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Research Article

Land Value Capture Potential of Jakarta's LRT: Early Post-Operational Evidence from Residential Property Prices in TOD Zones

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Abstract: Jakarta's recent light rail transit (LRT) development has been promoted as part of a broader transit-oriented development (TOD) agenda. However, empirical evidence on whether early-stage operations influence surrounding land values is limited. This study examines residential land prices within 1 km of the Dukuh Atas–Cawang LRT corridor to assess the roles of structural property attributes and proximity to urban amenities. A dataset of 97 residential properties was analyzed using a hedonic price model (HPM) to identify significant predictors and a Multiscale Geographically Weighted Regression (MGWR) to capture spatial variation in their effects. The results show that building area, proximity to high schools, and proximity to the central business district (CBD) are positively associated with land prices, while distance to LRT stations has no significant effect. These findings indicate that accessibility to key amenities currently outweighs transit access in shaping land values. The study contributes to TOD and Land Value Capture (LVC) research in Southeast Asia by providing post-operational evidence from an emerging megacity context and suggests that coordinated urban design, land use integration, and station area improvements are required for LRT investments to generate measurable value uplift.

Keywords: Hedonic price model; Land value capture; Residential property; LRTJabodebek; Transit-Oriented development

1. Introduction

Mass public transportation investments, such as LRT in urban areas, are often expected to provide economic benefits in the form of increased land values around station corridors. Transit-oriented development (TOD) emphasizes the integration of transportation and land use by building compact, mixed-use, and pedestrianized transit-oriented areas (Karina et al., 2025; Gunawan et al., 2020). The Land Value Capture (LVC) framework extends this idea by asserting that increases in land value caused by public investments should be recaptured through instruments such as taxes, betterment levies, or developer contributions (Berawi et al., 2021; Li and Huang, 2020). Both concepts are increasingly being applied in metropolitan regions to link transit investment with sustainable urban growth.

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Evidence from São Paulo shows that LVC mechanisms can generate significant revenue when well-designed and supported by local policy (Alberto and Nobre, 2023). However, despite a strong theoretical basis, Land Value Uplift (LVU) outcomes vary considerably across time and location. Research shows that intermodal connectivity, service quality, and neighborhood context influence the magnitude of price premiums near transit corridors, and in many cases, significant LVU emerges only after several years of operation (Vergel-Tovar et al., 2025; Muhammad et al., 2024). These mixed results leave an important question for early-stage systems in developing megacities: Do proximity to new LRT stations already produce measurable changes in residential land value, or does the market response require more time and supporting interventions?

Jakarta, Indonesia, offers a distinct case for examining this issue. As a megacity with recent investments in LRT infrastructure, its first line began operation in 2019, followed by the Jabodebek line in 2023, connecting central and peripheral areas along the Dukuh Atas–Cawang corridor. The city government has promoted policies aligned with international TOD principles to integrate transport and land use (Hasibuan and Mulyani, 2022), with the expectation that these efforts will create value that can be captured through LVC tools. However, ridership remains low (Pramudita and Nataadmadja, 2023), and no empirical evidence has yet determined whether early-stage operations have influenced residential land prices near the LRT stations in Jakarta.

This study is the first to provide post-operational evidence from Jakarta's LRT corridor using a combined hedonic price model (HPM) and multiscale geographically weighted regression (MGWR) approach. HPM estimates how individual property attributes contribute to overall price through regression analysis of structural and locational factors, while MGWR builds on this framework by accounting for spatial variation and assigns each variable a specific scale of influence to show how its effect differs across locations. This study assesses whether accessibility to LRT stations and urban amenities affects residential land prices within TOD zones and whether these effects vary spatially across neighborhoods. The results clarify the current stage of value creation in Jakarta's LRT system and identify the conditions under which LVC strategies could be most effective, contributing to both academic literature and policy discussions.

2. Literature Study

Several empirical studies have investigated how transit station proximity affects land and property values. These studies primarily rely on the HPM to quantify the effect of spatial accessibility, particularly the distance to transit, while controlling for structural and neighborhood characteristics. This section focuses on prior empirical results and methodological approaches that inform this study's choice of variables. Table 1 summarizes the selected studies from global cities with varied transit systems and development stages.

Studies generally support the argument that transit access influences property values, although the size and direction of the effect vary, with varied transit systems and development stages. In cities like Mumbai, Beijing, Wuhan, and Kuala Lumpur, property values tend to rise with proximity to rail stations (Muhammad et al., 2024; Sharma and Newman, 2018; Dai et al., 2016). In polycentric Beijing, Zhou et al., 2022 found that accessibility to metro and bus networks significantly increased housing prices, with metro stations having a stronger influence and spatial variation across subcenters.

In contrast, Pilgram and West, 2018 reported diminishing or non-significant premiums in Minneapolis after the light rail system matured, further showing that market adaptation may reduce initial transit-induced gains. Similarly, Yin et al., 2025 showed that accessibility improvements in the 15-minute city context do not always translate into higher land prices, as transit access integrates with mixed-use amenities and pedestrian networks. In Chengdu and Adelaide, weaker or absent effects further imply that local market dynamics, service levels, or neighborhood integration can reduce the price premium (Kashkooli et al., 2025; Yang et al., 2020).

The importance of context is a recurring theme. Evidence indicates that the effect of transit accessibility depends on complementary factors such as land use mix, amenity access, and pedestrian connectivity. Without these supporting elements, station proximity alone may not drive value changes. Methodologically, most studies apply global regression models, such as the OLS-based HPM, which assume spatial stationarity. However, the relationship between accessibility and land value may vary across neighborhoods. This motivates the use of spatially explicit models, such as MGWR, to capture local coefficient variations.

In terms of geography, the Southeast Asian context remains underrepresented. Prior research has largely focused on mature rail systems, which leaves early-stage implementations in developing megacities unexplored. Jakarta has been absent from most global TOD and LVC studies, despite its recent LRT expansion.

Table 1 Research on the Relationship between TOD and Land Value

No	Author (Year)	City, Country	Findings
1.	Sharma and Newman, 2018	Mumbai, India	Land values increase significantly within a short radius of the station.
2.	Dai et al., 2016	Beijing, China	Every 100 m reduction in distance to stations increased unit prices by 96.5 yuan/m^2 around interchange stations, and 27.4 yuan/m^2at the network average
3.	Muhammad et al., 2024	Kuala Lumpur, Malaysia	House prices increased by about 5.6% for every 100 meters closer to an LRT station
4.	Zhou et al., 2022	Beijing, China	Metro and bus accessibility positively affect housing prices in a polycentric city; metro accessibility has a stronger and spatially variable impact across subcenters.
5.	M. Zhang and Xu, 2017	Wuhan, China	MRT construction created up to ¥21.65 billion land-value spike in station corridors; a 0.5 % capture could yield ¥109 million to subsidize MRT operations.
6.	Kashkooli et al., 2025	Adelaide, Australia	Accessibility to subway stations did not significantly impact apartment prices
7.	Pilgram and West, 2018	Minneapolis, USA	Initial light-rail premium faded over time as markets stabilized, indicating that accessibility effects can diminish in mature systems.
8.	Yin et al., 2025	China	Transit accessibility alone does not guarantee higher land prices; integration with mixed-use functions and pedestrian networks is critical.
9.	Yang et al., 2020	Chengdu, China	Reducing distance to stations by 100 m before the pandemic significantly increased house prices; the effect weakened during the pandemic.

