



Evolving land value effects of BRT and MRT: Evidence from Jakarta's mobility transition

Franco Jauregui-Fung^{a,*}, Tobias Kuhnimhof^b, Jeffrey Kenworthy^c

^a German Institute of Development and Sustainability (IDOS), RWTH Aachen University, Germany

^b RWTH Aachen University, Germany

^c Frankfurt University of Applied Sciences, Curtin University Sustainability Policy Institute, Germany

ARTICLE INFO

Keywords:

Bus rapid transit (BRT)
Mass rapid transit (MRT)
Transit accessibility
Residential land value
Land value uplift (LVU)
Geographically weighted regression (GWR)
Transjakarta
Jakarta

ABSTRACT

Bus rapid transit (BRT) has been widely adopted in emerging economies for its affordability and incremental implementation potential. Yet, many cities are now starting to implement urban rail as a higher-quality mass-transit alternative. This raises the question of the role of existing BRT networks once rail arrives, particularly regarding their land-value effects. This paper examines how BRT-related land value uplift (LVU) evolves after rail begins operation, using Jakarta as a case study. The study analyses residential land values around Transjakarta BRT and MRT Jakarta stations for 2017 (pre-rail) and 2021 (post-rail) using Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR). The findings reveal that (1) proximity to Transjakarta stations was associated with uplift in 2017, particularly in South Jakarta; (2) by 2021, BRT proximity penalties were reported citywide, especially in the north and east, but also in Central Jakarta; and (3) proximity to MRT Jakarta stations was associated with consistent uplift in 2021, with strongest effects at upgraded interchange nodes in South Jakarta. The timing and spatial coherence of these patterns are consistent with a rail-led substitution mechanism in which urban policy attention and developer actions concentrate willingness-to-pay near rail, while stand-alone BRT corridors increasingly reflect proximity penalties in prices. Policy recommendations include strategic co-location and integration of BRT-MRT stations, mitigating BRT proximity effects with context-sensitive station design, and timely transit-oriented development (TOD) and land value capture (LVC) at integrated hubs to harness value where market signals are strongest.

1. Introduction

In an effort to improve urban mobility and reduce congestion and greenhouse gas emissions, many local governments in emerging economies are investing in mass transit systems that provide fast operating speed, large passenger capacity and dedicated right-of-way infrastructure. Among these, bus rapid transit (BRT) became globally popularised in the 2000 s as a cost-effective solution, widely claimed to offer similar benefits to those of urban rail at a significantly lower capital cost. While definitions often differ across contexts (Bradley, 2010), BRT typically runs on segregated busways with enhanced station environments, level boarding platforms, pre-boarding fare collection and high-capacity buses featuring multi-door boarding and alighting (Bradley, 2010; Deng & Nelson, 2011; Levinson et al., 2003).

Because of its affordability and incremental implementation potential, BRT was widely adopted in cities with limited transit infrastructure,

especially in high-density urban areas with growing private motorisation and reliance on popular transport (Jauregui-Fung, 2022b). In these contexts, BRT represented the first step towards phasing out operational challenges often associated with popular transport (Asimeng & Jauregui-Fung, 2025). As a result, by 2024 BRT systems were operating in 191 cities worldwide, including 64 in Latin America and 46 in Asia. In Africa, six systems were in operation (BRTData, 2024), with 13 more under planning or implementation (Birungi, 2024).

Since its peak in 2013, however, the BRT momentum has slowed. Many cities have struggled to expand or maintain service quality within consolidated urban fabrics and existing paratransit services (Asimeng & Jauregui-Fung, 2025; Nguyen & Pojani, 2018; Wu & Pojani, 2016). Although BRT is relatively more affordable than urban rail, it still requires upfront capital and institutional capacity, especially in cities where transit has historically been unregulated and unsubsidised.

At the same time, several cities in emerging economies with

* Corresponding author.

E-mail addresses: Franco.Jauregui@idos-research.de, franco.jauregui@rwth-aachen.de (F. Jauregui-Fung).

<https://doi.org/10.1016/j.cstp.2025.101668>

Received 15 August 2025; Received in revised form 3 November 2025; Accepted 18 November 2025

Available online 20 November 2025

2213-624X/© 2025 The Authors. Published by Elsevier Ltd on behalf of World Conference on Transport Research Society. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

relatively successful BRT operations have entered a new phase of mass-transit development by investing in urban rail projects, such as metro or light-rail systems. These are increasingly promoted as long-term solutions to chronic congestion and symbols of global competitiveness. The coexistence of BRT and rail introduces new dynamics in accessibility, urban form and real-estate development. This raises the key question of the role of BRT networks within this new urban mobility landscape, and, more specifically, how the introduction of urban rail affects the spatial and economic outcomes once associated with BRT accessibility.

This is particularly relevant in light of the economic co-benefits attributed to mass-transit investments, such as their influence on land values and urban growth (Debrezion, Pels, & Rietveld, 2007; McIntosh, Newman, Trubka, & Kenworthy, 2017; Mohammad, Graham, Melo, & Anderson, 2013; Wardrip, 2011). While existing literature already agrees that urban rail generates significant land value uplift (LVU) in both Western cities (Cervero & Kang, 2011; Sharma & Newman, 2017), and more recently in Global South cities (Dhindaw, Kumaraswamy, Prakash, Chanchani, & Deb, 2021; Sharma & Newman, 2018a, 2018b; Wang, Tong, Gao, & Chen, 2019), the durability and spatial reach of BRT-related LVU are more context dependent. As rail arrives, it may reprice urban locations and reassign where LVU concentrates. Understanding how rail affects BRT-associated LVU is thus a core policy concern.

This paper examines how capitalisation of BRT accessibility into land values is reshaped by urban rail over time with Jakarta as a remarkable case study. Transjakarta, the world's longest BRT system (ITDP, 2019), has operated since 2004, while the city's first metro line, MRT Jakarta, began service in 2019. Using Ordinary Least Squares (OLS) and Geographically Weighted Regression (GWR) models, the analysis explores residential land-value effects around BRT and MRT stations in 2017 and 2021. This study contributes to a growing body of research on BRT and LVU, but advances it by addressing how the shift towards urban rail reshapes the spatial pattern of residential land values, while also offering policy recommendations to improve design and multimodal integration in cities in emerging economies.

The article proceeds as follows. Section 2 reviews existing literature on BRT and LVU and the identified research gap. Section 3 introduces Jakarta's evolving urban mobility context and Section 4 outlines the methodology. Section 5 presents the regression results, followed by Section 6, which discusses the findings and draws policy implications. Section 7 concludes with reflections for cities navigating transitions from bus-based to rail-based mass transit.

2. Previous studies on the relationship of BRT systems and value uplift

Mass-transit capitalisation reflects a balance between accessibility premiums and proximity penalties. While the former is mainly supported by urban rail's grade separation and reliability, the latter tends to be sharper at immediate surroundings for bus-based services. These proximity-induced effects, such as air and noise pollution, traffic snarls, road vibration and fuel-related odour, are associated with technological and operational features of conventional bus-based services (Kilpatrick, Throupe, Carruthers, & Krause, 2007; Rodríguez & Vergel-Tovar, 2018). Moreover, because direct land-price data are scarce, many studies proxy land value with property prices, which can conflate building attributes with location effects (Mohammad et al., 2013; Wardrip, 2011). Where land data are available, hedonic models are standard and spatial approaches are increasingly used to capture non-stationary effects across neighbourhoods (Du & Mulley, 2012; Zolnik, 2021).

With this framing in mind, literature focused on BRT-associated LVU has been limited until recently, partly because many systems had not matured long enough to reveal transit-induced value change. A meaningful contribution to the literature was the meta-analysis of 23 studies worldwide conducted by Zhang and Yen (2020), which quantitatively differentiated the impact of BRT on land and property values.

They found that BRT tends to produce delayed uplift effects, unlike urban rail, and that the impact on land values is 27.5 % higher than on property values. This suggests that BRT has greater uplift potential where land is still undeveloped or underutilised, due to the flexibility of land to absorb changes in accessibility and land use in comparison to already built properties. Using the BRT Standard evaluation tool developed by ITDP (2016), the authors also found no statistical correlation between the quality, operating mechanism and maturity of BRT and LVU, highlighting the importance of complementary factors, such as transit-oriented development (TOD), zoning incentives, available land and a strong market for intensive station-area development (Gospodini, 2005; Huang, 1996).

When mapping the location of studied BRT systems, early research is largely situated in Global North cities such as Los Angeles, Brisbane and Ottawa and focused on property values, rather than land values (Cervero, 2004; Levinson et al., 2003; Levinson, Zimmerman, Clinger & Rutherford, 2002). These studies found mixed outcomes and were often constrained by stable, mature land markets with limited scope for land-use change, which dampened capitalisation into land values.

More recent work has shifted to the Global South, where rapid urbanisation and less regulated land markets can make accessibility-induced land value changes more observable, yet many studies still relied on property values as proxy, due to limited land-price data. Curitiba, Brazil, represents one of the earliest and most cited examples linking BRT investments to land-use change and value appreciation (Bocarejo, Portilla, & Pérez, 2013; Cervero & Dai, 2014; Levinson et al., 2003). Another study in Ecatepec de Morelos, Mexico, did not show significant windfall, but actually a loss in value for high-end properties close to an announced BRT corridor (Flores Dewey, 2010). This conforms to observations in cities with high-income disparities, where concerns over neighbourhood exclusivity or perceived social change play a key role.

Bogotá's TransMilenio in Colombia has received substantial attention. Several studies have identified positive effects of BRT proximity on property values, particularly for commercial uses (Bocarejo et al., 2013; Muñoz-Raskin, 2010; Perdomo Calvo, Mendoza Álvarez, Mendieta López, & Baquero Ruiz, 2007; Rodríguez & Mojica, 2008; Rodríguez & Mojica, 2009; Rodríguez & Targa, 2004). However, the effects vary by income level and property type. Muñoz-Raskin (2010) found no premium for low-income housing, a modest premium for middle-income housing and mixed effects for high-end housing. Over time, nevertheless, Guzman, Enríquez, and Hessel (2021) observed that low-income areas now benefited from BRT-related accessibility, while medium- and high-income neighbourhoods showed either neutral or even negative effects. These findings reflect both a spatial reconfiguration of demand and a decline in BRT's perceived attractiveness in more exclusive residential areas. This temporal reconfiguration is consistent with a potential substitution mechanism once a higher-quality rail alternative becomes salient.

