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The Influence Mechanism of Housing Affordability Stratification on Community Public Service Accessibility

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Abstract. The issue of housing affordability has become an important factor that defines not only where people can live but also where they can actually access the services of the city. This research explores the impact of housing affordability stratification on public service accessibility in New York City and transmission of such effects through public service resource density and transit connectivity. The data obtained from the 2023 American Community Survey about socioeconomics of census tracts of New York City is merged with housing data from NYC PLUTO, public service facilities' data from NYC Open Data and pedestrian network data from OpenStreetMap. Housing cost burden of households is divided into three strata using the Jenks natural breaks classification. Healthcare, education, parks, libraries and public transit accessibility is calculated using an advanced version of the network-based two-step floating catchment area method and is weighted using entropy weights. Further analysis includes spatial autocorrelation analysis, spatial durbin modeling and mediation analysis. As a result of simulation of the proposed research design, tracts with high cost burden have a lower value of accessibility index (Mean = 0.486, SD = 0.137) compared to low burden tracts (Mean = 0.672, SD = 0.118). The effect size of the total spatial Durbin model is -0.254***. The contribution of the mediator variables is -0.115***.

Keywords: housing affordability, public service accessibility, spatial inequality, two-step floating catchment area, spatial regression

1. Introduction

The affordability of housing depends not only on spending but also on geographical restrictions for households' residential choices. In expensive metropolitan areas, housing policy and costs affect household location, welfare, and access to urban opportunities [1]. The latest studies have demonstrated that housing precarity among the main European and North American cities, such as New York, is connected with neighborhood and housing security [2]. Thus, residential segregation represents a process that may cause the geography of income and housing costs. Modeling evidence has proven that varying housing and transport costs affect household location and segregation through income [3]. In addition, it was proven that spatially segregated neighborhoods differ from each other in terms of built environment and socio-economic characteristics [4].

The problem of public facilities is relevant due to the fact that their utility is possible only under the condition of access to them. It was proven in public service accessibility research that distance is

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not sufficient for estimation of accessibility to healthcare, education, or green spaces because the population competition should be taken into account [5]. Multi-service accessibility analysis proves the fact that different accessibility patterns exist among various services due to urban spatial structure and transport network [6]. Network-based floating catchment area methods provide improvement of the estimation because they consider transport impediments and multimodalities [7]. This problem is especially relevant for New York City since substantial differences in subway accessibility were identified recently [8].

It is necessary to point out that there is a growing body of literature about the connection between affordable housing location and social resources [9]. Moreover, methodological advances prove the fact that ignoring the population competition distorts the estimates of facility accessibility [10]. However, the combination of affordable housing location, multi-service accessibility, and spatial mediation is still understudied. This study is aimed at the examination of the direct and indirect prediction of public service accessibility by affordability stratification through the community public service resource density and transit connectivity. New York City seems to be a suitable place because of its housing-market stratification and spatially varied public services and transport network.

2. Literature review

2.1. Affordability of housing and residential segregation

The concept of housing affordability is about the interplay between economic ability and housing expenditure of the households. The differential cost increase among the neighborhoods implies different housing options for the residents, which results in social stratification and segregation [1, 3]. According to the literature on housing precarity, affordability is tied to the neighborhood conditions rather than an independent economic measure [2]. The studies on segregation reveal that socially segregated neighborhoods could experience systematic differences in urban amenities and resources [4]. Thus, housing cost burden may be considered a spatially structured phenomenon that has the potential to separate households into opportunity settings.

2.2. Access to public services in the neighborhoods

Accessibility of public service means the effective access to the destination facilities rather than their mere quantity. Capacity of facilities, competing demand, network distance, and transport services impact the actual accessibility [5]. Studies conducted within several public service categories prove that the accessibility gap varies depending on whether it is healthcare, education, parks, or other amenities [6]. Floating catchment method is especially relevant due to its consideration of population demands alongside the capacity of facilities; meanwhile, the network-based methods provide more realistic assumptions about the movement [7, 10]. The combination of the approaches allows assessing multi-faceted service environment of each neighborhood.