This gap highlights the lack of spatially detailed evidence on how accessibility and urban form influence residential land prices in the early LRT corridor in Jakarta. This study addresses this issue by applying hedonic and spatial regression models to identify key determinants of land value variation along the Dukuh Atas–Cawang alignment.

3. Methods

3.1 Study Area and Data Collection

This study focuses on the Dukuh Atas–Cawang corridor of Jakarta's LRT Jabodebek, which runs through South Jakarta and surrounding districts. The corridor was selected because it represents the most mature segment of the Jabodebek system, connecting the CBD with high-density mixed-use neighborhoods such as Setiabudi, Kuningan, and Pancoran. From a data perspective, the Dukuh Atas–Cawang corridor provides the only complete set of post-operational property listings and consistent spatial data within a single urban jurisdiction; hence, controlled comparison of accessibility and amenity effects can be conducted. The research addresses two objectives: (1) to identify variables that significantly influence residential property prices within 1 km of LRT stations and (2) to examine the spatial distribution of relationships between public amenities accessibility and property prices using the MGWR model.

The 1-km buffer reflects typical TOD catchment zones based on international standards (500–1000 m). In this study, the TOD influence area was delineated using a single 1-km buffer around each LRT Jabodebek station. This distance represents the globally accepted pedestrian-accessibility threshold for transit-oriented developments, corresponding to approximately a 10–15-minute walking range (Berawi, Miraj, et al., 2020; Suzuki et al., 2015). Similar to prior peer-reviewed studies that modeled transit-related land value effects, (Wang et al., 2025; Lu et al., 2023; Su et al., 2021; Berawi, Aprianti, et al., 2020; Berawi et al., 2018) applied a fixed 1-km buffer, all of which reported that this scale effectively captures the strongest accessibility-driven price gradients while avoiding overlaps between adjacent station catchments. Given Jakarta's dense morphology and closely spaced stations, testing multiple buffer scenarios (e.g., 500 m or 1.5 km) would have introduced spatial multicollinearity and diluted TOD effects across non-walkable areas. Therefore, the 1 km radius was deemed the most appropriate representation of effective walkable accessibility within the Jabodebek LRT corridor. Key TOD zones in the corridor, such as Dukuh Atas, Setiabudi (Rasuna Said), Kuningan, Cikoko, Cawang, and Ciliwung, cover areas transitioning from CBD functions to mixed-use residential development within a 1-km buffer, consistent with Jakarta's RDTR zoning framework.

Properties were filtered based on three main criteria: (1) valid geolocation coordinates within 1 km of the selected LRT stations were included in the spatial completeness listings; (2) data integrity only records with complete attributes (land area, building area, bedrooms, and price) were retained; and (3) all listings were posted during the same post-operational period (March 2025) to ensure market comparability. These criteria followed the methodological framework adopted in spatial housing studies using open data (Berawi, Aprianti, et al., 2020; Xu and Zhang, 2016).

Figure 1 shows the mapped locations from the collected data for analysis. The map indicates that residential properties are evenly distributed throughout South Jakarta, with several properties listed outside the region's administrative boundaries. Data were sourced via web scraping from Lamudi.co.id using keywords such as "rumah dijual," properti residential," and "Jakarta Selatan." This method was chosen for its efficiency and scalability in urban housing market studies (Wei et al., 2022). Duplicates were removed from the initial dataset of over 3,500 listings (yellow dots) collected in March 2025 using unique ad identifiers and attribute similarity. Some property listings fall outside the boundaries of the South Jakarta Administration.

Figure 1 also shows the locations within the 1-km catchment zones (blue buffers) surrounding the Jabodebek LRT stations. The analysis focuses on the South Jakarta administrative area, delineated by subdistrict (Kecamatan) boundaries, to examine land price variation within TOD zones (Dukuh Atas, Setiabudi, Rasuna Said, Kuningan, Cikoko, and Ciliwung). A multi-step cleaning process was applied to refine the dataset. First, records with missing critical attributes, such as land price, building area, or land area, were excluded. Second, implausible values were removed based on the thresholds identified in the thesis analysis.

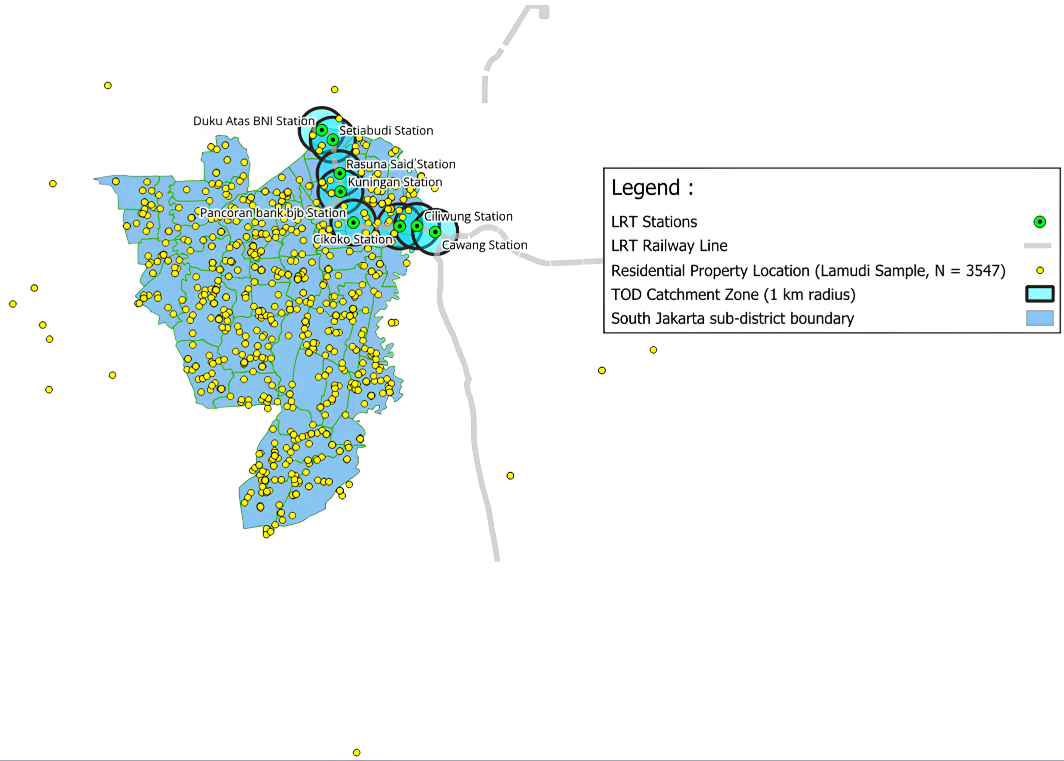

Figure 1 Distribution of Residential Properties of South Jakarta

Properties with land prices below IDR 1 million/m² or above IDR 200 million/m² were excluded, as were listings with building areas smaller than 20 m² or larger than 2,000 m^2 and land areas below 20 m² or above 1,500 m^2. Third, outlier detection was conducted by visually inspecting price scatterplots against area variables and flagging extreme values inconsistent with Jakarta's market norms. Finally, the bathroom count was dropped because it matched the number of bedrooms in many listings, making it redundant as an independent predictor.