Beyond Latin America, studies in Asian cities also reveal important insights into how planning and context mediate BRT's impact on land values. Studies in Beijing and Guangzhou reported increased real estate prices due to high-quality BRT infrastructure and pedestrian accessibility (Deng, Ma, & Nelson, 2016; Cervero & Dai, 2014; Suzuki, Cervero, & Iuchi, 2013). Yet, the Guangzhou Metro was found to have a stronger influence on property values than BRT, except in cases where BRT provided better travel times and lower fares (Salon, Wu, & Shewmake, 2014). Xiamen is another Chinese city with several studies that explored BRT effects on property prices using non-spatial and spatial hedonic pricing models and non-linear relationships (Yang, 2021; Yang et al., 2019a; Yang et al., 2019b; Yang et al., 2020). Consistent with the proximity penalties noted at the start of this section, Xiamen showed that buyers were willing to pay more to live near to, but not too close to, stations, due to concerns over congestion, noise and other disamenities associated with bus-based services.

Other cities that have documented these proximity penalties are

Bogotá (Guzman et al., 2021; Muñoz-Raskin, 2010; Rodríguez & Targa, 2004; Rodríguez & Mojica, 2009) and Brisbane (Mulley, 2014; Zhang, Yen, Mulley, & Sipe, 2020). Particularly in cities in emerging economies, buses are often associated with lower socio-economic status, reinforcing a form of bus stigma that can dampen the potential for real estate appreciation around BRT stations (Rodríguez & Vergel-Tovar, 2018), especially in high-income neighbourhoods (Guzman et al., 2021; Yang et al., 2020).

BRT proximity-induced effects contrast against the positive proximity effects of urban rail, which is generally more desirable due to its grade separation, speed and stronger association with high-end development. (Salon et al., 2014). Yang (2021) further suggested that, once a metro line opens, BRT's role may diminish and potentially lead to the evaporation of BRT-accessibility premiums (Yang, 2021; Yang et al., 2019a; Yang et al., 2020). As expectations rise and alternatives improve, proximity penalties can become more salient over time and accessibility impacts tend to decrease as a transit network becomes more comprehensive (Shyr, Andersson, Wang, Huang, & Liu, 2013), particularly with the addition of rail lines, which further weakens BRT's marginal contribution. This has timing implications for application of land value capture (LVC) mechanisms, as Zhang and Yen (2020) argue. If implemented too late, they may miss the window of uplift potential created by new transit access. This emphasises the need for early coordination between infrastructure planning and land policy.

In summary, while much of the literature focuses on property values, emerging research shows that BRT can indeed generate substantial LVU under the right conditions (Zhang & Yen, 2020). However, this impact is neither immediate nor guaranteed. It depends on the station's context, urban form, surrounding land availability and the broader planning framework, and, more importantly, it may decrease over time, especially with the introduction of urban rail. Despite these insights, empirical evidence from Global South megacities comparing BRT and rail effects on land values over time remains limited. This paper addresses that gap by comparing residential land transactions in a city with an already compelling BRT network across two years, pre-rail and post-rail. This design is used to test whether BRT's earlier capitalisation weakened or reversed once metro operations began, and to map where such substitution is most pronounced across the city. To the authors' knowledge, this is the first same-city, multi-period comparison of both BRT and urban rail effects on land values in rapidly urbanising contexts. Accordingly, the study expects (1) weaker or reversed BRT effects along overlapping BRT-MRT corridors, and (2) stronger substitution in higher-income areas in the centre where proximity penalties and status effects are pronounced.

3. Jakarta's evolving urban mobility landscape

3.1. DKI Jakarta

The Special Capital City Region of Jakarta (DKI Jakarta) is the capital of Indonesia, the fourth most populous country, located in one of the world's most dynamic regions. The growth and sprawl of the urbanised area in the last 35 years have resulted in DKI Jakarta becoming a megacity with a population of 10.6 million inhabitants and an annual population growth rate of 1.2 per cent (BPS-Statistics, 2020). Jakarta was built incrementally without proper urban planning and the growth of the suburbs beyond the city's borders has increased exponentially

since the 1990s (Hendra & Barus, 2022). This led to the formation of the metropolitan region of Jabodetabek or Greater Jakarta, composed of DKI Jakarta and the surrounding cities of Bogor, Depok, Tangerang and Bekasi. Jabodetabek houses 31.5 million people and is expected to become the world's most populous region by 2030 with a total population of 35.6 million people (Razvadauskas, 2018). This would make it the first Global South region to become the world's largest megacity. Due to its economic relevance, the number of commuters from the surrounding cities makes the total population of DKI Jakarta swell to approximately 12 million people during the day (Angelina, Vallée, & Louen, 2017).

Its car-oriented planning in favour of investments in road infrastructure for private vehicles during the second half of the 20th century and the deterioration of its public transport, characterised by informal buses and minibuses (*angkots*), in parallel to economic growth, led to the growth of motorisation during the 1990s (Abiad, Farrin, & Hale, 2019; Acharya & Morichi, 2007; Saraswati & Ramadhan, 2020). Moreover, increases in fuel subsidy and no policies for car control have also contributed to the growth of private mobility, as subsidies not only benefit low-income, but also middle- and upper-income households (Angelina et al., 2017).

Consequently, Jakarta's car and motorcycle ownership levels are similar to those of cities with a higher income. In 2019, there were 776 motorcycles and 267 cars per 1000 people (BPS-Statistics, 2020). These figures do not consider the number of cars and motorcycles outside DKI Jakarta that commute into the city on a daily basis from the other areas of Jabodetabek. It is estimated that 75 per cent of households own at least one motorcycle, while 25 per cent own at least one car (Angelina et al., 2017). The high levels of motorisation also translate into private vehicles accounting for 79 per cent of the share of motorised modes, whereas the share of transit (including all transit modes) has decreased from 57 to 25 per cent between 2002 and 2019 (Adiatma, 2020). As a result, Jakarta ranks among the most congested urban areas worldwide (Saraswati & Ramadhan, 2020), which is strongly linked to rapid urbanisation and suburbanisation processes (Benita, 2023; Roberts, Sander, & Tiwari, 2019).

3.2. The arrival of mass transit: Transjakarta and the new railway systems

In 2004, Jakarta opened the first BRT system in Indonesia and Southeast Asia: Transjakarta (Ernst & Sutomo, 2010). The decision in favour of a BRT was due to the lack of resources to afford the construction of a metro system and the positive image of Bogotá's TransMilenio, which inspired Jakarta's governor (Angelina et al., 2017). The first corridor Kota-Blok M of 12.9 km was implemented within the first nine months (Angelina et al., 2017; Ernst, 2005) at the lowest capital cost among peer implemented BRTs (Hidalgo & Carrigan, 2010). Transjakarta faced several challenges due to the design of the BRT components, such as maintenance, operations and public acceptance (Saraswati & Ramadhan, 2020). Gradually, Transjakarta has been able to overcome these challenges with a series of policies and strategies to expand the network (Jauregui-Fung, 2022a). In 2007, the system operated exclusively on seven dedicated corridors, but in 2013, direct service routes were launched to expand the network beyond trunk routes. The system continued expanding and in 2016, regarded as a tipping point in Transjakarta's evolution, feeder services were also

launched (Adiwinarto, 2020), signalling a shift towards broader service integration and coverage.

Today, Transjakarta's network consists of 13 corridors totalling 251.2 km (Fitriani, Kharisma, Sampurna, Sholihah, & Susanti, 2019) and 248 routes that serve 82 per cent of the population of DKI Jakarta within 500-metre radius (Adiwinarto, 2020; ITDP, 2022). A significant milestone has been the establishment of the *Jak Lingko* integrated fare system in 2018, which has formalised paratransit minibus services, called Mikrotrans (ITDP, 2021). Under *Jak Lingko*, users can combine trips for a 3-hour period using non-cash payment, with a ticket that costs a maximum of 5,000 Indonesian Rupiah (IDR) (0.32 USD, current value), while a single trip costs only 3,500 IDR (0.22 USD, current value) (ITDP, 2021; Adiwinarto, 2020; Bank Mandiri, 2022). Mikrotrans has enabled Transjakarta to increase service coverage to areas inaccessible to larger buses due to street characteristics.

Apart from Transjakarta, Jakarta has recently introduced new rail lines. Jabodetabek already had a commuter rail network called KRL Commuterline, established during the Dutch colonial occupation to connect Jakarta with the surrounding areas. After a period of neglect during the 1960s, the system was renovated in 2011. KRL Commuterline has a network of 418.5 km with six integrated lines (Abiad et al., 2019; Farda & al-Rasyid Lubis, 2018; PT. Kereta Commuter Indonesia, 2020). Three additional lines are planned.

However, the great shift towards urban rail occurred in 2019 with the opening of Phase 1 of the first metro line, MRT Jakarta, which runs from South to Central Jakarta with 13 stations (ITDP, 2021). Phase 2, currently under construction, will add 11.8 additional kilometres extending northward, with completion expected by 2029. MRT Jakarta also plans three additional lines in the future, with an east–west line as Phase 3. In 2019, the elevated light rail transit line, LRT Jakarta, also opened with 5.8 km on Jakarta's northeast side. An expansion of 20 km is underway to form a circular line (ITDP, 2021). In 2023, an additional elevated light-metro system commenced operations, LRT Jabodebek, which was implemented through a public–private partnership (Hendra & Barus, 2022). The system features two lines connecting Jakarta with Bogor, Depok and Bekasi.