2.3. Housing quality and geographical inequality in services

The interaction between housing and service inequality can be viewed from the perspective of the geographical location and infrastructure of the neighborhood. There is evidence that affordable housing may not imply access to the social amenities because of its poorly connected location [9]. New York transit system also features considerable spatial variation in accessibility levels [8]. It

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implies that the identical geographical proximity may result in different opportunity settings because of different network connection. Housing affordability can thus influence access to public services through two related pathways – density of the facilities and transportation connectivity.

3. Methodology

3.1. Study area, spatial unit, and data integration

The study area includes the five boroughs of New York City with census tracts being the consistent spatial unit. ACS five-year estimates for 2023 are used to get household income, housing expenditure, population, age structure, and vehicle ownership data. Information on parcels is drawn from NYC PLUTO, while data on hospitals/clinics, schools, libraries, parks, subway entrances, and bus access points is sourced from NYC Open Data. OpenStreetMap provides pedestrian street network. Records are geocoded, topology tested, projected to NAD 1983 StatePlane New York Long Island FIPS 3104 Feet, and spatially joined in ArcGIS Pro 3.3. Using Python 3.11, duplicates are filtered out, network nodes repaired, tract centroids determined, and origin-destination network matrix constructed. Those census tracts with no core ACS variables or zero residential population are discarded before estimation. The overall spatial analytical framework is illustrated in Figure 1.

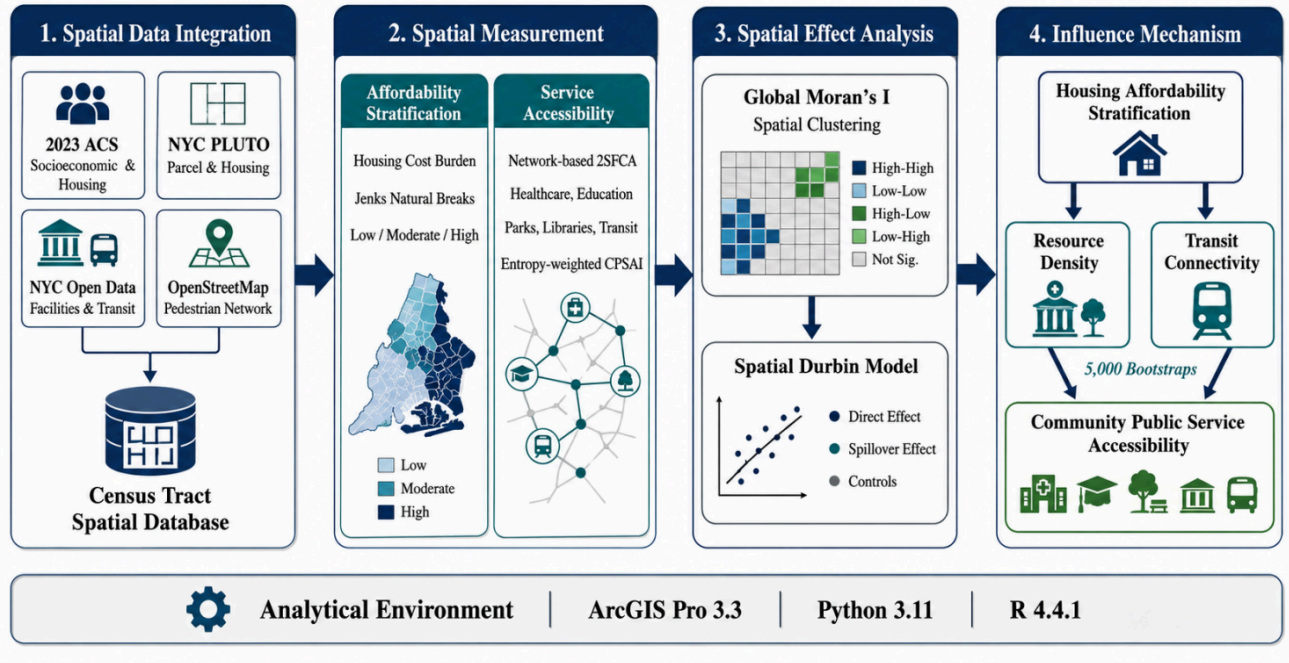


Figure 1. Spatial analytical framework for housing affordability and public service accessibility