All measurements were standardized, such as area in m^2 and prices in IDR, and coordinates were geocoded. The final dataset contains 97 properties with complete structural and locational attributes, including distances to LRT stations and other point of interests (POIs), which form the explanatory variables used in both the OLS-based HPM and MGWR models. Figure 2 shows the final sample and their proximity to the POIs.

Figure 2. The map illustrates the 97 residential properties included in the analytical dataset alongside key POIs that represent accessibility determinants in the model public high schools (SMA), hospitals (RS), malls, universities, urban parks, and the central business district (CBD). Each POI category was spatially referenced to capture proximity-based effects on land prices within the 1 km TOD catchment zones surrounding Jabodebek LRT Phase 1A stations. Denser clusters of residential listings and multiple overlapping POI nodes are visible in Setiabudi and Rasuna Said, indicating stronger accessibility synergy and higher locational value.

Although the final dataset consisted of 97 residential listings, this sample size aligns with comparable spatial housing-price studies using web-scraped datasets in urban rail contexts (Wang et al., 2025; Su et al., 2021; Berawi, Aprianti, et al., 2020). While Lamudi data represent asking rather than transaction prices, previous research has shown that online listing platforms capture market signals with high correlation to actual sales trends in emerging markets where transaction-level data are restricted (Liu et al., 2024; Wei et al., 2022). The data cleaning procedure employed strict filtering to remove incomplete, duplicated, and implausible entries, following established property-valuation standards (Bax et al., 2019). Moreover, a spatial cross-verification was conducted using the official Land Value Zome or Zona Nilai Tanah (ZNT) map published by Indonesia's National Land Agency (BPN) to mitigate potential bias and strengthen the dataset's external validity. The verified MGWR high-value clusters in Dukuh Atas, Setiabudi, and Rasuna Said overlapped with ZNT-designated premium zones (IDR > 20 million/m²), confirming that the Lamudi-based price distribution falls within the realistic market range of Jakarta. This spatial overlay verification supports the methodological reliability of using web-scraped data for postoperational LRT value assessment.

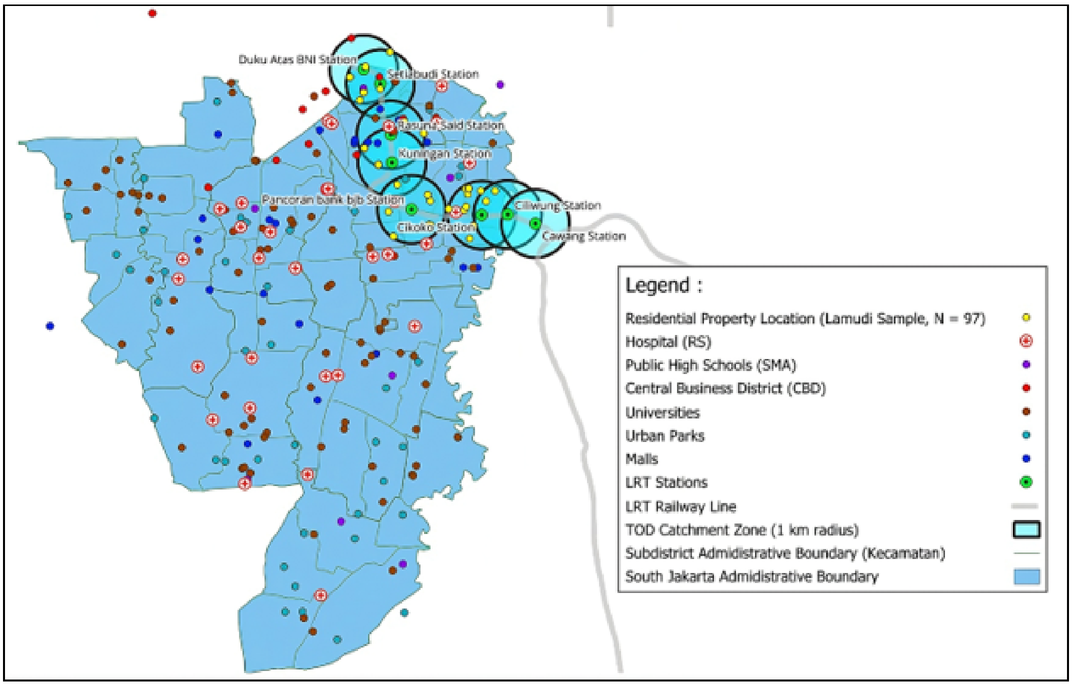

Figure 2 Location of Residential Properties and Point-of-Interest (POI) Variables Used in the Model

3.2 Model Selection and Rationale

This study combines the HPM and MGWR to examine both global and local residential land price determinants. The HPM estimates the contribution of structural and locational attributes to the overall property value by decomposing market prices into their component characteristics. Its linear specification provides a clear monetary interpretation of how each attribute affects value. However, HPM assumes spatial stationarity, meaning that the estimated relationships are constant across the study area.

The MGWR addresses spatial heterogeneity to address this limitation. Each variable is assigned its own spatial bandwidth to represent the geographic influence scale. Variables such as CBD proximity operate at the city scale, whereas others such as LRT distance show more localized effects. The sequential use of HPM and MGWR helps identify statistically significant predictors at the global level and reveals how their effects differ across neighborhoods.

Alternative spatial econometric models, including the spatial lag model (SLM) and the spatial error model (SEM), were considered. Although these approaches address spatial dependence, they still treat all variables as operating at a uniform scale. The traditional GWR was also reviewed; however, the MGWR was selected for its improved flexibility and lower parameter bias through variable-specific bandwidths. Given the heterogeneous urban form of Jakarta, the HPM–MGWR combination provides the most suitable framework for detecting both corridor-wide and localized value patterns.

3.3 Hedonic Pricing Model

According to Zulkarnain and Arvianti, 2021, residential land prices reflect the aggregated implicit values of individual property attributes. HPM estimates the contribution of each attribute to observed land prices. The linear regression form used in this study is as follows:

$$P_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \cdots + \beta_k X_{ik} + \varepsilon_i \tag{1}$$

where:
P_i is the land price per m^2 of property i,
β_0 is the intercept,
β_k is the regression coefficient for the k-th variable,
β_k is the value of the k-th variable for property i,
ε_i is the error term.