These rail modes are also integrated into the *Jak Lingko* fare system, with a maximum fare of 10,000 IDR (0.63 USD) per trip (Sofa, 2023). This integration helps reduce travel costs, which are much higher for urban rail (e.g., the longest trip on MRT Jakarta can cost up to 14,000 IDR or 0.88 USD, while the longest trip on LRT Jabodebek can cost up to 20,000 IDR or 1.23 USD). Intermodal integration also promotes the redesign of certain stations as intermodal hubs to boost ridership, such as CSW-ASEAN station, which receives 100,000 MRT passengers daily, while 90,000 and 25,000 daily passengers use Transjakarta's corridors 1

and 13 (ITDP, 2021). Figs. 1 and 2 show Jakarta's current mass-transit offer.

Note: Educational categories follow Kusumah and Wasesa (2023): not completed elementary school (LOW), graduated elementary and junior high school (MIDDLE), and graduated high school (HIGH). BALANCED is interpreted as areas with a relatively even distribution of residents across educational categories. The authors used educational attainment as proxy for neighbourhood socioeconomic strata (SES) due to absence of small-area income/consumption data.

4. Methodology

This study applied a hedonic pricing model through a regression analysis using ArcGIS software, focusing on understanding the determinants of residential land value in Jakarta. This approach allows measuring the influence of Transjakarta stations on the land value among other influential variables, such as accessibility to MRT Jakarta stations and other urban amenities. Therefore, the focus of the regression models is to explain variations in residential land value based on multiple location-specific explanatory variables, particularly distance to BRT stations. The general linear regression model is expressed as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_k x_k + \varepsilon.$$

Where:

y is the dependent variable: residential land value (IDR/m²).

β s are the coefficients for explanatory variables (x).

ε is the random error.

The selected regression methods are the following:

- (1) Ordinary Least Squares (OLS), which generates a single global equation for the entire study area, and
- (2) Geographically Weighted Regression (GWR), which allows coefficients to vary by location, enabling localised regression equations.

OLS assumes a spatially stationary process, whereas GWR accounts for spatial non-stationarity by allowing coefficients of the explanatory variables to vary across different locations based on the spatial relationship with the dependent variable (ArcGIS Pro 3.1 (2023b, 2023c)). This feature is relevant for this study as the impact of mass-transit stations on land values may differ across neighbourhoods. Thus, GWR provides a set of local models that enable an analysis of how the strength and direction of relationships between explanatory variables and residential land value vary spatially (Mulley, 2014; Yang et al., 2020).

The objective of the regression analysis is to determine how various urban features, especially Transjakarta stations, influence residential



Fig. 1. Mass transit modes in DKI Jakarta. Photos: Franco Jauregui-Fung, 2024.

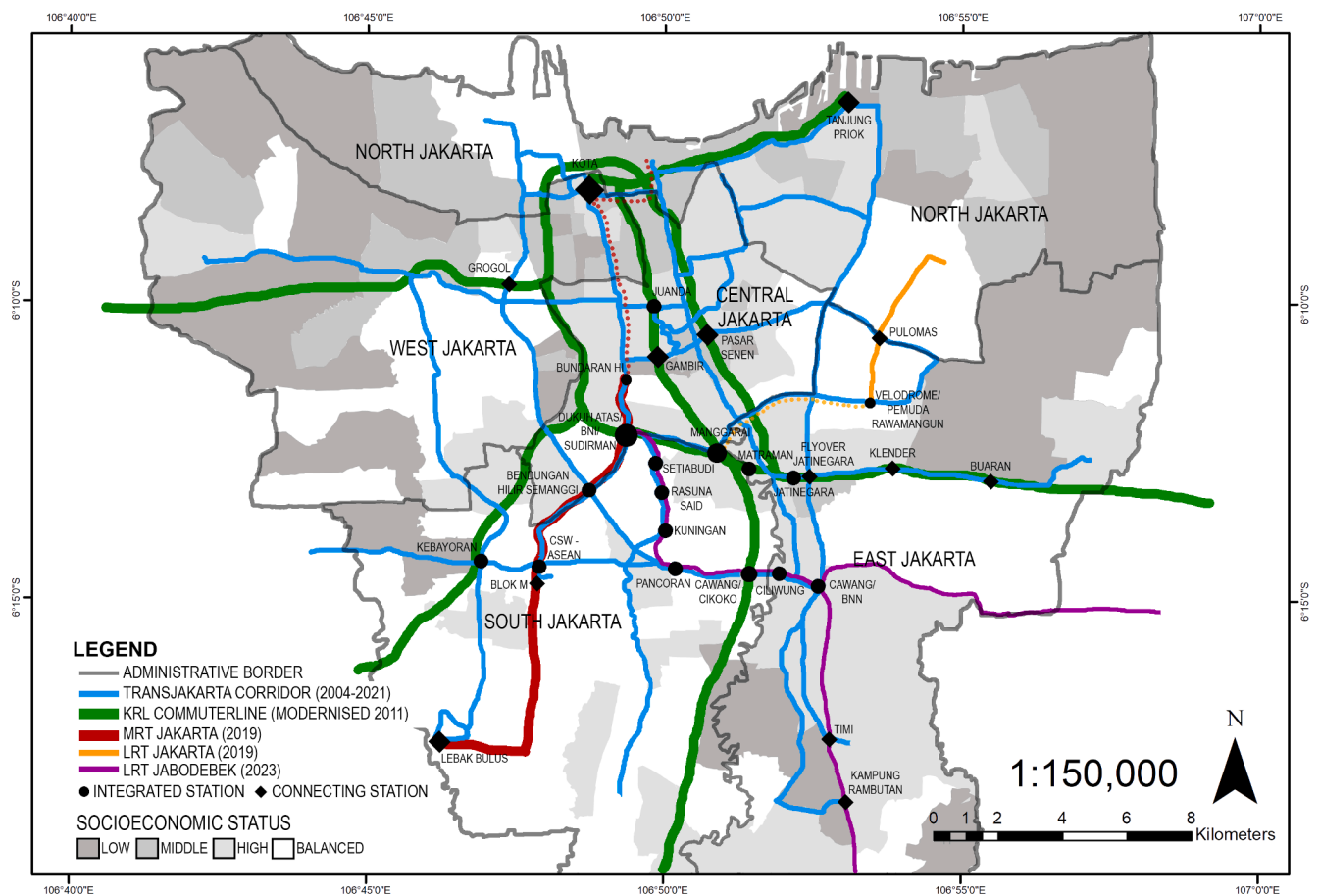


Fig. 2. Map of DKI Jakarta with the current mass transit offer and spatial distribution of educational attainment (proxy for socioeconomic strata, SES). Source: Authors.

Table 1
Explanatory variables.

Explanatory variable	Description	Format
Transjakarta station	Distance (m) from each land point to nearest BRT station	Point (shp)
MRT Jakarta station	Distance (m) from each land point to nearest MRT station	Point (shp)
LRT Jakarta station	Distance (m) from each land point to nearest LRT station	Point (shp)
KRL Commuter. station	Distance (m) from each land point to nearest Commuterline station	Point (shp)
Apartment	Distance (m) from each land point to nearest apt. building (≥ 5 floors)	Point (shp)
Cloud kitchen	Distance (m) from each land point to nearest food delivery services	Point (shp)
ATM	Distance (m) from each land point to nearest ATM	Point (shp)
Hospital	Distance (m) from each land point to nearest hospital	Point (shp)
Hotel	Distance (m) from each land point to nearest hotel (≥ 3 stars)	Point (shp)
Mall	Distance (m) from each land point to nearest shopping mall	Point (shp)
Modern retail	Distance (m) from each land point to nearest modern retail chain	Point (shp)
Gas station	Distance (m) from each land point to nearest gas station	Point (shp)
University	Distance (m) from each land point to nearest university	Point (shp)
High school	Distance (m) from each land point to nearest high school	Point (shp)
Middle school	Distance (m) from each land point to nearest middle school	Point (shp)
Open space	Distance (m) from each land point to nearest urban park or open space	Point (shp)
Population density (800 m radius)	Number of people per pixel (ppp) in 100 m x 100 m grid	Raster data

Source: Authors.

land value under *ceteris paribus* conditions. A spatial buffer of 800 m (roughly a 10-minute walk) was drawn around each station of Transjakarta's entire network to assess their potential influence on land

values, among the other explanatory variables. This threshold is based on planning standards for walkable transit access and TOD (Kementerian PUPR, 2020). Additionally, several studies use an 800-metre buffer for BRT accessibility (Cervero & Kang, 2011; Deng et al., 2016).

This study systematically compared official and semi-official data sources, namely (1) land-value zones published by the Indonesian Ministry of Agrarian Spatial Planning/National Land Agency (ATR/BPN), (2) land value surveys by Bank Indonesia, and (3) residential land value per square metre (IDR/m²) from an independent valuation & advisory firm that conducts real estate appraisals. The third dataset was retained as the dependent variable because it uniquely provided dense, citywide, point-level coverage for the selected reference years and is technically suited to station-scale analysis, whereas land-value zones were polygonal (zonal averages) and the other transaction records exhibited standardisation/coverage gaps. Data validity is grounded in documented, city-specific evidence on these sources and in a qualitative check that the point observations align with their host ATR/BPN land value-zones, Jakarta's official public benchmark used in peer-reviewed research. Taken together, these elements support the credibility of the appraisal point transactions for the selected years.

Table 1 presents the selected explanatory variables.

Although MRT Jakarta, LRT Jakarta and KRL Commuterline are all rail-based systems, they were conceived, planned and operated independently, with only partial fare and service integration achieved after their opening under the *Jak Lingko* framework. During the selected reference year, these systems operated separately in terms of governance, infrastructure and catchment areas. Therefore, accessibility to each system was calculated separately to reflect their distinct operational stages and spatial influence.

