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A Critical Analysis of the Standard Urban Model in the Context of Greater Manchester

Shu Wang[1,a,*]

[1]*University College London, The Bartlett Faculty of the Built Environment, London, United Kingdom*
a. shu.wang.23@ucl.ac.uk
**corresponding author*

Abstract: This study critically examines the applicability of the Standard Urban Model (SUM) in the context of Greater Manchester, utilizing empirical data and spatial analysis to explore its operational limitations and potentials. Originally conceptualized by William Alonso, the SUM provides a theoretical framework to understand intra-urban economic dynamics predicated on a monocentric city structure. Through a comprehensive dataset encompassing census demographics, housing prices, and GIS-mapped land-use patterns from 2015, this paper investigates the model's ability to predict and describe urban land rent gradients and residential distribution relative to the city's Central Business District (CBD). The findings indicate that while the SUM may provide a generalized view of urban structure, it significantly underestimates the socio-economic diversities, technological advancements, and cultural influences that are inherent in urban development. Particularly, the analysis reveals that rental price declines with distance from the CBD are not as pronounced as predicted by the SUM, with a low coefficient of determination (R^2=0.2551). Furthermore, the study highlights how urban development in Manchester deviates from the monocentric model due to historical shifts, regeneration efforts, and the emergence of multi-centric hubs. This research underscores the necessity for adapting urban economic models to reflect the complexities and dynamic nature of modern cities, suggesting a shift towards more nuanced and flexible frameworks that accommodate the multifaceted influences on urban landscapes.

Keywords: Standard Urban Model, Great Manchester, urban economics, spatial analysis, critical analysis

1. Introduction

The Standard Urban Model (SUM), formulated by William Alonso in 1964, provides a theoretical framework for analyzing the spatial distribution of economic activities within cities [1]. The model, built on the concept of a monocentric city, posits that urban entities, including households and businesses, make location decisions based primarily on the trade-offs between land costs and the benefits of proximity to a city's Central Business District (CBD). According to Alonso, this trade-off results in distinct land use patterns and rent gradients, which decrease as distance from the CBD increases [1].

Despite its widespread acceptance and application, the SUM's suitability in contemporary urban settings, particularly in cities experiencing rapid socio-economic changes and technological

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advancements, has been a subject of debate among urban researchers. Greater Manchester, with its industrial legacy and transformations into a multifaceted metropolitan area, presents a unique case to explore the efficacy and limitations of the SUM. This region has undergone significant economic shifts, from a manufacturing powerhouse in the early 20th century to a diversified economy, which challenges the monocentric assumptions of the SUM [2].

This paper aims to undertake a detailed empirical examination of the SUM within the urban dynamics of Greater Manchester. It seeks to assess whether the traditional interpretations of the model adequately capture the complexity of modern urban forms or if they fall short in the face of evolving urban landscapes marked by multi-centric developments, cultural heterogeneity, and the digital economy. By leveraging comprehensive datasets including census demographics, Geographical Information Systems (GIS)-mapped land-use patterns, housing price statistics, and transportation statistics, this study not only critiques the standard model’s predictive power but also explores its adaptability to the changing contours of city life.

Through this analysis, the research will contribute to a nuanced understanding of the interplay between urban economic theories and the real-world phenomena of city development, with a focus on the integration of empirical data and theoretical insights to better inform urban planning and policy decisions. By contextualizing the SUM in Greater Manchester, this paper endeavors to bridge the gap between classical urban economic models and contemporary urban realities, potentially guiding the evolution of new theoretical frameworks that more accurately reflect the dynamics of modern cities.

2. Data and Methodology

This research integrates quantitative data from various sources to evaluate the SUM’s relevance to Greater Manchester’s urban dynamics. The primary data sources include the 2015 Census, as shown in Table 1, which provides a snapshot of the demographic makeup of Manchester, and GIS data that maps out land usage patterns [3]. Table 2 demonstrates the housing market data from 2014-2015, along with transportation statistics, offer insights into commuting behaviors and residential pricing relative to the city’s CBD [4, 5]. By incorporating the datasets, the research assesses SUM’s ability to accurately forecast urban land utilization and economic distributions within an evolving urban center. Figure 1 shows the procedures of data analysis.