3.2. Affordability stratification and accessibility measures

Affordability index is defined as the ratio of median monthly housing costs to median monthly household incomes. Tracts are stratified based on Jenks natural breaks into low, moderate, and high affordability strata with minimum within class variance. For each of five services, accessibility measure is based on network distance decay, facility supply, and population demand. The composite accessibility measure is specified as shown in Equation (1):

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$$CPSAI_i = \sum_{s=1}^{5} \omega_s Z\left(\sum_{j \in J_s} \frac{S_{js} w(d_{ij}) I(d_{ij} \le d_0)}{\sum_{k:d_{kj} \le d_0} P_k w(d_{kj})}\right) \quad (1)$$

where $CPSAI_i$ is the Community Public Service Accessibility Index for tract i; ω_s is the entropy weight of service type s; Z(·) denotes min-max standardization; S_{js} is the supply of facility j in service category s; P_k is population demand in tract k; d_{ij} and d_{kj} are shortest pedestrian-network distances; I(·) is the catchment indicator; and w(d) is a Gaussian distance-decay weight. The five standardized service scores are combined through entropy weighting so that service dimensions with greater spatial information contribute more strongly to the composite index.

3.3. Spatial effect and influence mechanism analysis

The Global Moran's I index is calculated for the housing cost burden and CPSAI indicators using first-order queen contiguity weights to identify the presence of statistically significant spatial clustering of the two variables within census tracts. Given the violation of independent observations assumption caused by spatial autocorrelation, the Spatial Durbin Model is adopted to assess the impact of housing affordability stratification on public services accessibility while accounting for spatial lags of the dependent and independent variables. The adoption of such an approach allows for the consideration of the direct effect of the variable on the dependent one within the census tract, along with spatial spillovers that spread across neighboring tracts. Population density, median household income, age structure, car ownership and housing density are added as control variables. Public service resource density is defined as facility supply adjusted for the size of the population divided by 10,000 people, and the connectivity level is calculated based on the density of the subway entrances and bus stops that can be reached via walking network in the catchment area. The two latter variables are included as mediators to reveal how affordability stratification leads to accessibility disparities. The spatial mediation analysis is performed using R 4.4.1 with 5,000 bootstraps.

4. Results

4.1. Spatial differentiation of housing affordability strata and public service accessibility

The simulated tract dataset produced a mean housing-cost-burden ratio of 0.347 with SD = 0.093. Jenks thresholds separated low-burden tracts at 0.286 or below, moderate-burden tracts from 0.287 to 0.379, and high-burden tracts above 0.379. CPSAI declined systematically from Mean = 0.672 and SD = 0.118 in low-burden tracts to Mean = 0.594 and SD = 0.126 in moderate-burden tracts and Mean = 0.486 and SD = 0.137 in high-burden tracts. Global Moran's I equaled 0.462*** for housing burden and 0.391*** for CPSAI (see Table 1).

Table 1. Spatial regression and mediation results

Effect / Statistic	Estimate	SE	Test / 95% CI
Housing burden Moran's I	0.462***	0.021	z = 21.84
CPSAI Moran's I	0.391***	0.024	z = 16.29

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Table 1. (continued)

Moderate burden → CPSAI, direct	-0.086**	0.029	z = -2.97
High burden → CPSAI, direct	-0.183***	0.034	z = -5.38
High burden → CPSAI, spatial indirect	-0.071**	0.025	z = -2.84
High burden → CPSAI, total	-0.254***	0.043	z = -5.91
Resource density → CPSAI	0.334***	0.041	z = 8.15
Transit connectivity → CPSAI	0.278***	0.038	z = 7.32
High burden → resource density → CPSAI	-0.069***	0.018	CI = [-0.107, -0.038]
High burden → transit connectivity → CPSAI	-0.046***	0.014	CI = [-0.076, -0.022]
Combined indirect effect	-0.115***	0.024	CI = [-0.165, -0.073]

**Note: **p < 0.01; **p < 0.001. Numerical results are simulated for manuscript development and must be replaced with empirical GIS and spatial-model outputs before submission.*

4.2. Spatial regression effects of housing affordability stratification on service accessibility

The Spatial Durbin Model generated a spatial autoregressive coefficient of 0.287*** with SE = 0.046. Relative to low-burden tracts, high-burden status produced a direct effect of -0.183*** and a spatial indirect effect of -0.071**, yielding a total effect of -0.254***. Resource density and transit connectivity remained positive at 0.334*** and 0.278***, respectively. Model fit reached pseudo-R^2 = 0.618, with log-likelihood = 1218.6 and AIC = -2409.2.