All explanatory variables were converted into distance measures (in metres) using ArcGIS's Closest Facility tool. The shortest distance from each residential land transaction point to the closest point of interest (explanatory variable) was computed. To determine the optimal set of explanatory variables, Exploratory Regression was conducted to evaluate all possible combinations of variables to identify those that best explain the variation in residential land value (ArcGIS Pro 3.1, 2023a).

Table 2
Dependent variable and influential explanatory variables (2017).

Variable	Unit	Mean	SD	Median	Min	P10	P90	Max
Residential land value	Million IDR/m ²	28.16	20.84	20.82	3.77	9.32	65.14	131.76
Apartment	m	1,387	775	1,272	119	533	1,996	5,388
Mall	m	1,541	642	1,451	192	734	2,348	4,022
Modern retail	m	454	262	394	27	165	764	1,519
Gas station	m	1,256	473	1,224	189	715	1,959	2,917
University	m	1,015	500	944	13	440	1,748	3,327
Open space	m	659	434	639	21	145	1,266	2,652
Population density (800 m radius)	People per km ²	0.00	6,215	-2,357	-17,012	-6,218	9,791	12,687
Transjakarta station	m	806	302	786	89	397	1,183	1,900

Source: Authors.

Notes:

- Residential land value is nominal million IDR/m² for readability. All model estimates and maps use IDR/m².
- Population density is mean-centred by year, therefore the mean is 0.00 by construction; SD reflects dispersion around the yearly average.
- MRT Jakarta was not operational in 2017, so the variable is omitted.

Table 3
Dependent variable and influential explanatory variables (2021).

Variable	Unit	Mean	SD	Median	Min	P10	P90	Max
Residential land value	Million IDR/m ²	21.85	16.17	16.21	3.54	6.76	42.77	107.49
Apartment	m	1,777	1,135	1,406	58	772	3,325	6,977
Mall	m	1,471	502	1,412	151	936	2,093	3,781
Modern retail	m	450	285	384	33	134	843	1,547
Gas station	m	1,145	472	1,082	119	557	1,870	2,463
University	m	891	501	845	35	399	1,362	2,948
Open space	m	602	348	600	10	173	935	2,521
Population density (800 m radius)	People per km ²	0.00	3,591	−789	−11,723	−3,497	4,837	17,096
Transjakarta station	m	841	334	804	104	416	1,248	2,677
MRT Jakarta station	m	6,744	4,182	5,607	450	1,981	13,519	14,894

Source: Authors.

Notes:

- Residential land value is nominal million IDR/m² for readability. All model estimates and maps use IDR/m².
- Population density is mean-centred by year, therefore the mean is 0.00 by construction; SD reflects dispersion around the yearly average.
- Due to MRT Jakarta's limited coverage and the citywide land-value sample, distances to MRT are often several kilometres.

Table 4
OLS regression results for 2017 and 2021. Dependent variable: Residential land value in IDR/m².

Year	2017		2021	
Variable	Coefficient (IDR/m ²)	P-value	Coefficient (IDR/m ²)	P-value
Intercept	46,135,153	***	31,217,299	***
Apartment	−6,493	***	−1,483	**
Mall	−10,017	***	−8,724	***
Modern retail	26,280	***	12,086	***
Open space	−11,844	***	−3,198	**
Gas station	6,443	***	4,834	***
University	3,163	**	4,829	***
Population density	−922	***	383	**
Transjakarta station	−11,088	***	5,946	***
MRT station	—	—	−1,890	***
Adjusted R ²	0.523		0.521	

Source: Authors.

Notes:

- Coefficients indicate estimated change in land value per square metre (IDR/m²) associated with a one-unit increase in the explanatory variable.
- Asterisks denote statistical significance: **p < 0.01, ***p < 0.001.
- MRT Jakarta was not operational in 2017, so the variable is omitted for that year.

Tables 2 and 3 present residential land value as the dependent variable and the final set of most influential explanatory variables.

These variables were used in the OLS and GWR models for two reference periods. The first is 2017, which covers transactions between January 2017 and July 2018 (n = 1,226 transactions). By this time, all 13 corridors of Transjakarta were already operating (Adiwinarto, 2020). The second period is 2021 and covers transactions between January 2021 and December 2021 (n = 920 transactions). By this time, MRT Jakarta and LRT Jakarta were already operating. The transactions are spatially dispersed across Jakarta's five municipalities rather than confined to a sub-market.

The OLS model results are presented in tabular format, as they offer a

single global set of coefficients that apply uniformly across the study area. In contrast, GWR models generate local coefficients that vary spatially. Therefore, the results are presented through maps, which allow for the visualisation of spatial variation in the relationships between residential land value and explanatory variables. This distinction in presentation methods reflects the methodological differences between global and local regression approaches. To represent spatial variation in coefficients, the GWR maps were classified using the Natural Breaks (Jenks) method. This approach groups data values by minimising variance within classes and maximising variance between them, which is particularly effective when coefficient distributions are skewed or uneven. As a result, the maps reflect the underlying statistical structure of the GWR outputs and support a nuanced visual interpretation of coefficient intensities across space. For interpretability, negative distance coefficients are read as uplift (higher values closer to the station), while positive distance coefficients are read as proximity penalties (lower values closer to the station).

5. Results

5.1. Global regression results: OLS models (2017 and 2021)

The resulting OLS models had an Adjusted R² value of 0.52 for both years 2017 and 2021 (Table 4). For 2017, the variables that generated a negative coefficient were Distance to Apartment, Mall, Open space and Transjakarta station, meaning that closer proximity to these features was associated with higher residential land values. Conversely, the variables Distance to Modern retail, Gas station and University had a positive coefficient, indicating that closer proximity was associated to lower land values. In addition, the negative coefficient for Population density suggested that land in denser areas had lower values. In 2021, most correlations remained consistent, with three significant changes. First, Distance to Transjakarta station turned positive, showing that proximity to Transjakarta stations was now associated with lower residential land values. Second, Distance to MRT Jakarta station, introduced for 2021, had a negative coefficient, indicating higher land values closer to MRT stations. Finally, Population density switched to a positive coefficient,

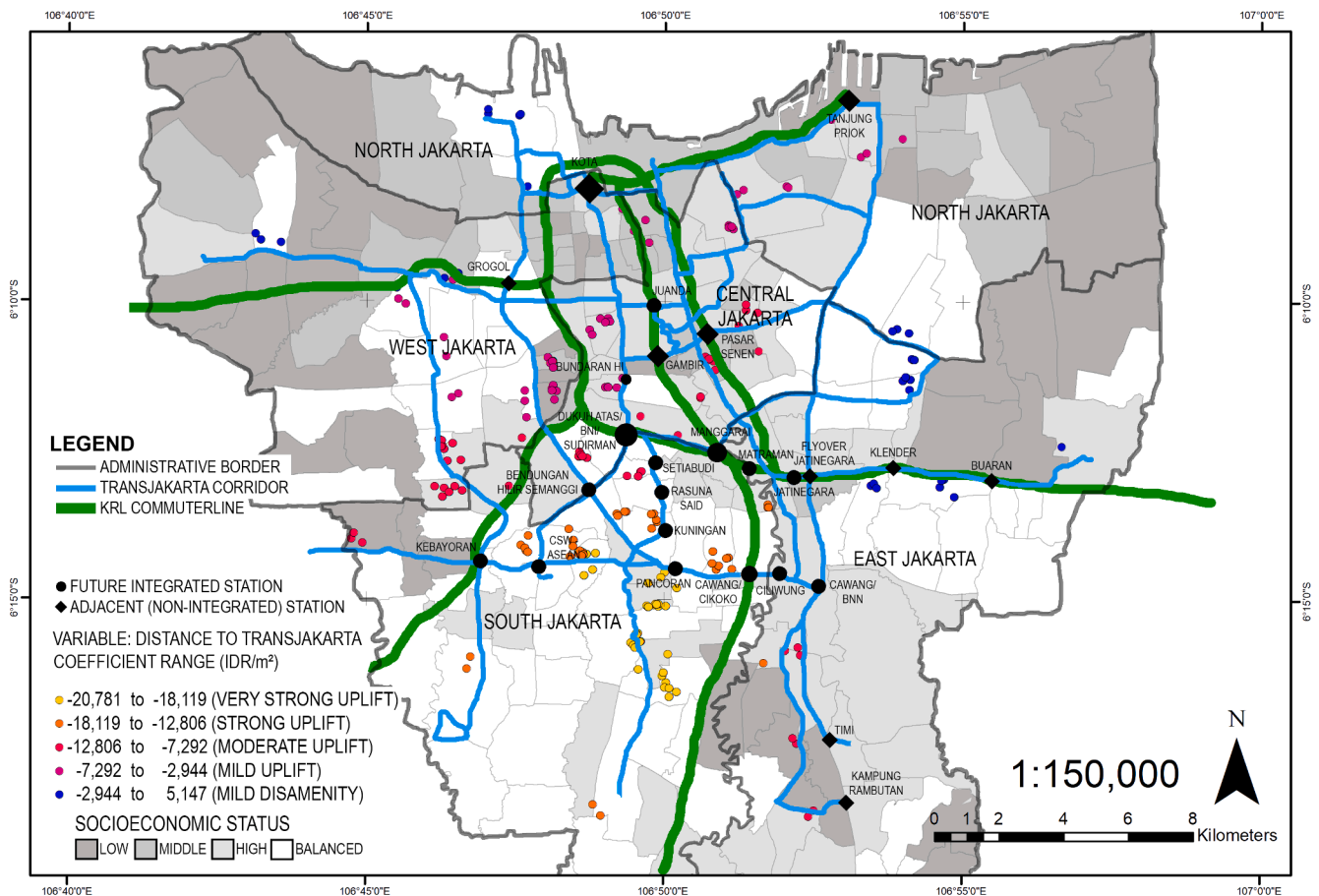


Fig. 3. GWR model with residential land value per m^2 in 2017. Variable Distance to Transjakarta station overlaid with spatial distribution of educational attainment (proxy for SES).

Source: Authors.