A linear functional form in monetary terms (IDR/m²) was selected for its interpretability and policy relevance. Although quadratic or cubic models can capture nonlinear relationships, the linear specification offers direct elasticity interpretation and remains the standard in policy-oriented HPM studies (Lu et al., 2023; Bax et al., 2019). Diagnostic tests confirmed that residuals showed no curvature or systematic patterns and indicated that the observed price dynamics could be adequately represented by a linear model. All variables were entered simultaneously using the enter method, and the model was estimated at a 5% significance level using IBM SPSS Statistics 26.

3.4 Data Analysis Procedure

The analysis followed three main stages. Descriptive statistics were first calculated to summarize the distribution of variables. Second, the Pearson correlation analysis was performed to explore the bivariate relationships between the land price and potential predictors. The variables included in the regression model were chosen based on both theoretical relevance and correlation results, which refer to those already described in Section 3.1.

Before estimating the model, diagnostic tests were performed to verify the suitability of OLS regression. These included the Kolmogorov–Smirnov test for residual normality, scatterplot inspection for homoscedasticity, the Durbin–Watson statistic for autocorrelation with values close to 2 indicating no serial correlation, and the Variance Inflation Factor (VIF) for multicollinearity, with all predictors below the threshold of 5 indicating an acceptable level of independence among variables (Cui et al., 2022; Deaconu et al., 2016).

The structural attributes included building area, land area, and number of bedrooms. Locational attributes captured proximity to specific urban amenities: LRT stations, shopping malls, hospitals, high schools, parks, universities, and the CBD. The dummy variables were coded as 1 when the property was located within the defined catchment of the amenity and 0 otherwise. A value of 1 was assigned to the CBD if the property was within the Sudirman–Rasuna Said–Gatot Subroto triangle. The same coding rule was applied for the other amenities, using catchment distances consistent with Jakarta's TOD planning standards.

The third stage involved estimating the OLS-based HPM and interpreting the coefficients to identify the significant structural and locational drivers of land price. MGWR was then applied to capture spatial variation in these relationships. MGWR used an adaptive bandwidth to account for variations in property distribution across the study area, with bandwidths selected for each explanatory variable to reflect the spatial scale at which it influences land price. Factors such as CBD proximity were estimated over broader spatial extents, whereas building area and LRT distance were modeled at more localized scales. Local parameter estimates were mapped to show how each variable's influence changes across neighborhoods. The standardized residuals were examined to identify areas where the observed prices deviated from the model predictions. These deviations may indicate unmeasured amenities or disamenities.

Socioeconomic and environmental control variables, such as income level, population density, and land-use mix, were not explicitly incorporated into the regression model due to data unavailability at the Jakarta parcel level. This constraint is common among urban hedonic and spatial pricing studies employing web scraped datasets, as neighborhood indicators are often aggregated at coarser spatial resolutions that cannot be precisely matched to property listings (Wang et al., 2025; Liu et al., 2024). To compensate for these data gaps, the model relied on structural and accessibility variables, such as building area, proximity to LRT stations, schools, malls, hospitals, and the CBD, which have been shown to explain a large proportion of property-price variation in dense metropolitan areas (Su et al., 2021; Berawi, Aprianti, et al., 2020). Furthermore, the MGWR framework indirectly captured the socioeconomic context, which allows coefficient heterogeneity to vary spatially across neighborhoods, reflecting differences in local income, land-use intensity, and built-environment quality (Lu et al., 2023; Wei et al., 2022). Future studies should integrate demographic data from BPS or satellite-derived urban form indices to enhance explanatory robustness and policy relevance for equitable LVC implementation. Figure 3 illustrates the overall research workflow.

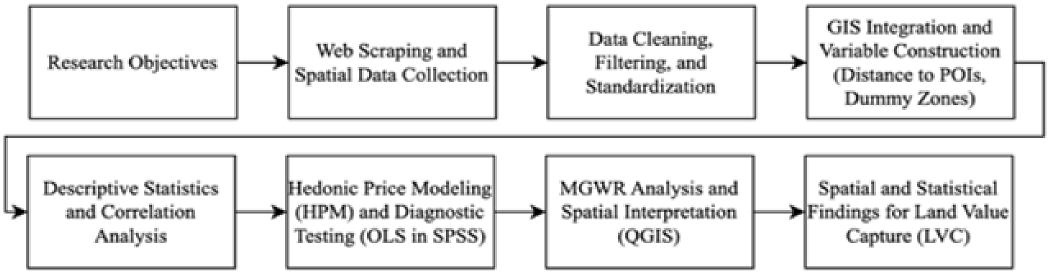

Figure 3 Research Workflow for Hedonic Land Value and Spatial Analysis

4. Results and Discussion

4.1 Descriptive Statistics and Correlation Analysis

Table 2 presents the characteristics of the 97 residential properties located within 1-km the LRT stations in Jakarta. Land prices range from IDR 3.95 million/m^2 to IDR 149.25 million/m^2, which reflects substantial spatial variation between CBD-adjacent locations and mixed-use or residential neighborhoods farther from the core. The building areas range from 36 m^2 to 1,800 m^2, with an average of 386 m^2, while the land areas average 353 m^2. Most properties are located 500–600 m from the nearest LRT station, which is consistent with the intermediate-density urban form of the corridor. In terms of proximity to amenities, 39% of properties are near malls, 75% near hospitals, 22% near high schools, 32% near parks, 68% near universities, and 44% near or inside the CBD.

Several predictors show significant positive correlations with land price. The building area ($r = 0.532$), land area ($r = 0.407$), hospital proximity ($r = 0.453$), and park proximity ($r = 0.333$) were all at the 1% significance level. These results align with earlier studies that identified physical size and health-related or recreational access as factors contributing to residential value (Darendra and Riyanto, 2025; Mueller et al., 2022).

Negative correlations were observed for distance to the CBD ($r = 0.421$), proximity to high schools ($r = 0.265$), proximity to malls ($r = 0.209$), and proximity to universities ($r = 0.242$). These findings are consistent with those of W. Zhang et al., 2025, Kumar et al., 2024, and Liu et al., 2024, who reported lower property prices in locations farther from education or activity centers.

Bivariate correlations help identify potential drivers of land value, but they do not control for variables' overlapping effects. In the next section, a multivariate regression model is applied to assess these factors within a more comprehensive structure and to test whether TOD-related attributes influence prices beyond other property and locational characteristics.

4.2 Hedonic Regression Results

All diagnostic tests indicated that the data satisfied the assumptions of normality, homoscedasticity, independence, and multicollinearity. Therefore, the model was suitable for inference. The Durbin–Watson statistic was 2.077, indicating no autocorrelation. The VIF values ranged from 1.132 to 3.482, which is well below the threshold of 5 and shows the absence of multicollinearity. The Shapiro–Wilk and Kolmogorov–Smirnov tests supported residual normality, whereas the Glejser test showed no evidence of heteroskedasticity. The regression identified three variables with statistically significant effects on residential land prices: building area, proximity to a high school, and proximity to the CBD (Table 3). The coefficient for building area was IDR 29,045.93/m² (p-value < 0.001), which means each additional square meter increased land price by approximately IDR 29,000 when other factors were held constant. The high school variable had a coefficient of IDR 18.4 million (p-value < 0.001), which represents a 51% increase relative to the average land price. The CBD dummy had the highest coefficient at IDR 33.95 million/m² (p-value = 0.001), reflecting strong buyer preference for employment and commercial hubs in Jakarta.