Table 1: The 2015 Manchester’s demographic profile

all_residences		area_ha		density	
Mean	7738.53795	Mean	349.771947	Mean	35.5092409
Standard Error	94.2355875	Standard Error	22.6868672	Standard Error	1.16924239
Median	7616	Median	228.62	Median	33.9
Mode	6003	Mode	354.53	Mode	44.8
Standard Deviation	1640.349	Standard Deviation	394.907919	Standard Deviation	20.3528798
Sample Variance	2690744.83	Sample Variance	155952.264	Sample Variance	414.239716
Minimum	5063	Minimum	63.27	Minimum	1.6
Maximum	13909	Maximum	3426.9	Maximum	125.8
Sum	2344777	Sum	105980.9	Sum	10759.3
Total observations	303				
Wards	Bury, Bolton, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford				

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Table 2: The 2014 Q2 to 2015 Q3 Machester's housing ststistics summary

Categorie s	medianprice_2 014q2	medianprice_2 014q3	medianprice_2 014q4	medianprice_2 015q1	medianprice_2 015q2
Sum	41142053	41760877	42475546	4320800	43548612
Average	134451.1536	136473.4542	138808.9739	141202.6144	142315.7255
Max	422500	449500	449500	460000	436250
Min	54950	59950	61000	57000	54000
Wards	Bury, Bolton, Manchester, Oldham, Rochdale, Salford, Stockport, Tameside, Trafford				
MSOA_C ount	306				

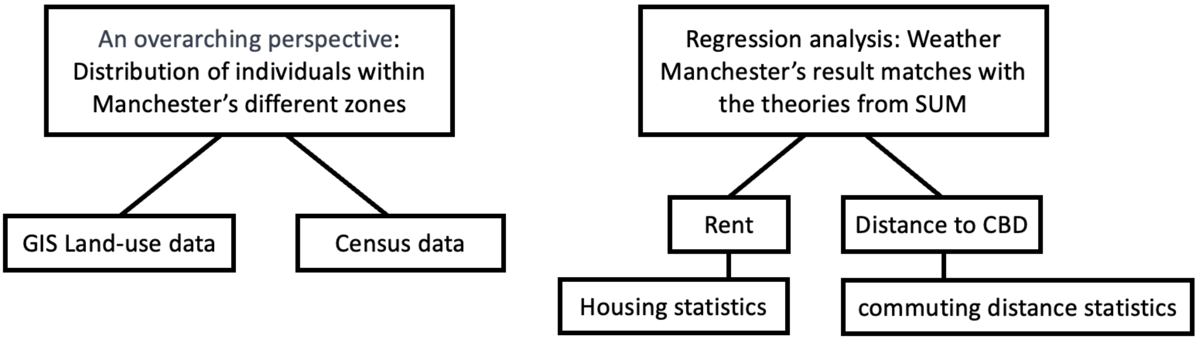

Figure 1: Procedures of data analysis

2.1. Demographic Data and GIS Land Coverage

The study utilizes census and land-use data for Manchester to visualize the population distributions across the city's 10 metropolitan areas. With a specific focus on Manchester's commercial, industrial and residential zones, the study may conduct a comparative analysis by overlaying the SUM's thoretiocal prediction patterns onto the visual representation of Manchester's zoning in reality. Therefore, the result would enable to examine of the model's accuracy in capturing the spatial dynamics of population distribution, and identifies potential discrepancies where the model may not accurately reflect urban realities. The comparative analysis results, illustrated in Figure 2, reveal a substantial discrepancy between the hypothesized outcomes and actual rent prices. This disparity is particularly pronounced in South Manchester, where the rent prices exceed those in the majority of Manchester's CBD.

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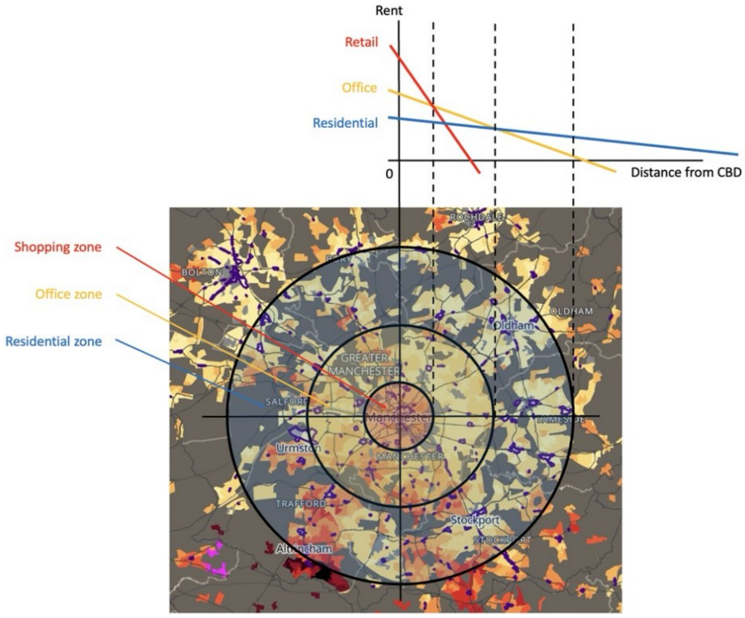

Figure 2: Comparative analysis of housing price trends in Manchester

2.2. Housing Statistics and Commuting Patterns

In addition, the SUM posits that rents decrease exponentially with distance from a city's CBD, formulated mathematically as the power-law equation of $y = kx^{-\beta}$, which y indicates the rental prices of properties and x indicates the commuting distance.

