. However, if apartments make up the majority of vacant housing (like in Blackpool and Liverpool, which account for approximately 56.8% and 53.1% of the total number of vacant housings, respectively), they may not be able to fully meet the needs of large families who require more bedrooms, resulting in minimal impact on housing vacancy.

(2) Socio-economic factors. When studying the impact of labor force engaged in the service industry, it is worth noting that there are significant differences in its impact on housing vacancies between shrinking and expanding urban areas [19]. In shrinking cities such as Blackpool, the increase in service industry employment is correlated with the increase in vacant housing, which is consistent with previous research on deindustrialized urban areas. On the one hand, compared to traditional manufacturing, the service industry typically requires less labor-intensive business, which may lead to unemployment and result in more vacant properties in specific areas. On the other hand, although the tertiary industry has a large workforce in shrinking urban areas, these regions may not provide sufficient promotion prospects for these employees, who typically have higher education, professional and management knowledge, as well as higher income levels that enable them to afford better housing. Therefore, these skilled workers may relocate from shrinking urban areas with limited growth opportunities, declining population, economic stagnation, and deteriorating infrastructure, leading to an increase in vacant housing.

On the contrary, in urban areas with sustained population growth, such as Liverpool, employment in the tertiary industry may have little impact on housing vacancies. This difference can be attributed to the time gap between data collection and the implementation of government policies aimed at promoting the development of the tertiary industry, as observed by Liverpool. In 2016, the Liverpool City Area Joint Management formulated the City Area Growth Strategy, which aims to improve productivity, skills, and employability by cultivating a variety of businesses and encouraging entrepreneurship [20]. This strategy prioritizes the development of several tertiary industries, including advanced manufacturing, finance and professional services, and tourism economy, with the goal of promoting employment in these areas. However, given that the vacant housing data in this study was collected in 2021, which is only four years after the implementation of this strategy, the housing market may need additional time to adapt to the growth of service industry employment in Liverpool, thus limiting the impact on housing vacancy.

Compared with employment in the tertiary industry, unemployment is a key determinant and has a more significant impact on housing vacancies. It is a common factor for contraction (such as in Blackpool in this study) and urban growth (represented by Liverpool). This observation confirms previous research conducted in the United States and New Zealand, indicating that limited employment opportunities may encourage residents to seek better prospects in economically stable areas, thereby affecting housing vacancy rates.

(3) Housing market factors. Regarding the housing market, although previous studies have shown a potential link between lower housing prices and higher vacancy rates, the median housing price may not be the determining factor for the emergence of vacant housing [21]. This difference may stem from the inherent non elasticity of the housing market, where price fluctuations - whether upward or downward - do not necessarily translate into corresponding changes in housing supply. In fact, as early research has shown, due to oversupply, price declines may even exacerbate vacancy problems. On the contrary, housing prices may more accurately reflect the dynamics of housing demand; When supply exceeds demand, prices usually fall, leading to an increase in vacant units.

(4) Building environmental factors. Regarding building environment factors, whether in the shrinking city of Blackpool or the growing Liverpool, the number of public facilities does not seem to be a significant driving force for housing vacancy. This discovery is in stark contrast

to numerous studies conducted in the Asian context. A reasonable explanation is that residents may prioritize the quality of public facilities over quantity when evaluating available resources in the community, although current research has not explored this aspect [22]. Therefore, regardless of whether urban areas are shrinking or expanding, the impact of the number of public facilities on housing vacancy rates may be minimal.

In terms of commercial facilities, this study suggests that, consistent with previous research, their quantity may be a factor in reducing (Blackpool) and increasing (Liverpool) housing vacancy rates in urban areas. However, the impact of commercial facilities on housing vacancy rates varies in different urban environments. On the one hand, as demonstrated by this study, the impact of commercial facilities seems to be more pronounced in shrinking urban areas compared to continuously growing commercial facilities. On the other hand, the increase in commercial facilities may lead to more vacant housing in shrinking areas, while the opposite effect may occur in growing areas [23]. This difference may be due to commercial facilities (such as the shops and restaurants selected in this study) failing to meet the consumption needs of local residents in shrinking urban areas, thereby exacerbating the vacancy problem. On the contrary, in constantly developing urban areas, the provision of commercial facilities may better meet local demand and effectively reduce housing vacancies.

Furthermore, the extent of developed regions does not seem to affect the number of vacant homes in Blackpool or Liverpool, which contradicts the results of a study conducted in China. One possible explanation is that developed regions may have an indirect impact on housing vacancy, similar to the observation in Ohio, USA [24, 25]. In this case, mixed use development methods in developed regions can increase real estate value, attract more investment, and ultimately reduce housing vacancies without directly affecting them.

5 Conclusion

5.1 Summary of key findings

In summary, this study aims to take Blackpool and Liverpool as examples to delve into the potential driving factors behind the continuous shrinking and expansion of vacant housing in urban environments. These urban scenarios represent the continuum of urban transformation processes, including urbanization, suburbanization, de urbanization, and re urbanization. In these situations, the widespread existence of vacant housing poses a global challenge, with profound impacts on the physical environment (manifested as deteriorating infrastructure), social cohesion (due to increased violence and weakened community connections), personal well-being (affecting physical and mental health), and local housing markets.