Table 2 Descriptive Statistics of Variables (N = 97)

	Minimum	Maximum	Mean	Std. Deviation
Price_land_Rp	3,947,368	149,253,731	35,845,333.22	23,044,293.386
Area_building_m2	36	1,800	386.22	359.746
Land area_m2	29	1,415	352.98	322.457
Number of bedrooms_m2	1	10	4.80	1.956
Distance_LRT_m	96	986	580.09	227.139
Dummy_Mall	0	1	0.39	0.491
Dummy_Hospital	0	1	0.75	0.434
Dummy_High School	0	1	0.22	0.414
Dummy_Park	0	1	0.32	0.469
Dummy_CBD	0	1	0.44	0.499
Dummy_University	0	1	0.68	0.469
Valid N (listwise)				

Table 3 Hedonic Regression Result for Residential Land Price (Rp/m^2)

Variable	Coefficient (B)	t-statistic	p-value
(Constant)	18,827,531	2.416	0.018
Building area (m^2)	29,045.93	3.526	<0.001
Land area (m^2)	–1,579.17	–0.172	0.864
Number of bedrooms	–96,802.28	–0.091	0.928
Distance to LRT (m)	–18,357.02	–1.655	0.102
Near Mall (dummy)	–14,045,024	–1.716	0.090
Near Hospital	7,044,197	0.850	0.398
Near High School (dummy)	18,419,124	3.642	<0.001
Near Park (dummy)	–5,310,653	–0.812	0.419
Near CBD (dummy)	33,948,874	3.287	0.001
Near University	487,886	0.069	0.945

Distance to LRT stations that shows a negative coefficient but is not statistically significant at the 5% level (p = 0.102) suggests that proximity to LRT does not directly explain the variation in land prices, at least in the early phase of operation. The mall variable, with a p-value of 0.090, is weakly significant and shows a negative sign, which may reflect concerns about congestion or noise near commercial areas. Other predictors, such as land area, bedroom count, and proximity to hospitals, parks, or universities, do not have statistically meaningful effects. The lack of influence from parks and hospitals could be attributed to the relatively uniform accessibility across the sample or different priorities among landed property buyers.

The model yielded an adjusted R^2 of 0.503, which explains just over half of the observed variation in land prices. The moderate Adjusted R^2 value (0.503) aligns with previous hedonic and spatial housing price studies in large metropolitan areas (Liu et al., 2024; Lu et al., 2023), indicating reasonable explanatory power given the complexity of urban property markets. Residual variance likely reflects unobserved attributes, such as neighborhood socioeconomics or design quality, which can be further explored in future studies. This supports the transition to the MGWR approach to more accurately capture spatial heterogeneity.

The F-statistic of 10.714 (p-value < 0.001) confirms the overall validity of the model. Based on the significant variables, the estimated regression equation is as follows:

Land Price = 18,827,531+(29,045.93 × Building Area)+(18,419,124 × High School Dummy)+(33.948.874,142 × CBD Dummy).

4.3 Spatial Analysis Using MGWR

The MGWR assigns each variable its own spatial bandwidth to capture how factors operate at different geographic scales (Wang et al., 2025). A large MGWR bandwidth indicates a citywide influence, whereas a small bandwidth reflects an effect limited to the neighborhood level. The model was applied to examine how property attributes influence land prices along Jakarta's LRT corridor.

To ensure data robustness, all explanatory variables included in the MGWR were prescreened through classical statistical diagnostics in the OLS model. Multicollinearity was tested using the VIF, with all values below 5, indicating no significant inter-variable correlation. In addition, the residual autocorrelation and normality tests confirmed that the OLS residuals met the standard assumptions. Because MGWR uses the same variable set, these results ensure that the spatial model is free from linear redundancy.

Unlike the global OLS model, MGWR captures variations across neighborhoods, providing localized insights that can guide LVC strategies. Model accuracy was evaluated using RMSE and MAE. The RMSE values ranged from IDR 42.4 to 42.5 million/m^2, and the MAE values ranged from IDR 35.5 to 35.8 million. The small difference between the RMSE and MAE values indicates stable prediction performance. The building area, bedroom count, and LRT distance were the most consistent contributors.

The building area consistently produced positive coefficients ranging from +0.248 to +0.537 across the corridor. The strongest effects were concentrated in Dukuh Atas, Setiabudi, and Rasuna Said, indicating that structural attributes significantly contribute to property values in premium TOD zones. The LRT distance showed consistently negative coefficients between −0.234 and −0.166, with the most pronounced influence in Dukuh Atas, Setiabudi, and Pancoran. These results reveal early signs of TBV in these areas.

Mall proximity yielded positive coefficients between +0.0336 and +0.0499, with the highest values observed in Dukuh Atas, Setiabudi, and Pancoran. These results point to a high demand premium for commercial amenities where access to retail services is highly valued. High school proximity had negative coefficients between −0.34 and −0.265, with the strongest effects (−0.34 to −0.315) in Dukuh Atas, Setiabudi, and Rasuna Said (0.34 to 0.315). The results highlight the importance of educational accessibility in shaping household preferences for residential locations. CBD proximity produced the strongest negative coefficients between −0.482 and −0.451, concentrated in Dukuh Atas, Setiabudi, and Karet. The results confirm the CBD's metropolitan-scale influence on property prices along the corridor.

To classify LVC priority zones, the local coefficient of each variable in a station catchment was scored from 1 (low influence), 2 (moderate influence), to 3 (high influence) based on its relative magnitude within the observed range. The total score for each catchment was then calculated across all variables and classified into three tiers. High potential zones scored 13, medium potential zones between 9 and 12, and low potential zones 8. This scoring system integrates structural, transit, and amenity influences to reflect multidimensional value drivers rather than a single factor.

High-potential zones, such as Dukuh Atas and Setiabudi, scored consistently high across all variables, making them prime candidates for zoning intensification, developer contributions, and land value taxation. Medium potential zones, including Rasuna Said and Kuningan, showed strong building area and CBD effects but more moderate transit and amenity influences. They are suitable for hybrid LVC strategies that combine zoning incentives with infrastructure levies. Low-potential zones such as Pancoran, Cikoko, and Ciliwung recorded weaker overall coefficients and may require infrastructure and amenity upgrades before LVC policies can be effectively applied.

The scoring results for each catchment are summarized in Table 4. Figure 4 presents the MGWR output for the building area as an example of spatial variation. Additional outputs were generated for the LRT distance, mall distance, high school distance, CBD distance, and bedroom count.

