Understanding Residential Development in a High-Quality Transit Area (HQTA): An Application of Deep Learning

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Introduction

Transportation and land use are closely connected—how we build roads, rail lines, and transit systems affects where people live, work, and play, and vice versa. In recent years, considering public transit as a sustainable mobility option, housing development around public transit has become an attractive policy option to limit excessive urban expansion and utilize existing transportation infrastructures. While many studies have explored the relationship between land use and transportation, including the impacts of transit systems on residential development and vice versa, they often overlook how different types of properties—such as vacant lots versus already occupied sites—develop in response to transit access. This gap in research is partly due to the lack of comprehensive data that systematically archives development records based on property types. The purpose of this research project is to fill this research gap by employing a deep learning algorithm and separately examining the contributing factors to vacant lot and occupied property development near transit.

Study Methods

Taking the high-quality transit areas (HQTAs) in Los Angeles County as the study area, this research employed the latest deep learning model, called a foundation model, to detect and classify residential development on vacant and occupied properties. The model identifies the development by comparing longitudinal satellite images retrieved from the Google Earth Engine Application Programming Interface (GEE-API). The foundation model analyzes 186,519 parcels in the study areas. It classifies them into four types with an accuracy of 94.3 percent: occupied unchanged (169,146 parcels), vacant unchanged (10,130 parcels), occupied developed (5,112 parcels), and vacant developed (2,131 parcels). The classification becomes the dependent variable of two multi-level logistic regression (MLR) models: vacant and occupied. The models estimate the likelihood of parcels experiencing resident development based on the contributing factors in a hierarchical structure at the property and neighborhood levels.

Employing cutting-edge AI techniques and considering the heterogeneity of property types, this research identifies the unique contributing factors to vacant and occupied property development.

Findings

The findings confirm that the contributing factors of development are not the same for vacant and occupied parcels. While the property-level factors are more significant than neighborhood-level factors for both vacant and occupied lot development, the findings identify variations in the significance of the factors at the property level. Occupied parcel development presents consistent patterns identified in previous research. For example, occupied lots with lower values and building value ratios are more likely to be developed. This implies that the properties that require lower land assembly costs (e.g., acquisition, relocation, demolition, clearance, and site preparation) are more attractive for residential development. Similarly, occupied lots in core cities are more likely to occur. This suggests the core cities' policy attention to infill development. However, vacant parcel development presents a contrast to previous research. The findings indicate that vacant lots with smaller sizes and higher values are more likely to be developed. This probably shows the lack of vacant lots in desirable areas.

Another interesting contrast between vacant and occupied lot development is that the occupied lot development is more likely to be associated with urban functions/amenities. In contrast, vacant lot development tends to occur in areas with a balance between urban amenities and residential contexts. Consistent contributing factors to vacant and occupied lot development are walkability and inner suburbs. Both vacant and occupied lots in the neighborhoods with a high-quality pedestrian environment are more likely to be developed. However, the inner suburban cities tend to experience residential development on vacant and occupied properties much less than the other areas.

Policy Recommendations

This research provides insight into adjusting local and regional housing development policies and developing new policies customized for the unique characteristics of potential developable properties. This research especially emphasizes the heterogeneity of the contributing factors to the development of vacant and occupied parcels. These findings provide a good starting point for local governments in developing customized sustainable development policies. Municipal governments may need to pay policy attention to making the vacant lots at less desirable locations more attractive, while reducing overall regulations for promoting occupied lot development. Regional collaboration between the core and suburban cities, particularly inner suburban cities, needs to be considered in terms of sharing and transferring the core cities' experiences with infill development. It is important to incorporate developers into the collaboration and policy development since the likelihood of vacant and occupied lot developments reflects developers' motivation for profitability. This research also found the nuance of people's residential location preferences, from balancing between tranquility and urban amenities to a preference for urban amenities. Thus, updating land use and zoning regulations would be considered to promote balance.

About the Author

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