To empirically test this hypothesis within the context of Manchester, the study uses local housing and commuting pattern statistics. Specifically, after randomly selecting a sample of residential locations from each of Manchester's Middle Super Output Areas (MSOAs), statistics on housing prices and commute distances to Manchester's CBD could be plotted on a regression model, which enables the study to assess how well the data fits the predicted power-law relationship, as illustrated in Figure 3. The strength of this fit will be measured by the coefficient of determination (R^2). If the data are closely fitted to the hypothesized power-law equation, it would provide evidence to support the SUM's effectiveness in describing the relationship between rent and distance in Manchester.

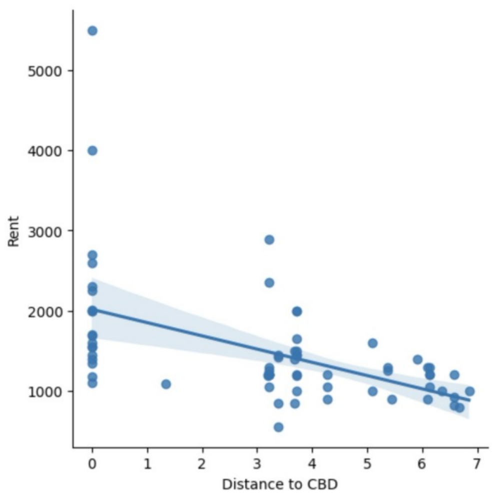

Figure 3: Property prices relative to proximity to Manchester's CBD based on 2015 Q2 data

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3. Consensus, Limitations and Advancements

While recognizing the SUM's theoretical value in explaining basic urban structures, the findings underscore its limited applicability to capture the complexities of contemporary real-world urban settings. Both the results from the comparative analysis and the regression deviate significantly from the predictions of the SUM, which is evidenced by the low R^2 value (0.2551) that indicates a weak correlation between the observed rental prices and the model's prediction of exponential decrease in rent with increasing traveling distance from the CBD. The study goes further to explore the reasons for these inconsistencies between the model and real-world observations.

3.1. Ignorance of Cultural and Social Factors

A study by Liotta et al. examined data from 192 cities to explore whether the SUM aligns with the observed distribution of the internal structure across cities [6]. Their findings suggest that the SUM predicts a consistent, homogenous pattern in how a city's population is distributed, however, they demonstrate that there may be variations among cities and even within individual neighborhoods [6]. As Betty discusses, reasons that contribute to such variation for cities may be shaped by the preferences of residents as well as historical and cultural influences [7]. For example, for Wythenshawe, a neighborhood in South Manchester, where the construction of local motorways significantly impacted the geographical distribution of the population. The majority (65%) of the residential population is located on the eastern side, further away from the CBD, while a smaller proportion (35%) of residents is on the western side, closer to the CBD [2].

Besides, Barabantseva emphasizes The article also highlights the concept of "ethnic enclaves," illustrated by Manchester's Chinatown [8]. She suggests that these enclaves establish a link between physical space and individuals based on their shared cultural heritage and identity, which has led to the high-density clustering of Chinese ethnic population within Manchester's Chinatown [8].

Collectively, these insights from the Manchester suggest that the SUM would not completely account for the socio-cultural dynamics that influence how people distribute themselves within a city.

3.2. Fixed Time Scale

A second significant limitation of the SUM lies in its static nature, which does not reflect the evolving timelines and dynamic transformations inherent in urban development. Manchester serves as a quintessential example of this dynamic evolution. Initially emerging as a key industrial city in 19th-century Europe, catalyzed by political factors and the First Industrial Revolution, Manchester quickly established itself as a central hub for textile production in the UK [9]. The city's strategy for enhancing local industrial efficiency led to the early concentration of the light cotton industry [9]. This industrial focus resulted in a geographic and socio-economic stratification within the urban space, where the working class predominantly settled near the city center, and the upper-middle class established residences in more distant, suburban zones [10].