Table 4 LVC Potential Zones in Jakarta's LRT Corridor Based on Variables' MGWR Coefficients

Station (Catchment)	Building Area	LRT Distance	Mall Distance	High School Distance	CBD Distance	Total Score	LVC Priority
Dukuh Atas	High (+): 3	High (-): 3	High (+): 3	High (-): 3	High (-): 3	15	High
Setiabudi	High (+): 3	High (-): 3	High (+): 3	High (-): 3	High (-): 3	15	High
Rasuna Said	High (+): 3	High–Moderate (-): 2	High–Moderate (+): 2	High (-): 3	High–Moderate (-): 2	12	Medium
Kuningan	High (+): 3	High–Moderate (-): 2	High–Moderate (+): 2	High–Moderate (-): 2	High–Moderate (-): 2	11	Medium
Pancoran (Bank BJB)	High–Moderate (+): 2	Weak (-): 1	Moderate–Low (+): 2	Moderate–Weak (-): 2	Low (-): 1	8	Low
Cikoko	Low (+): 1	Weak–Moderate (-): 2	Low (+): 1	Weak (-): 1	Low (-): 1	6	Low
Ciliwung	Low (+): 1	Moderate (-): 2	Low (+): 1	Weak (-): 1	Low (-): 1	6	Low

The MGWR-based LVC scoring in Table 3 provides a practical interpretation of the statistical coefficients for urban planners. High-score zones, such as Dukuh Atas and Setiabudi, indicate prime areas for policy instruments, such as density bonuses, developer exactions, or value capture levies, where structural and accessibility coefficients are strongest. Medium-score areas, such as Rasuna Said and Kuningan, demonstrate transitional potential. It indicates that mixed regulatory incentives could stimulate further market response. Low score catchments (Pancoran–Ciliwung) indicate areas where infrastructure and amenity upgrades should precede fiscal extraction. This translation of statistical magnitudes into actionable planning zones aligns with evidence-based spatial planning principles (Dhindaw et al., 2021).

Although official land transaction records from Indonesia's National Land Agency, fiscal offices, or bank appraisal databases remain inaccessible to researchers, a qualitative spatial triangulation was performed to strengthen the credibility of the MGWR results. The high-value clusters identified by the model, particularly in Dukuh Atas, Setiabudi, and Rasuna Said, coincide with the officially recognized premium commercial zones in Jakarta's Rencana Detail Tata Ruang (RDTR) and the Zona Nilai Tanah (ZNT) boundaries published by BPN. This spatial alignment provides an indirect validation that the observed price gradients reflect genuine market capitalization effects around the Jabodebek LRT stations rather than platform listing bias.

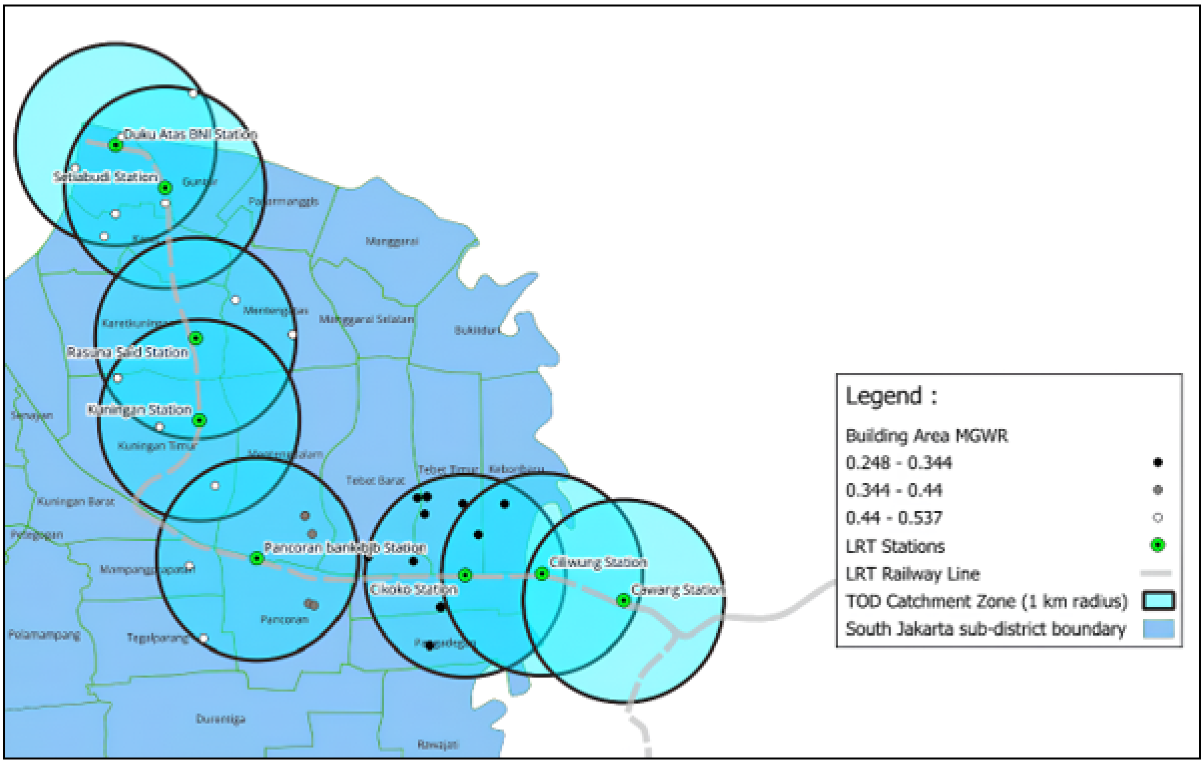

Figure 4 Output of MGWR for Building Area

Similar approaches relying on web-scraped property data have been widely adopted in peer-reviewed and indexed journals (Wang et al., 2025; Lu et al., 2023; Wei et al., 2022; Berawi, Aprianti, et al., 2020), where official cadastral or appraisal data are unavailable. These studies emphasize spatial logical verification and internal model diagnostics instead of direct government triangulation, acknowledging the institutional barriers that limit data transparency in many developing contexts. Consistent with this body of work, our research applied spatial validation through RDTR and ZNT overlays, confirming that land value clusters identified by MGWR correspond to established urban hierarchies and transit-oriented development corridors.

Nevertheless, future research should pursue integrated frameworks that combine open-market listings, government-assessed land values (NJOP and ZNT), and professional appraisal datasets to improve valuation accuracy and enhance the empirical basis for implementing LVC mechanisms in Indonesia's urban transport corridors.

4.4 Discussion

The results show that building area, proximity to high schools, and proximity to the CBD are the main drivers of residential land value in the Jakarta LRT corridor. These outcomes support **Rosen1974** hedonic price theory, where property prices reflect the combined value of individual attributes. These findings are also consistent with studies by Jaroszewicz and Horynek, 2024; Lu et al., 2023; Huang and Dallerba, 2021 on the strong influence of structural features and access to education. The CBD proximity premium mirrors patterns in European cities, where central locations benefit from shorter commutes and better access to services (Rehak et al., 2018).

Unlike findings from many TOD studies in Bogotá, Wuhan, and Kuala Lumpur, proximity to Jakarta's LRT stations does not yet have a significant effect on land prices. This outcome contrasts with a study by Berawi et al., 2018 conducted during the construction phase of the LRT and predicted a strong and immediate positive impact of station proximity on land values. In the case of Jakarta, the absence of a measurable premium during the early operational stage indicates that accessibility to urban amenities currently exerts a greater influence than transit access. Dai et al., 2016 reported comparable outcomes in Beijing, where new metro lines initially had minimal price effects in neighborhoods already served by multiple transport options.