Notes:

- Coefficients are in IDR/m^2 .
- Negative coefficients indicate LVU. Coefficient categories were classified using the Natural Breaks (Jenks) method. Labels such as very strong, strong, moderate and mild uplift and mild disamenity are relative only to this specific model output and not universally defined thresholds.
- Educational categories follow Kusumah and Wasesa (2023): not completed elementary school (LOW), graduated elementary and junior high school (MIDDLE), and graduated high school (HIGH). BALANCED is interpreted as areas with a relatively even distribution of residents across educational categories. The authors used educational attainment as proxy for neighbourhood SES due to absence of small-area income/consumption data.

suggesting that denser areas had become more desirable residential locations over time.

5.2. Local regression results: GWR models (2017 and 2021)

The GWR models outperformed OLS models in explaining the spatial variation of residential land values, with higher Adjusted R^2 values of 0.72 for 2017 and 0.61 for 2021. This confirms that local relationships between residential land value and explanatory variables differ spatially across Jakarta, with a particular focus on Distance to Transjakarta and MRT Jakarta stations.

5.2.1. Influence of Transjakarta stations across Jakarta

In 2017, the coefficients of Distance to Transjakarta station were predominantly negative in South Jakarta, especially around two stations of Corridor 1, the first BRT corridor implemented (Fig. 3). Blok M station is the bus terminal of Corridor 1 and, since 2019, is also in proximity to

the Blok M BCA MRT station. ASEAN station is part of the CSW-ASEAN intermodal station that connects four Transjakarta stations (ASEAN and Kejaksaan Agung for Corridor 1, CSW 1 for the aboveground Corridor 13, including the 13E express line, and CSW 2 for non-BRT Transjakarta buses) and the ASEAN MRT station. These results indicate that proximity to BRT stations was associated with higher residential land values, especially in high-income and middle-class areas in South Jakarta. However, a few sectors in North and East Jakarta, associated with lower-income neighbourhoods and industrial areas, already showed weaker negative coefficients. In some peripheral areas, coefficients were already positive, indicating early signs of BRT proximity penalties. This divergence suggests that, while Transjakarta still offered benefits in affluent, central areas, these were more limited in lower-income or less-integrated neighbourhoods.

By 2021, this spatial pattern had reversed, as the coefficients were positive across all five municipalities (Fig. 4), indicating that residential land value decreases as proximity to BRT increases. This suggests that

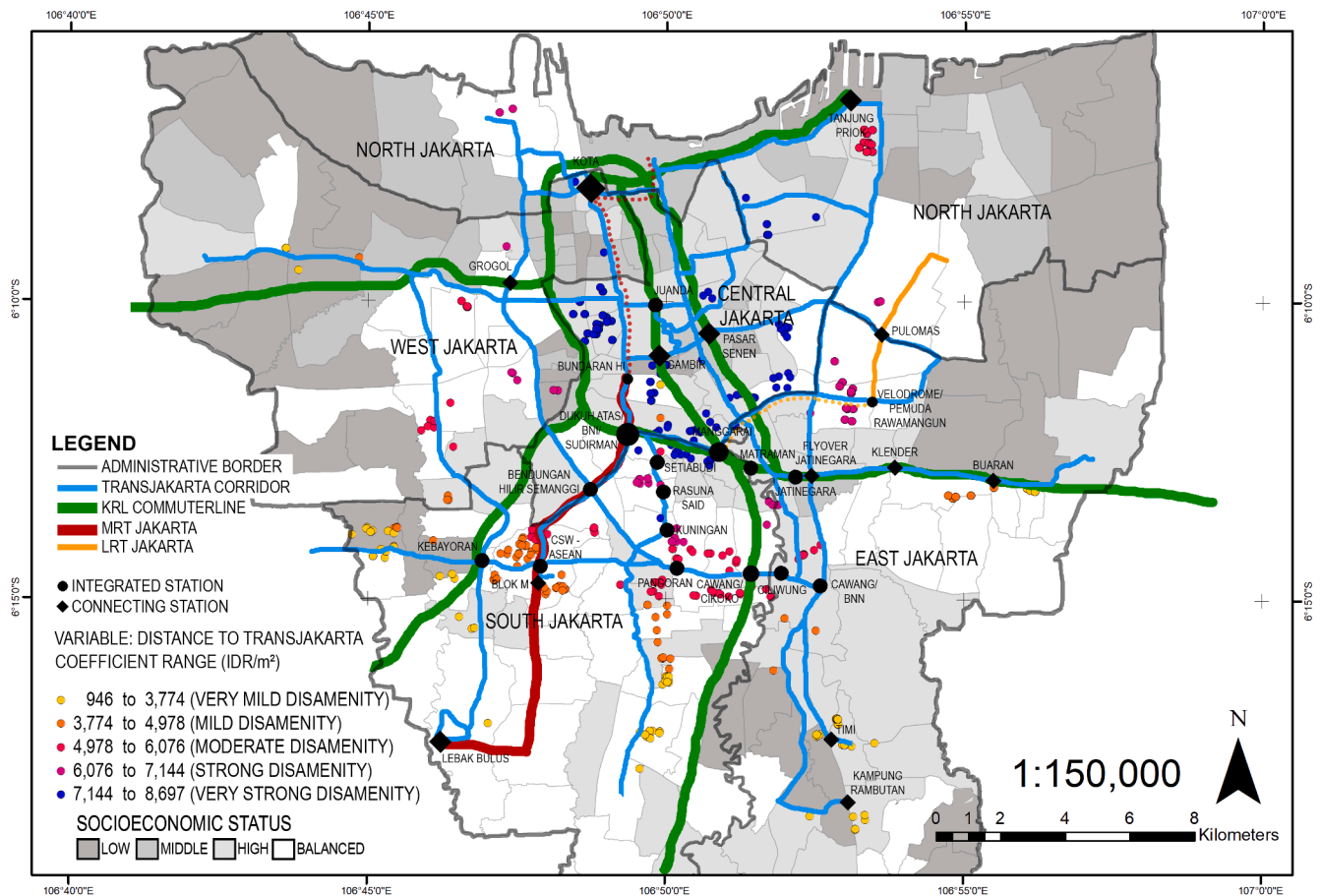


Fig. 4. GWR model with residential land value per m² in 2021. Variable Distance to Transjakarta station overlaid with spatial distribution of educational attainment (proxy for SES):

Source: Authors.

Notes:

– Coefficients are in IDR/m².

– Positive coefficients indicate disamenity effect. Coefficient categories were classified using the Natural Breaks (Jenks) method. Labels such as very mild, mild, moderate, strong and very strong disamenity are relative only to this specific model output and not universally defined thresholds.

– Educational categories follow Kusumah and Wasesa (2023): not completed elementary school (LOW), graduated elementary and junior high school (MIDDLE), and graduated high school (HIGH). BALANCED is interpreted as areas with a relatively even distribution of residents across educational categories. The authors used educational attainment as proxy for neighbourhood SES due to absence of small-area income/consumption data.

the accessibility benefits once associated with BRT had diminished, and negative externalities were now more striking. The citywide spread of positive coefficients indicated that no single sub-market drives the reversal. Notably, Central Jakarta showed some of the highest positive coefficients, even more so than in northern and eastern areas. This means that proximity penalties were stronger in the centre. On the other hand, South Jakarta, which had shown the highest LUV in 2017, now exhibited the lowest positive coefficients in 2021, indicating that the disamenity effects were less severe than in other areas. This spatial gradient suggests that the characteristics of Transjakarta stations and their relationship to the surrounding urban environment may be relevant when studying BRT impacts on land values.

5.2.2. Influence of MRT Jakarta across Jakarta

The GWR model for 2021 revealed a striking contrast when analysing Distance to MRT Jakarta station, as it showed consistent negative coefficients across the city, especially in South and Central Jakarta, particularly around Blok M and CSW-ASEAN stations (Fig. 5). This signalled a clear uplift near MRT stations, suggesting that the system has become a desirable urban asset. Unlike Transjakarta, MRT Jakarta benefits from higher perceived quality, reliability and status. This pattern aligns with the concentration of policy attention and investment

around urban rail.

Was Transjakarta's decline driven by MRT Jakarta? The timing (pre- vs post-rail) and spatial coherence of the results are consistent with a rail-led substitution mechanism. Between 2017 and 2021, BRT coefficients flipped positive, while MRT coefficients, introduced in 2021, were robustly negative, with the strongest rail-side uplift concentrated at interchange nodes that received visible upgrades in South Jakarta. Absent rail, some BRT-adjacent tracts might still have exhibited penalties as networks matured. Nevertheless, the breadth and intensity of 2021 penalties suggest market repricing towards MRT Jakarta where policy and developer actions concentrated. The contrast between BRT and MRT underscores the role of mode quality, integration and station-area design, alongside public perception and infrastructure investment, in shaping land values. The study, however, does not claim causality, but rather reports associations that are elaborated in the following section, which compares the results with existing literature and draws policy implications.