Blackpool and Liverpool, both characterized by high vacancy rates, were selected as the focus of this survey to compare and contrast the driving forces behind vacant housing in different urban dynamics. Blackpool is a shrinking town with a continuously decreasing population and limited economic activity, in stark contrast to Liverpool, an emerging city with a growing population and broad development prospects. Based on previous research, this study identified several potential influencing factors: demographic variables, including population changes over the past five years and household composition (including smaller and larger households); Socioeconomic indicators, such as employment and unemployment rates in the tertiary industry; Housing market indicators, especially median housing prices; And building environment elements, including the number of public and commercial facilities, the scope of developed land for integrated residential, commercial, and industrial use, and the density of road networks.

When analyzing the data, the study initially drew a distribution map of vacant housing in

these two urban areas, revealing a high concentration in the city center. Subsequently, it examined the spatial correlation between the number of vacant homes and various other factors, acknowledging that some variables may not have shown statistically significant associations. Regarding demographic factors, recent population changes seem to have little impact on shrinking (Blackpool) and growing (Liverpool) urban areas, possibly due to the time lag between demand changes and housing supply responses. In the family structure, only the surge of small families demonstrates the ability to reduce vacant housing, mainly in shrinking urban areas, which may be related to housing ownership patterns and population living needs. This impact has not been observed in the constantly developing cities, possibly due to the influx of young people who may not be seeking permanent residency. At the same time, in both cases, the impact of large families can be ignored, which may be due to a mismatch between the availability of housing types and residents' needs. In the socio-economic field, it has been found that employment in the tertiary industry has only increased housing vacancy rates in shrinking urban areas such as Blackpool, which may be due to deindustrialization and the underdeveloped tertiary industry leading to the relocation of skilled workers. On the contrary, high unemployment rates have become the main driving force for vacant housing in both cities, reflecting a decrease in economic activity and limited development opportunities, which in turn has driven population outflow from economically declining areas. The housing market factors represented by the median housing price are not significantly correlated with the incidence of vacant housing in shrinking or growing urban areas, which may be due to the lack of elasticity in the housing market. On the contrary, housing prices can serve as a dynamic indicator of housing demand. In the already built environmental factors, regardless of the urban environment, the number of public facilities has little impact on vacancy rates, which may be because residents prioritize the quality of public facilities over quantity - an aspect not explored in this study. However, commercial facilities have become an important driving force, and their impact varies between shrinking and growing urban areas. In shrinking areas like Blackpool, commercial facilities may not be able to meet local demand, exacerbating housing vacancy issues, while in growing areas like Liverpool, they may effectively meet consumer demand, thereby reducing vacancy rates. In urban areas that are constantly shrinking or growing, the direct impact of developed land area and road density on housing vacancy rates is limited. Developed regions may increase real estate value through mixed use development, indirectly affecting housing vacancy rates, while the insufficient impact of road density may stem from complex interactions between different subregions.

Finally, in terms of strategies to alleviate housing vacancy, current methods often rely on passive measures such as taxing long-term vacant properties or developing more adaptive strategies based on the needs and resource utilization of local residents. Based on the research results, several suggestions have been put forward: firstly, policy makers should ensure that housing supply is consistent with population structure. Secondly, they should cultivate employment capacity through support policies for related industries, especially the tertiary industry in the deindustrialization era. Government support is crucial for the service-oriented economy in shrinking urban areas such as Blackpool. Thirdly, facilities should be provided according to the needs of local residents, emphasizing quality rather than quantity, in order to effectively reduce housing vacancies. Both public and commercial facilities should meet local needs and ensure the provision of high-quality services.

5.2 Limitations and further research direction

This study is not without its limitations. Firstly, the data sources used in this study may hinder its ability to capture the latest trends. Given that most of the data comes from the 2021 census, this analysis mainly reflects the situation of vacant housing three years ago, rather than insights

into the current situation. Secondly, reliance on online data collection methods may lead to discrepancies between survey results and real-world conditions, particularly for data related to the built environment. This dependence may compromise the accuracy of the results, as online data may not fully represent the actual situation on the ground. The third limitation stems from the choice of research field. Due to only studying two cases, representing the shrinkage and growth of urban areas, the driving factors identified in this study may be specific to the environment and may not be generalizable to other environments. Due to limitations in resource and data accessibility, this study focuses on some driving factors of vacant housing. However, the interactions between variables can be complex and multifaceted. In addition to the limited factors that contribute to housing vacancy discussed in this study, there may be other factors such as interest rate fluctuations and qualitative factors related to macro level government policies and even individual perceptions of their living environment. These aspects can serve as valuable avenues for future research aimed at comprehensively investigating the occurrence of vacant housing.

Author's Profile

Ruidan Sun was born in Guiyang, Guizhou, China, in 2001. She completed her Bachelor's degree in Urban Planning and Design at Xi'an Jiaotong-Liverpool University in China. In 2024, she obtained her Master's degree in Urban Regeneration and Development at the University of Manchester in the UK. Her main research directions are urban planning and spatial analysis.

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