Ridership remains below the design capacity, feeder connectivity is weak, and the surrounding station areas lack a walkable urban form. Early implementation prioritized physical construction without institutional coordination or land-use integration. Such conditions are common in early-stage transit investments, where infrastructure precedes regulatory and market maturity. Similar patterns have been observed in Manila's MRT (Endo et al., 2024) and Bogotá's TransMilenio (Munoz-Raskin, 2010), where value capture mechanisms became effective only after several years of coordinated station-area development and increased service reliability. Seoul's experience also illustrates that land value growth depends on long-term alignment between transport expansion, zoning adaptation, and private sector participation (Lee, 2022).

From a theoretical standpoint, the findings show that the value creation in Jakarta's corridor depends on the coordination among transit accessibility, land use, and governance. Therefore, the results imply that transit investment should be aligned with spatial and institutional reforms. Urban design improvements, density incentives, and coordinated governance are prerequisites for effective LVC. Policy interventions can prioritize three instruments: (1) TOD design measures such as continuous pedestrian networks and active frontages within 800 meters of stations; (2) zoning incentives including higher floor area ratios (FAR) and inclusionary housing in high-potential zones such as Dukuh Atas and Setiabudi; and (3) value capture tools such as betterment levies, developer obligations, and joint development agreements to link private development with public infrastructure upgrades. Phased implementation can direct initial revenues from premium zones toward preparatory improvements in weaker catchments such as Cikoko and Cawang.

These insights connect empirical evidence to institutional challenges in urban governance in Jakarta. Fragmented authority among transport operators, developers, and local planning agencies obstructs the coordinated implementation of TOD and LVC. Therefore, strengthening inter-agency mechanisms and adopting shared planning mandates will be essential for converting accessibility gains into equitable and sustained land value growth.

5. Conclusions

This study examined the early postoperational impact of LRT in Jakarta on residential land values within TOD zones. The analysis shows that structural attributes and proximity to key urban amenities still dominate price formation, while accessibility to LRT stations does not yet produce a measurable premium. These outcomes indicate that Jakarta's LRT is in an early value-creation phase where market response depends on the maturity of surrounding land-use and institutional coordination. Beyond confirming these patterns, the study provides broader lessons for TOD and LVC development in emerging megacities. The results confirm that value creation in early-stage TOD systems relies on the integration of transport investment with land-use and institutional coordination. The experience of Jakarta demonstrates that physical infrastructure alone cannot generate value uplift without complementary planning measures. Aligning transit expansion, zoning incentives, and stakeholder collaboration will be critical to strengthening the foundation for future LVC implementation. The combination of HPM and MGWR offers a replicable framework for analyzing post-operational transit impacts and can be applied to other developing metropolitan regions facing similar institutional and spatial conditions. However, this research is limited to landed residential properties along a single corridor and a cross-sectional dataset. Future studies should expand to multiple transit corridors, include commercial and vertical housing types, and apply longitudinal data to track temporal changes as Jakarta's LRT system and its supporting policies mature.

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Author Contributions

M.K.I. designed the study, collected and analyzed the data, and drafted the manuscript. M.S. supervised the research framework and made critical revisions to the manuscript. G.S. supervised data collection and analysis. S.H.Z. reviewed and provided feedback to improve the original manuscript. C.C.F. reviewed and edited the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

References

Alberto, E., & Nobre, C. (2023). Implementing land value capture in a global south city: Evaluation of the experience in the city of sao paulo, brazil. *Revista Brasileira de Estudos Urbanos e Regionais*, *25*, e202327. https://doi.org/10.22296/2317-1529.RBEUR.202327PT

Bax, D., Zewotir, T., & North, D. (2019). A gamma generalised linear model as an alternative to log linear real estate price functions. *Journal of Economic and Financial Sciences*, *12*(1), 1–11. https://doi.org/10.4102/jef.v12i1.476

Berawi, M. A., Aprianti, L., Saroji, G., Sari, M., Miraj, P., & Kim, A. A. (2020). Land value capture modeling in residential area using big data approach method. *Engineering Journal*, *24*(4), 249–259. https://doi.org/10.4186/ej.2020.24.4.249

Berawi, M. A., Miraj, P., Saroji, G., & Sari, M. (2020). Impact of rail transit station proximity to commercial property prices: Utilizing big data in urban real estate. *Journal of Big Data*, *7*(1). https://doi.org/10.1186/s40537-020-00348-z

Berawi, M. A., Suwartha, N., Kurnia, K., Gunawan, Miraj, P., & Berawi, A. R. B. (2018). Forecasting the land value around commuter rail stations using hedonic price modeling. *International Journal of Technology*, *9*(7), 1329–1337. https://doi.org/10.14716/ijtech.v9i7.2589

Berawi, M. A., Suwartha, N., Salim, A. V., Saroji, G., & Sari, M. (2021). Developing mobile application for land value capture scheme to finance urban rail transit projects. *International Journal of Technology*, *12*(7), 1448–1457.

Cui, L., Li, H., Ma, X., & Gu, H. (2022). Using the hedonic model to analyze how the characteristics impact the housing price in beijing during 2011–2018. *ACM International Conference Proceeding Series*, 235–242. https://doi.org/10.1145/3572647.3572682

Dai, X., Bai, X., & Xu, M. (2016). The influence of beijing rail transfer stations on surrounding housing prices. *Habitat International*, *55*, 79–88. https://doi.org/10.1016/j.habitatint.2016.02.008

Darendra, N. S., & Riyanto, E. (2025). Hedonic pricing model (hpm) on south tangerang residential property value. *Planning Malaysia*, *23*(1), 319–333. https://doi.org/10.21837/PM.V23I35.1681

Deaconu, A., Lazar, D., Buiga, A., & Fatacean, G. (2016). Marginal prices of improvements made to blocks of flats: Empirical evidence from romania. *International Journal of Strategic Property Management*, *20*(2), 156–171. https://doi.org/10.3846/1648715X.2015.1121415

Dhindaw, J., Kumaraswamy, S. K., Prakash, S., Chanchani, R., & Deb, A. (2021). Synergizing land value capture and transit-oriented development: A study of bengaluru metro. *World Resources Institute*. https://doi.org/10.46830/wripn.20.00082

Endo, K., Edelenbos, J., & Gianoli, A. (2024). Finance arrangements and governance modes toward sustainable infrastructure: The case of urban railway projects in manila, the philippines. *Discover Sustainability*, *5*(1), 1–25. https://doi.org/10.1007/S43621-024-00405-0

Gunawan, Berawi, M. A., & Sari, M. (2020). Optimizing property income in transit oriented development: A case study of jakarta tod. *Civil Engineering and Architecture*, *8*(2), 136–143. https://doi.org/10.13189/cea.2020.080211