6. Discussion and policy recommendations

These results reveal a marked rebalancing of residential values between 2017 and 2021 as Jakarta's mobility system evolved, with three

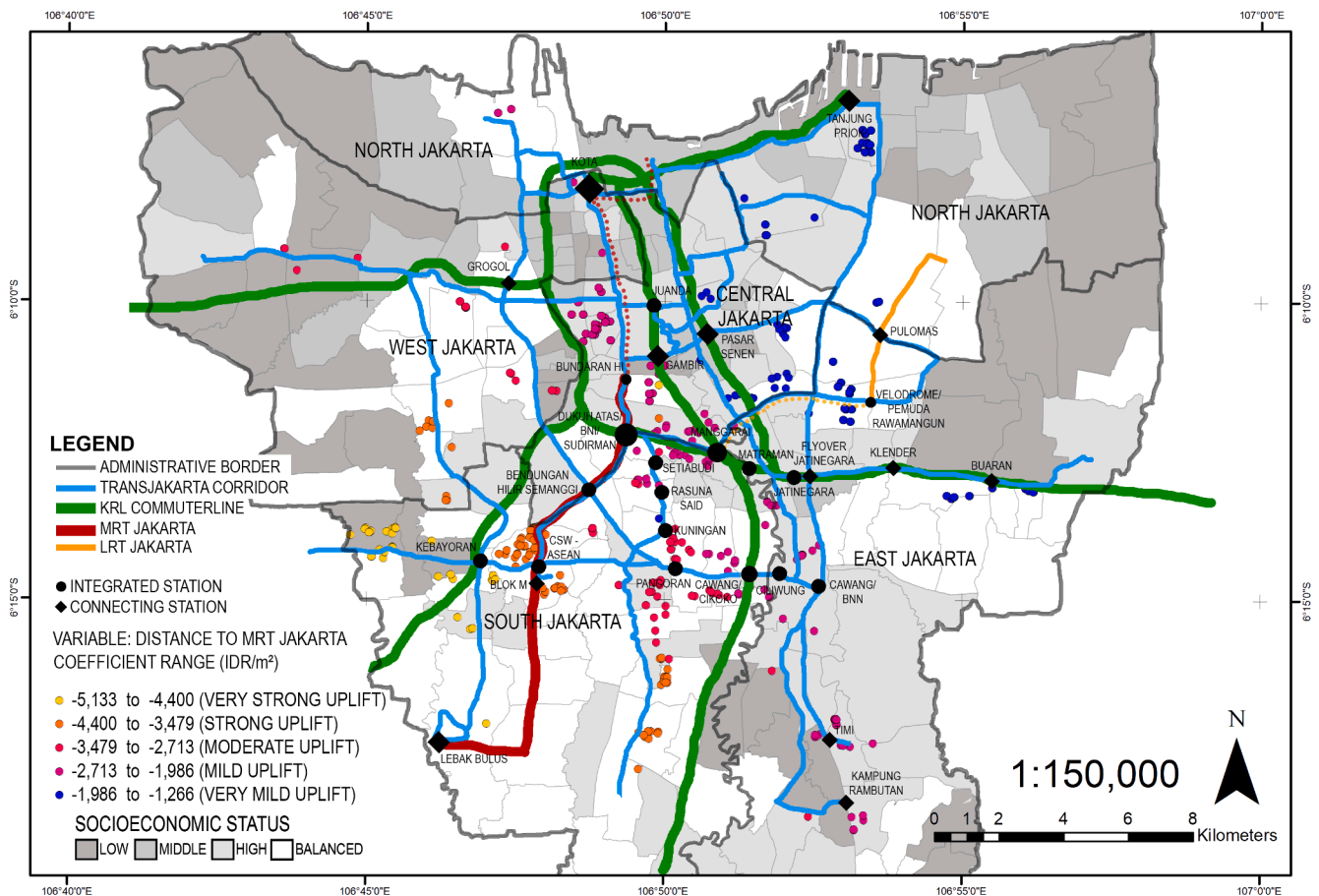


Fig. 5. GWR model with residential land value per m² in 2021. Variable Distance to MRT Jakarta station overlaid with spatial distribution of educational attainment (proxy for SES):

Source: Authors.

Notes:

- Coefficients are in IDR/m².
- Negative coefficients indicate LVU. Coefficient categories were classified using the Natural Breaks (Jenks) method. Labels such as very strong, strong, moderate, mild and very mild uplift are relative only to this specific model output and not universally defined thresholds.
- Educational categories follow Kusumah and Wasesa (2023): not completed elementary school (LOW), graduated elementary and junior high school (MIDDLE), and graduated high school (HIGH). BALANCED is interpreted as areas with a relatively even distribution of residents across educational categories. The authors used educational attainment as proxy for neighbourhood SES due to absence of small-area income/consumption data.

highlights. First, BRT premiums like in other cities in emerging economies tend to attenuate over time (Guzman et al., 2021; Yang et al., 2019b; Yang et al., 2020), as networks mature and high-quality alternatives re-anchor market expectations. The attenuation manifested as citywide BRT proximity penalties in 2021, with heterogeneity by sub-market: stronger penalties in Central, North and East Jakarta and milder effects in the south. Second, the shift from negative to strongly positive coefficients in Central Jakarta is more consistent with price formation along stand-alone BRT corridors. Government actions and developer strategies around MRT stations helped concentrate uplift around rail, while BRT corridors without comparable integration and design investments increasingly priced in proximity penalties. This mechanism differs from contexts in industrialised countries, where motorisation levels in central areas are usually lower. Finally, the coefficient shift for population density from negative to positive indicates stronger valuation of centrality and amenity bundles in denser areas, independent of direct MRT adjacency.

The spatial inequality in BRT station environments is clearly visible in Jakarta's urban landscape. Fig. 6 compares two Transjakarta stations in different neighbourhoods. The left photo shows Karet Sudirman station in South Jakarta, situated within a high-income area surrounded by modern high-rises, landscaped streets and more accessible pedestrian

infrastructure. In contrast, the right photo depicts Simpang Cempaka station in North Jakarta, located beneath a highway flyover with minimal integration into the urban fabric. Pedestrian accessibility is visibly neglected and surrounding commercial or residential investment is limited. These contrasting visuals help explain why models showed stronger uplift near BRT stations in South Jakarta and stronger disamenity effects in the north. The quality of urban integration, station design and land-use context matters. They also demonstrate how BRT implementation has been uneven across income groups and neighbourhoods, supporting the broader argument that infrastructure alone is not sufficient to shape urban land markets.

There are several factors why MRT Jakarta operation may have weakened Transjakarta's impact. First, MRT Jakarta implementation reoriented public planning, design and integration efforts towards rail nodes, with visible station-area improvements and TOD initiatives, signalling a change in urban policy and durable public commitment. Fig. 7 shows the Literature Park Martha Christina Tiahahu next to Blok M BCA MRT station in South Jakarta as an example of MRT Jakarta's TOD strategy. These investments plausibly redirected developers' attention and bidding towards areas served by MRT Jakarta. In contrast, the marginal contribution of proximity to stand-alone BRT stations declined, particularly where BRT corridors did not receive comparable



Fig. 6. Disparities in Transjakarta station design. Left: Karet Sudirman station (Corridor 1, South Jakarta). Right: Simpang Cempaka station (Corridor 10, North Jakarta). Photos: Franco Jauregui-Fung (2024).

design improvements or intermodal integration upgrades.

Second, the transition from localised BRT uplift to citywide BRT penalties alongside strong MRT uplift aligns with a substitution mechanism, where visible policy choices and developer strategies concentrate willingness-to-pay near urban rail, reducing BRT's contribution unless stations are integrated. Although the models identify associations rather than causal effects of specific regulations or projects, the spatial coherence across years linked with timing of rail operations and station-area upgrades makes a price-formation explanation more plausible. These findings are supported with international evidence suggesting that premiums generated by BRT accessibility may diminish or evaporate

with the expansion of urban rail (Yang et al., 2019a; Yang et al., 2019c), particularly considering that it tends to generate stronger, longer-lasting premiums than BRT (Zhang & Yen, 2020).

Therefore, this paper highlights three main policy recommendations. First, better-integrated transit planning is essential. Since the first track of MRT Jakarta runs along Transjakarta's Corridor 1 and the line intersects with at least five other corridors, integrated station planning offers a chance to mitigate Transjakarta's negative effects. Blok M and CSW-ASEAN stations demonstrate that integration can help retain value, as Transjakarta positive coefficients were lower around these stations, while MRT Jakarta negative coefficients were among the strongest, i.e.,



Fig. 7. Literature Park Martha Christina Tiahahu developed by MRT Jakarta. Photo: Franco Jauregui-Fung (2024).

the most LVU-consistent. Ongoing and future MRT expansions should be aligned strategically with existing Transjakarta stations to boost network accessibility. Second, proximity effects along BRT corridors require systematic mitigation, including design strategies that reduce conflicts and dwell-time externalities, deployment of zero-emission bus fleets to curb noise and local pollutants, and context-sensitive station design. BRT stations are often isolated in medians and accessed via long, narrow connecting bridges. Institutional coordination across agencies is necessary to align infrastructure investment with land-use policy, density and development incentives. Third, TOD and LVC mechanisms should be timed where market signals are strongest, such as at integrated BRT-MRT hubs, while pairing BRT-corridor upgrades with public-realm improvements. Apart from the timing, tailored LVC strategies should account for location-specific differences (Yang et al., 2020).

7. Conclusions

BRT remains an attractive solution for cities in emerging economies aiming to reduce congestion and pollution. It can deliver high passenger capacity at a fraction of urban rail's capital cost and can be incrementally implemented. Nevertheless, an emphasis on minimising costs and timelines often limits BRT's potential to generate LVU. Unlike rail, BRT is still largely perceived as a technical intervention rather than a tool for influencing land markets. The academic literature on BRT's impact is only just burgeoning and has not yet been broadly integrated into urban policy.

This paper examined the effects of Transjakarta's BRT corridors and MRT Jakarta on residential land values using OLS and GWR models for 2017 and 2021. The results show that the positive impact of BRT stations diminished over time and became negative, particularly in the centre and the peripheral areas in the north and east, while the disamenity effects were less pronounced around stations in South Jakarta. Conversely, MRT Jakarta's service emerged as the dominant driver of land value appreciation, particularly in South Jakarta too. These findings align with other studies that suggest that BRT's LVU diminishes with the introduction of higher-quality urban rail. This reversal is interpreted as market repricing: the opening of MRT Jakarta with visible station-area interventions re-anchored expectations and redirected developer bidding towards the rail line, reducing Transjakarta's marginal contribution along unimproved BRT corridors.

Therefore, this paper suggests the need to strategically integrate BRT and MRT stations to sustain bus-based benefits once urban rail enters the network. Where BRT and MRT overlap, co-location and seamless integration can retain value on both modes. Where BRT stands alone and proximity penalties are unaddressed, these disamenities are priced into residential land values. Moreover, timing TOD and LVC instruments is essential at integrated BRT-MRT hubs where market signals are strongest, whereas BRT proximity effects should be curbed by context-sensitive station design and cleaner bus fleets.