However, the urban landscape of Manchester has shifted dramatically from its original industrial base due to the inner-city regeneration initiative in 1984. As the former industrial areas were being revitalized, the city saw a substantial decrease in its reliance on manufacturing, with the sector's contribution to the city's overall economic output plummeting from 70% in the mid-20th century to a mere 10% by 2008 [11]. This transformation was marked by the introduction of office-centric industries into the heart of Manchester, which significantly altered both the city's economic focus and its spatial organization [12]. Such historical progression underscores the inadequacy of SUM, highlighting its failure to capture the temporal shifts in economic roles and spatial arrangements of urban evolutions.

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3.3. Assumption Simplification and Ignorance of Spatial Disparities

Thirdly, the SUM would be constrained by its underlying premises that envisage a free market without trade restrictions, marked by uniform productivity, business uniformity, and a singular urban center. According to Alonso, this framework presupposes that all economic actors are primarily motivated by profit maximization, a supposition that contradicts with the distinctive industrial configuration of Manchester [1]. However, the city's landscape, segmented by industrial plants running east to west and interspersed by specialized economic zones such as NOMA, Salford Quays, and MediaCityUK, challenges the model's simplistic assumptions [13]. These zones enhance disparate productivity levels throughout Manchester, fostering a polycentric urban structure. This complex spatial distribution of economic activities better corresponds with the Multiple Nuclei Model, which recognizes the existence of several growth centers within a city, offering a more nuanced depiction of urban dynamics than the simplistic SUM [14].

3.4. Ignorance of Urban Environment Diversities

Also, in contrast to the Hoyt Model, the SUM simplistically views urban landscapes as uniform, without considering the impact of diverse geographic features or the non-linear movement patterns of commuters. This model may fail to acknowledge the influence of transportation networks, grid layouts, and natural barriers, which are critical in shaping urban dynamics, and underestimates the complexity inherent in urban settings. While Alonso suggests that focusing on such specifics may detract from grasping the core concepts of urban economics, Richardson and colleagues argue for a holistic view that incorporates various urban elements, (e.g. rivers, streets, and architectural features) into economic modeling [1, 15]. For instance, Manchester's unique features, such as its lowland areas and parks, introduce physical and social obstacles that disrupt the linear commuting patterns. According to Jacobs, to truly understand an urban area's economic and social performances, it is essential to integrate these diverse elements into the analysis, considering how major transportation routes and local infrastructures contribute to the city's overall structure [16]. This comprehensive approach is vital for accurately representing and responding to the complexities of urban life.

3.5. Technology Enhancement

Lastly, the SUM exhibits limitations in its ability to address the swift influences of technological and knowledge advancements on urban development. As highlighted by Colding and Barthel [17], SUM struggles to adequately capture the dynamic changes induced by the integration of smart city initiatives and advanced technologies. In Manchester, for example, the implementation of such strategies has demonstrably reshaped social housing patterns, establishing new paradigms. A prime illustration of this is Angel Square 1, a skyscraper built in the 2010s, which exemplifies the adoption of sustainable construction practices. These practices not only reduced embodied energy but also minimized the detrimental environmental impacts [18]. Notably, this sustainable approach has enhanced the value of nearby properties, adding approximately £37 million in external benefits, despite its distance from the CBD [18]. However, the existing SUM framework fails to sufficiently account for these marginal benefits arising from technological advancements, which suggests the inadequacy of the SUM to incorporate these rapidly evolving urban dynamics.

4. Conclusion

In conclusion, this critical evaluation of the SUM applied to the urban landscape of Manchester reveals discrepancies between the model's theoretical foundations and the empirical realities of contemporary urban dynamics. It demonstrates that while SUM offers a foundational framework for

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understanding urban economic interactions based on proximity to central business districts, it struggles to capture the intricate interplay of socio-economic factors, cultural dynamics, and technological advancements that shape modern urban environments. These findings highlight the imperative for evolving urban economic models towards a more comprehensive and adaptable framework that can encompass the complexities and inherent dynamism of cities like Manchester.

This necessitates the integration of empirical data alongside acknowledging the existence of multiple urban centers, the impact of technological progress, and the multifaceted nature of cultural diversity. By aligning theoretical approaches with observed realities of urban development, urban planners and policymakers can be better equipped to navigate the challenges and opportunities presented by 21st-century urbanization. A paradigm shift towards models that not only capture traditional economic principles but also demonstrate responsiveness to evolving urban landscapes could be advocated to ensure a continued relevance and effectiveness in guiding urban development and policy formulation.

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