Hasibuan, H. S., & Mulyani, M. (2022). Transit-oriented development: Towards achieving sustainable transport and urban development in jakarta metropolitan, indonesia. *Sustainability*, *14*(9), 5244. https://doi.org/10.3390/su14095244

Huang, Y., & Dallerba, S. (2021). Does proximity to school still matter once access to your preferred school zone has already been secured? *Journal of Real Estate Finance and Economics*, *62*(4), 548–577. https://doi.org/10.1007/s11146-020-09761-w

Jaroszewicz, J., & Horynek, H. (2024). Aggregated housing price predictions with no information about structural attributes—hedonic models: Linear regression and a machine learning approach. *Land*, *13*(11), 1881. https://doi.org/10.3390/land13111881

Karina, K., Sumabrata, J., & Berawi, M. A. (2025). Ridership optimization model of transit-oriented development in jakarta. *International Journal of Technology*, *16*(4), 1348. https://doi.org/10.14716/ijtech.v16i4.6522

Kashkooli, H. N., Soltani, A., & Javidi, F. (2025). The impact of public transportation accessibility on apartment prices in shiraz: A comparative study in a developing urban context. *Eco Cities*, *6*(2), 3406. https://doi.org/10.54517/ec3406

Kumar, V. S. S., Yoonus, S., & Anjaneyulu, M. V. L. R. (2024). Development of a land price model for a medium sized indian city. *International Real Estate Review*, *27*(2), 121–140.

Lee, J. K. (2022). New rail transit projects and land values: The difference in the impact of rail transit investment on different land types, values and locations. *Land Use Policy*, *112*, 105807. https://doi.org/10.1016/j.landusepol.2021.105807

Li, J., & Huang, H. (2020). Effects of transit-oriented development (tod) on housing prices: A case study in wuhan, china. *Research in Transportation Economics*, *80*, 100813. https://doi.org/10.1016/j.retrec.2020.100813

Liu, X., Chen, X., Orford, S., Tian, M., & Zou, G. (2024). Does better accessibility always mean higher house prices? *Environment and Planning B: Urban Analytics and City Science*, *51*(9), 2179–2195.

Lu, Y., Shi, V., & Pettit, C. J. (2023). The impacts of public schools on housing prices of residential properties: A case study of greater sydney, australia. *ISPRS International Journal of Geo-Information*, *12*(7), 298. https://doi.org/10.3390/ijgi12070298

Mueller, J. M., Loomis, J. B., Richardson, L., & Fitch, R. A. (2022). Valuing impacts of proximity to saguaro national park on house prices. *Applied Economic Perspectives and Policy*, *44*(3), 1359–1372.

Muhammad, A., Burhan, B., & Safian, E. (2024). Price model for transit-oriented developments in kuala lumpur, malaysia. *Real Estate Management and Valuation*, *32*(3), 20–30. https://doi.org/10.2478/remav-2024-0022

Munoz-Raskin, R. (2010). Walking accessibility to bus rapid transit: Does it affect property values? the case of bogota, colombia. *Transport Policy*, *17*(2), 72–84. https://doi.org/10.1016/j.tranpol.2009.11.002

Pilgram, C. A., & West, S. E. (2018). Fading premiums: The effect of light rail on residential property values in minneapolis, minnesota. *Regional Science and Urban Economics*, *69*, 1–10. https://doi.org/10.1016/j.regsciurbeco.2017.12.008

Pramudita, W., & Nataadmadja, A. (2023). Analysis of the performance of light rail transit (lrt) jakarta as a transport demand management (tdm) strategy. *IOP Conference Series: Earth and Environmental Science*, *1169*(1), 012021. https://doi.org/10.1088/1755-1315/1169/1/012021

Rehak, S., Kacer, M., & Wang, K. (2018). Estimating distance gradient in bratislava with different types of distance measurements. *25th Annual European Real Estate Society Conference*. https://doi.org/10.15396/ERES2018_259

Sharma, R., & Newman, P. (2018). Can land value capture make ppps competitive in fares? a mumbai case study. *Transport Policy*, *64*, 123–131. https://doi.org/10.1016/j.tranpol.2018.02.002

Su, S., Zhang, J., He, S., Zhang, H., Hu, L., & Kang, M. (2021). Unraveling the impact of tod on housing rental prices and implications on spatial planning: A comparative analysis of five chinese megacities. *Habitat International*, *107*, 102309. https://doi.org/10.1016/j.habitatint.2020.102309

Vergel-Tovar, C. E., Garcia, J. S., Alvarez, J. P., Mesa, S., Molano, I. L., Canon-Rubiano, L., & Correa-Garzon, L. M. (2025). Estimation of the anticipation effects of the metro project on real estate dynamics in bogota, colombia. *Journal of Transport and Land Use*, *18*(1), 123–173. https://doi.org/10.5198/jtlu.2025.2593

Wang, Y., Liu, Z., Wang, Y., & Dai, P. (2025). Research on spatial differentiation of housing prices along the rail transit lines in qingdao city based on multi-scale geographically weighted regression analysis. *Sustainability*, *17*(9), 4203. https://doi.org/10.3390/su17094203

Wei, C., Fu, M., Wang, L., Yang, H., Tang, F., & Xiong, Y. (2022). The research development of hedonic price model-based real estate appraisal in the era of big data. *Land*, *11*(3), 334. https://doi.org/10.3390/land11030334

Xu, T., & Zhang, M. (2016). Tailoring empirical research on transit access premiums for planning applications. *Transport Policy*, *51*, 49–60. https://doi.org/10.1016/j.tranpol.2016.03.003

Yang, L., Chau, K. W., Szeto, W. Y., Cui, X., & Wang, X. (2020). Accessibility to transit, by transit, and property prices: Spatially varying relationships. *Transportation Research Part D: Transport and Environment*, *85*, 102387. https://doi.org/10.1016/j.trd.2020.102387

Yin, Z., Li, W., Li, C., & Zheng, Y. (2025). The relationship between accessibility and land prices: A focus on accessibility to transit in the 15-min city. *Travel Behaviour and Society*, *38*, 100914. https://doi.org/10.1016/j.tbs.2024.100914

Zhang, M., & Xu, T. (2017). Uncovering the potential for value capture from rail transit services. *Journal of Urban Planning and Development*, *143*(3), 04017006. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000383

Zhang, W., Lin, L., Zhu, Q., Chen, D., & Ha, W. (2025). The effects of new satellite campuses on land prices: Evidence based on micro land transaction data in china. *Applied Geography*, *176*, 103528. https://doi.org/10.1016/j.apgeog.2025.103528

Zhou, Y., Tian, Y., Jim, C. Y., Liu, X., Luan, J., & Yan, M. (2022). Effects of public transport accessibility and property attributes on housing prices in polycentric beijing. *Sustainability*, *14*(22), 14743. https://doi.org/10.3390/su142214743

Zulkarnain & Arvianti. (2021). An analysis of implicit value of property characteristics in residential property prices using a hedonic value approach. *International Journal of Technology*, *12*(6), 1168–1176. https://doi.org/10.14716/IJTECH.V12I6.5216