As this study focused exclusively on residential land values, further research is necessary to understand whether urban rail substitution is symmetric across commercial, retail and industrial land values. Furthermore, Jakarta's evolving network offers a natural next step: assessing LRT Jabodebek, opened in 2023 in South Jakarta and which includes stations with integrated access to Transjakarta. This would offer a promising opportunity to explore multimodal synergies.

Finally, given financing constraints and long construction periods, it is very unlikely that local governments in emerging economies will prioritise urban rail over BRT in the short-term. Although BRT may not be the most reliable instrument for long-run LVU without strong integration and design, it often serves as the first learning experience for cities on how to implement and operate institutional transit. That role should not be discounted. Unlocking BRT's fuller potential requires embedding it in a broader vision of inclusive, transit-oriented and compact urban development, treating the system not only as a means to

move buses efficiently, but also as a city-shaping infrastructure capable, with the necessary high-quality urban design features, of helping enhance local liveability. This could serve as a foundation for future rail development when cities are ready.

CRedit authorship contribution statement

Franco Jauregui-Fung: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Conceptualization. **Tobias Kuhnimhof:** Writing – review & editing. **Jeffrey Kenworthy:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors would like to thank the company Cityplan for their assistance in the data collection and execution of the regression models. Special thanks to Aulia Arfida Paramita and Haikal Muhammad for their support.

References

- Abiad, A., Farrin, K., Hale, C., 2019. *Sustaining transit investment in Asia's cities: a beneficiary-funding and land value capture perspective*. ADB (Asian Development Bank), Metro Manila.
- Acharya, S.R., Morichi, S., 2007. Motorization and role of mass rapid transit in East Asian megacities. *IATSS Res.* 31 (2), 6–16. [https://doi.org/10.1016/S0386-1112\(14\)60217-X](https://doi.org/10.1016/S0386-1112(14)60217-X).
- Adiatma, J.C., 2020. *A transition towards low carbon transport in Indonesia: a technological perspective*. IESR (Institute for Essential Services Reform), Jakarta.
- Adiwinarto, Y., 2020. *Intermodal integration: how Transjakarta improved urban mobility*. Retrieved from: <https://www.itdp.org/event/transjakarta-improved-urban-mobility/>.
- Angelina, S., Vallée, D.H.A., Louen, C., 2017. The barriers in the implementation process and the operation of innovative urban transport: the case of BRT Jakarta. In: Ricci, S., Brebbia, C.A. (Eds.), *WIT Transactions on the Built Environment: Urban Transport XXIII*, Vol. 176. WIT Press, Southampton, Boston, pp. 69–80.
- ArcGIS Pro 3.1. (2023a). Exploratory Regression (Spatial Statistics). Retrieved from <https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/exploratory-regression.htm>.
- ArcGIS Pro 3.1. (2023b). How Geographically Weighted Regression (GWR) works. Retrieved from <https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/how-geographicallyweightedregression-works.htm>.
- ArcGIS Pro 3.1. (2023c). How OLS regression works. Retrieved from <https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/how-ols-regression-works.htm>.
- Asimeng, E.T., Jauregui-Fung, F., 2025. Tailoring bus rapid transit to the complex realities of African Cities: critical issues and public policy planning approaches. *Transportation Research Interdisciplinary Perspectives* 30, 101351. <https://doi.org/10.1016/j.trp.2025.101351>.
- Bank Mandiri, 2022. FAQ: E-Money Jak Lingko. Retrieved from: <https://www.bankmandiri.co.id/en/campaign-e-money-jaklingko/C2%A0>.
- Benita, F., 2023. Exploring non-mandatory travel behavior in Jakarta City: Travel time, trip frequency, and socio-demographic influences. *Transportation Research Interdisciplinary Perspectives* 21, 100896. <https://doi.org/10.1016/j.trp.2023.100896>.
- Birungi, C., 2024. *Get on board with BRT: Unveiling the updated BRT Standard*. Retrieved from: <https://www.itdp.org/wp-content/uploads/2024/03/Get-on-board-with-BRT-Claire-Birungi.pptx.pdf>.
- Bocarejo, J.P., Portilla, I., Pérez, M.A., 2013. Impact of Transmilenio on density, land use, and land value in Bogotá. *Research in Transportation Economics* 40 (1), 78–86. <https://doi.org/10.1016/j.retrec.2012.06.030>.
- BPS-Statistics of DKI Jakarta Province, 2020. *DKI Jakarta Province in figures*. BPS-Statistics of DKI Jakarta Province, Jakarta.
- Bradley, M. J. (2010). *Ultra-efficient bus rapid transit timetabling*. (Doctor of Philosophy). Curtin University Sustainability Policy Institute, Perth. Retrieved from <https://espace.curtin.edu.au/handle/20.500.11937/75>.
- BRTData. (2024). Key indicators per region. Retrieved from <https://brtdata.org/>.
- Cervero, R., 2004. The property value case for transit. In: Dunphy, R. (Ed.), *Developing around Transit: Strategies and Solutions That Work*. Urban Land Institute, Washington DC.