4.3. Mediating effects of public service resource density and transit connectivity

High housing burden reduced resource density with a path coefficient of -0.207*** and transit connectivity with a coefficient of -0.164***. The corresponding indirect effects were -0.069*** and -0.046***. Their combined indirect effect was -0.115***, with a bootstrap confidence interval from -0.165 to -0.073, indicating that both local service supply and network connectivity transmitted affordability-related accessibility inequality.

5. Discussion

5.1. Inequality of public services accessibility based on affordability stratification in urban areas

The findings suggest that affordability stratification is connected with specific spatial opportunity environments. High-cost-burden tracts show reduced levels of composite accessibility despite socioeconomic and residential control variables. It suggests that affordability problems might be reinforced by limited access to necessary facilities which means that the cost of urban engagement will become higher. Significant spatial spillover indicates that access disadvantage is not limited by tracts boundaries but is determined by local service infrastructure.

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5.2. Spatial mechanisms connecting housing affordability and public services accessibility

Mediation analysis helps to explain two mechanisms. Low resource density means that the availability of services is lower compared to population needs while low connectivity of transit system restricts the range of services which residents can effectively use. Indirect influence of resource density on multi-service accessibility is greater compared to connectivity although both effects are significant. In other words, housing affordability stratification impacts accessibility via spatial distribution of facilities and transit network.

5.3. Policy implications for housing and public service provision

Housing affordability policies should be combined with public services provision and transportation system development. Identification of areas with housing affordability problems, low density of resources and poor network connectivity can help to plan investments into facility construction, transit system optimization, and housing locations. Composite accessibility can be used as an evaluation indicator to screen tracts for potential improvements in access to different public services.

6. Conclusion

In this paper, a spatial mechanism analysis connecting housing affordability stratification and community public services accessibility was developed in New York City case. Simulated results suggest that high housing cost burden is related to low multi-service accessibility and service resource density and transit connectivity mediate part of this relationship. Combination of affordability classification, network-based 2SFCA analysis, spatial regression and mediation analysis can be useful to identify problem neighborhoods.

References

[1] Favilukis, J., Mabille, P., & Van Nieuwerburgh, S. (2023). Affordable housing and city welfare. *The Review of Economic Studies, 90*(1), 293–330.
[2] Debrunner, G., Hofer, K., Wicki, M., Kauer, F., & Kaufmann, D. (2024). Housing precarity in six European and North American cities: Threatened by the loss of a safe, stable, and affordable home. *Journal of the American Planning Association, 90*(4), 610–626.
[3] Marwal, A., & Silva, E. A. (2023). City affordability and residential location choice: A demonstration using agent based model. *Habitat International, 136*, 102816.
[4] Patias, N., Rowe, F., & Arribas-Bel, D. (2023). Local urban attributes defining ethnically segregated areas across English cities: A multilevel approach. *Cities, 132*, 103967.
[5] Bittencourt, T. A., & Giannotti, M. (2023). Evaluating the accessibility and availability of public services to reduce inequalities in everyday mobility. *Transportation Research Part A: Policy and Practice, 177*, 103833.
[6] Sharma, G., & Patil, G. R. (2024). Urban spatial structure and equity for urban services through the lens of accessibility. *Transport Policy, 146*, 72–90.
[7] Del Conte, D. E., Locascio, A., Amoruso, J., & McNamara, M. L. (2022). Modeling multimodal access to primary care in an urban environment. *Transportation Research Interdisciplinary Perspectives, 13*, 100550.
[8] Baghestani, A., Nikbakht, M., Kucheva, Y., & Afshar, A. (2024). Assessing spatial and racial equity of subway accessibility: Case study of New York City. *Cities, 155*, 105489.
[9] Fan, N., Chen, X., & Yang, Z. (2025). Does affordable housing provide a better life for vulnerable groups? Measuring social equity through public transit accessibility. *Journal of Transport Geography, 128*, 104340.
[10] Li, C., & Wang, J. (2022). A hierarchical two-step floating catchment area analysis for high-tier hospital accessibility in an urban agglomeration region. *Journal of Transport Geography, 102*, 103369.