- Cervero, R., Dai, D., 2014. BRT TOD: Leveraging transit oriented development with bus rapid transit investments. *Transport Policy* 36 (November), 127–138. <https://doi.org/10.1016/j.tranpol.2014.08.001>.
- Cervero, R., Kang, C.D., 2011. Bus rapid transit impacts on land uses and land values in Seoul, Korea. *Transport Policy* 18 (1), 102–116. <https://doi.org/10.1016/j.tranpol.2010.06.005>.
- Debrezion, G., Pels, E., Rietveld, P., 2007. The impact of railway stations on residential and commercial property value: a meta-analysis. *The Journal of Real Estate Finance and Economics* 35 (2), 161–180. <https://doi.org/10.1007/s11146-007-9032-z>.
- Deng, T., Nelson, J.D., 2011. Recent developments in Bus Rapid Transit: a review of the literature. *Transport Reviews* 1 (1), 69–96. <https://doi.org/10.1080/01441647.2010.492455>.
- Deng, T., Ma, M., Nelson, J.D., 2016. Measuring the impacts of bus rapid transit on residential property values: the Beijing case. *Research in Transportation Economics* 60, 54–61. <https://doi.org/10.1016/j.retrec.2016.08.005>.
- Dhindaw, J., Kumaraswamy, S.K., Prakash, V.S., Chanchani, R., Deb, A., 2021. *Synergizing land value capture and transit-oriented development: a study of Bengaluru metro*. WRI India (World Resources Institute India), Bengaluru.
- Du, H., Mulley, C., 2012. Understanding spatial variations in the impact of accessibility on land value using geographically weighted regression. *Journal of Transport and Land Use* 5 (2), 46–59. <https://doi.org/10.5198/jtlu.v5i2.225>.
- Ernst, J.P., 2005. Initiating bus rapid transit in Jakarta, Indonesia. *Transportation Research Record* 1903 (1), 20–26. <https://doi.org/10.1177/0361198105190300103>.
- Ernst, J.P., Sutomo, H., 2010. BRT's Influence on public transport improvements in Indonesian cities. *Built Environment* 36 (3), 344–352. <https://doi.org/10.2148/benv.36.3.344>.
- Farda, M., al-Rasyid Lubis, H., 2018. Transportation system development and challenge in Jakarta Metropolitan Area, Indonesia. *International Journal of Sustainable Transportation Technology* 1 (2), 42–50. <https://doi.org/10.31427/IJSTT.2018.1.2.2>.
- Fitriani, S., Kharisma, P., Sampurna, H., Sholihah, S., Susanti, N., 2019. Sterilization of bus rapid transit special lane case study: Transjakarta. *Advances in Transportation and Logistics Research* 2 (2019), 473–480. <https://doi.org/10.25292/ATLR.V2I20.200>.
- Flores Dewey, O., 2010. *The value of a promise: Estimating the effects of a promise to build mass transit infrastructure on housing prices in Ecatepec, Mexico (Working paper)*.
- Gospodini, A., 2005. Urban development, redevelopment and regeneration encouraged by transport infrastructure projects: the case study of 12 European cities. *European Planning Studies* 13 (7), 1083–1111. <https://doi.org/10.1080/09654310500242121>.
- Guzman, L.A., Enríquez, H.D., Hessel, P., 2021. BRT system in Bogotá and urban effects: more residential land premiums? Research in Transportation Economics 90, 101039. <https://doi.org/10.1016/j.retrec.2021.101039>.
- Hendra, O., Barus, L.S., 2022. LRT's Transit Oriented Development in Jakarta, Bogor and Bekasi: The urban infrastructure development vs economic interest. Paper presented at the Sustainable Development Approaches, Cham.
- Hidalgo, D., Carrigan, A., 2010. *Modernizing public transportation: Lessons learned from major bus improvements in Latin America and Asia*. WRI (World Resources Institute) & EMBARQ, Washington, DC.
- Huang, H., 1996. The land-use impacts of urban rail transit systems. *Journal of Planning Literature* 11 (1), 17–30. <https://doi.org/10.1177/088541229601100103>.
- ITDP (Institute for Transportation and Development Policy), 2016. BRT rankings. Retrieved from: <https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/best-practices-2013/>.
- ITDP (Institute for Transportation and Development Policy), 2019. Transjakarta: a study in success. Retrieved from: <https://www.itdp.org/2019/07/15/transjakarta-study-success/>.
- ITDP (Institute for Transportation and Development Policy), 2022. *Transjakarta electric bus system*. Retrieved from: https://go.itdp.org/download/attachments/179346841/Transjakarta%20E-Bus%20System_Workshop%20E-Bus%20Kampala.pdf?version=1&modificationDate=1647515634812&api=v2&download=true.
- ITDP (Institute for Transportation and Development Policy), 2021. *Lessons learned from Jakarta's journey to integrated and resilient transport systems*. ITDP, New York, NY.
- Jauregui-Fung, F., 2022a. BRT Transjakarta: Phasing in, performing and expanding a new system within a consolidated urban area: Report for the “Inclusive and sustainable smart cities in the framework of the 2030 Agenda for Sustainable Development” Project. German Institute of Development and Sustainability (IDOS), Bonn.
- Jauregui-Fung, F., 2022b. Introduction to sustainable public transport solutions in Latin America and the Caribbean (LAC) and Asia: Report for the “Inclusive and sustainable smart cities in the framework of the 2030 Agenda for Sustainable Development” Project. German Institute of Development and Sustainability (IDOS), Bonn.
- Kementerian PUPR (Kementerian Pekerjaan Umum dan Perumahan Rakyat). (2020). *Hunian berbasis transit (TOD): Tantangan dan potensinya* (D. A. Soeranto, P. Marpaung, & C. R. P. Situmorang Eds.). Jakarta: Kementerian PUPR.
- Kilpatrick, J., Throupe, R., Carruthers, J., Krause, A., 2007. The impact of transit corridors on residential property values. *Journal of Real Estate Research* 29 (3), 303–320. <https://doi.org/10.1080/10835547.2007.12091201>.
- Kusumah, H., Wasesa, M., 2023. Unraveling the most influential determinants of residential segregation in Jakarta: a spatial agent-based modeling and simulation approach. *Systems* 11 (1), 20. <https://doi.org/10.3390/systems11010020>.
- Levinson, H.S., Zimmerman, S., Clinger, J., Rutherford, S., 2002. Bus rapid transit: an overview. *Journal of Public Transportation* 5 (2), 1–30. <https://doi.org/10.5038/2375-0901.5.2.1>.
- Levinson, H., Zimmerman, S., Clinger, J., Rutherford, S., Smith, R. L., Racknell, J. C., & Oberman, R. S. (2003). *TCRP Report 90: Bus rapid transit* (Vol. 1: Case studies in bus rapid transit). Washington, D.C.: Transportation Research Board.
- McIntosh, J., Newman, P., Trubka, R., Kenworthy, J., 2017. Framework for land value capture from investments in transit in car-dependent cities. *Journal of Transport and Land Use* 10 (1), 155–185. <https://doi.org/10.5198/jtlu.2015.531>.
- Mohammad, S.I., Graham, D.J., Melo, P.C., Anderson, R.J., 2013. A meta-analysis of the impact of rail projects on land and property values. *Transportation Research Part a: Policy and Practice* 50, 158–170. <https://doi.org/10.1016/j.tra.2013.01.013>.
- Mulley, C., 2014. Accessibility and residential land value uplift: Identifying spatial variations in the accessibility impacts of a bus transitway. *Urban Studies* 51 (8), 1707–1724. <https://doi.org/10.1177/0042098013499082>.
- Muñoz-Raskin, R., 2010. Walking accessibility to bus rapid transit: does it affect property values? the case of Bogotá, Colombia. *Transport Policy* 17 (2), 72–84. <https://doi.org/10.1016/j.tranpol.2009.11.002>.
- Nguyen, M.H., Pojani, D., 2018. Why do some BRT systems in the Global South fail to perform or expand? In: Shifan, Y., Kamargianni, M. (Eds.), *Advances in Transport Policy and Planning*, Vol. 1. Academic Press, pp. 35–61.
- Perdomo Calvo, J.A., Mendoza Álvarez, C., Mendieta López, J.C., Baquero Ruiz, A., 2007. *Study of the effect of the TransMilenio mass transit project on the value of properties in Bogotá, Colombia*. Lincoln Institute of Land Policy, Cambridge, MA.
- PT. Kereta Commuter Indonesia. (2020). *Rekayasa Operasional KRL Pada Masa PSBB Transisi*. Retrieved from <https://commuterline.id/informasi-publik/berita/rekayasa-operasional-krl-pada-masa-psbb-transisi>.
- Razvadauskas, F.V., 2018. *Megacities: developing country domination*. Retrieved from: https://go.euromonitor.com/strategy-briefing-cities-2018-megacities.html?utm_campaign=SC_18_10_02_Megacities&utm_medium=Email&utm_source=1_Outbound.
- Roberts, M., Sander, F.G., Tiwari, S., 2019. *Time to ACT: Realizing Indonesia's Urban potential*. World Bank Publications.
- Rodríguez, D.A., Mojica, C., 2008. Land value impacts of bus rapid transit: the case of Bogotá's TransMilenio. *Land Lines, Lincoln Institute of Land Policy*, April, 1–8.
- Rodríguez, D.A., Mojica, C.H., 2009. Capitalization of BRT network expansions effects into prices of non-expansion areas. *Transportation Research Part a: Policy and Practice* 43 (5), 560–571. <https://doi.org/10.1016/j.tra.2009.02.003>.
- Rodríguez, D.A., Targa, F., 2004. Value of accessibility to Bogotá's bus rapid transit system. *Transport Reviews* 24 (5), 587–610. <https://doi.org/10.1080/0144164042000195081>.
- Rodríguez, D.A., Vergel-Tovar, C.E., 2018. Urban development around bus rapid transit stops in seven cities in Latin-America. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability* 11 (2), 175–201. <https://doi.org/10.1080/17549175.2017.1372507>.
- Salon, D., Wu, J., Shewmake, S., 2014. Impact of bus rapid transit and metro rail on property values in Guangzhou, China. *Transportation Research Record* 2452 (1), 36–45. <https://doi.org/10.3141/2452-05>.
- Saraswati, K., Ramadhan, G., 2020. 15 Years on, Transjakarta is better than ever. Retrieved from Sustainable Transport 31 (January), 23–25. <https://www.itdp.org/wp-content/uploads/2020/02/ST31.snnew.pdf>.
- Sharma, R., Newman, P., 2017. Urban rail and sustainable development key lessons from Hong Kong, New York, London and India for emerging cities. *Transportation Research Procedia* 26, 92–105. <https://doi.org/10.1016/j.trpro.2017.07.011>.
- Sharma, R., Newman, P., 2018a. Can land value capture make PPP's competitive in fares? a Mumbai case study. *Transport Policy* 64, 123–131. <https://doi.org/10.1016/j.tranpol.2018.02.002>.
- Sharma, R., Newman, P., 2018b. Does urban rail increase land value in emerging cities? Value uplift from Bangalore Metro. *Transportation Research Part a: Policy and Practice* 117, 70–86. <https://doi.org/10.1016/j.tra.2018.08.020>.
- Shyr, O., Andersson, D.E., Wang, J., Huang, T., Liu, O., 2013. Where do home buyers pay most for relative transit accessibility? Hong Kong. Retrieved from Taipei and Kaohsiung Compared. *Urban Studies* 50 (12), 2553–2568. <http://www.jstor.org/stable/261445598>.
- Sofa, A., 2023. Taking public transport? Here's how to get JakLingko cards. Retrieved from: <https://smartcity.jakarta.go.id/en/blog/begini-cara-mendapatkan-kartu-jaklingko/>.
- Suzuki, H., Cervero, R., Iuchi, K., 2013. *Transforming cities with transit: transit and land-use integration for sustainable urban development*. World Bank, Washington, DC.
- Wang, X., Tong, D., Gao, J., Chen, Y., 2019. The reshaping of land development density through rail transit: the stories of central areas vs. suburbs in Shenzhen, China. *Cities* 89, 35–45. <https://doi.org/10.1016/j.cities.2019.01.013>.
- Wardrip, K., 2011. Public transit's impact on housing costs: a review of the literature. Retrieved from Insights from Housing Policy Research(august) 1–12. <http://www.reconnectingamerica.org/assets/Uploads/TransitImpactonHsgCostsfinal-Aug102011.pdf>.
- Wu, I., Pojani, D., 2016. Obstacles to the creation of successful bus rapid transit systems: the case of Bangkok. *Research in Transportation Economics* 60, 44–53. <https://doi.org/10.1016/j.retrec.2016.05.001>.
- Yang, L., 2021. Non-linear relationships between bus rapid transit and property prices. In: Yang, L. (Ed.), *Property Price Impacts of Environment-Friendly Transport Accessibility in Chinese Cities*. Springer Nature Singapore, Singapore, pp. 89–101.
- Yang, L., Chau, K.W., Chu, X., 2019a. Accessibility-based premiums and proximity-induced discounts stemming from bus rapid transit in China: Empirical evidence and policy implications. *Sustainable Cities and Society* 48, 101561. <https://doi.org/10.1016/j.scs.2019.101561>.
- Yang, L., Chau, K.W., Wang, X., 2019b. Are low-end housing purchasers more willing to pay for access to basic public services? evidence from China. *Research in Transportation Economics* 76, 100734. <https://doi.org/10.1016/j.retrec.2019.06.001>.

- Yang, L., Zhou, J., Shyr, O.F., Huo, D., 2019c. Does bus accessibility affect property prices? *Cities* 84, 56–65. <https://doi.org/10.1016/j.cities.2018.07.005>.
- Yang, L., Chu, X., Gou, Z., Yang, H., Lu, Y., Huang, W., 2020. Accessibility and proximity effects of bus rapid transit on housing prices: Heterogeneity across price quantiles and space. *Journal of Transport Geography* 88, 102850. <https://doi.org/10.1016/j.jtrangeo.2020.102850>.
- Zhang, M., Yen, B.T.H., 2020. The impact of bus rapid transit (BRT) on land and property values: a meta-analysis. *Land Use Policy* 96, 104684. <https://doi.org/10.1016/j.landusepol.2020.104684>.
- Zhang, M., Yen, B.T.H., Mulley, C., Sipe, N., 2020. An investigation of the open-system bus rapid transit (BRT) network and property values: the case of Brisbane, Australia. *Transportation Research Part a: Policy and Practice* 134, 16–34. <https://doi.org/10.1016/j.tra.2020.01.021>.
- Zolnik, E., 2021. Geographically weighted regression models of residential property transactions: Walkability and value uplift. *Journal of Transport Geography* 92, 103029. <https://doi.org/10.1016/j.jtrangeo.2021.103029>.