

Article

Examining Socio-Economic Inequality Among Commuters: The Case of the Jakarta Metropolitan Area

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Abstract

The rapid development of urban areas in surrounding regions has led to an increasing number of commuters within and between core-peripheral regions. However, variation in jobs and economic levels has exacerbated the socio-economic inequalities between metropolitan residents. Using the commuter data of the Jakarta Metropolitan Area, this study examines the socio-economic disparities of commuting behaviour, spatial patterns, and health between commuters with incomes lower and higher than the regional minimum wage. The article conducts quantitative descriptive statistics and a non-parametric test using the BPS—Statistics Indonesia 2019 commuter data that included 13,000 sample respondents from the Jakarta Province and its neighbouring districts. Our result reveals a significant impact of income level on the choice of private transportation mode, whilst having no effect on the choice of public transportation modes. Higher-income peripheral residents tend to commute to the core metropolitan area (Jakarta Province), while lower-income commuters typically travel between peripheral areas. The article also indicates the negative physical health impact of prolonged and early-hours commuting, especially for lower-income groups. The article proposes better public transportation that is convenient, safe, and reliable, to ensure a sustainable and resilient metropolitan area.

Keywords

commuters; health; inequality; Jakarta; metropolitan area; transportation

Issue

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1. Introduction

Metropolitan areas represent the rapid development of urban areas that sprawl to surrounding peripheral regions. This development transforms both urban and peripheral regions unprecedentedly, impacting social, economic, spatial, and health aspects. The emerging decentralisation of urban regimes globally exaggerates the impact of this urban and peripheral transformation as the variation of the local economy and governance capacities critically determine development. Thus, it is crucial for urban planning literature and empirical case studies to adapt and respond to the transformation.

The above conditions are reflected in the Jakarta Metropolitan Area (JMA) as the largest metropolitan area in Indonesia. Following the decentralisation in 2001,

the metropolitan area included one province and eight autonomous districts in two other provinces. Following the dispersion of manufacturing industries in the late 1980s and residential housing development in the 1990s, economic activities in the JMA developed rapidly, supported by infrastructure and transportation expansion. This development and growing economic activities led to the increasing population and commuters within the metropolitan area.

Presently, studies on commuting in Indonesia focus on socio-economic characteristics (Herdayati & Eryando, 2020; Kusmawan et al., 2021), travel experience and psychology (Kusmawan & Susilowati, 2020), and mode choice (Adhi, 2012; Ilahi et al., 2021; Rizki et al., 2019; Rosida et al., 2019). In a spatial context, studies of the JMA mainly cover politics and governance (Firman, 1998;

Hudalah, 2017; Salim & Hudalah, 2020), socio-economics (Rukmana & Ramadhani, 2021; Winarso & Firman, 2002; Winarso et al., 2015), urban economies (Aritenang, 2020; Firman & Fahmi, 2017; Hudalah & Aritenang, 2017; Hudalah & Firman, 2012; Hudalah et al., 2013), and geographical networks (Aritenang, 2021; Hidayati et al., 2019; Indraprahasta & Derudder, 2017, 2019).

Despite the wide variation within the metropolitan area, there is limited understanding of how socio-economic inequality determines commuters' transportation mode choice, commuting behaviour, and health conditions. The JMA provides an important case study with Jakarta as the core metropolitan area, the country's capital, financial centre, and the densest city. With Jakarta as the core, Indonesia's largest metropolitan area is surrounded by eight districts from two neighbouring provinces.

We hypothesise that a wide range of socio-economic and income inequality between Jakarta and its neighbouring districts may explain commuting behaviour and transportation mode choice and, consequently, health conditions. In this sense, the core implies the central financial district with a concentration of companies and employees that attracts high- and low-income commuters. Thus, this study expands on how socio-economic disparity determines commuting patterns and health conditions. Our study is important to understand how socio-economic variations among districts exert commuting and health conditions within metropolitan areas.

As such, the article asks the question: To what extent are there current socio-economic inequalities in the JMA and how does this socio-economic disparity determine commuting behaviour and health issues in metropolitan areas? Drawing from the BPS—Statistics Indonesia 2019 commuter data that included 13,000 sample respondents from five districts in Jakarta and eight neighbouring districts in the JMA, the article found wide socio-economic disparity and the significance of the impact of income level on the choice of transportation mode. The article further found that the odds of physical health issues are higher among commuters that had daily long-duration commuting. This article presents these contributions and concludes with the importance of local governments and urban planners in expanding the provision of public transport for commuters from the metropolitan peripherals.

This article is structured as follows: In the next section, we elaborate on the literature framework of metropolitan inequalities, such as socio-economic and health issues. After, in the section that follows, we present commuting data and research methodologies. The analysis section examines commuting behaviour and spatial flow and links with socio-economic and health problems in JMA. The last section concludes the discussion and elaborates on research contributions.

2. Socio-Economic Variation and Its Impact on Spatial Pattern, Transportation, and Health in the Metropolitan Area

2.1. Metropolitan Socio-Economic and Health Inequalities

Cities grow and develop and together form urban areas with a broad scope transcending administrative boundaries. On a larger scale, a metropolitan area emerges as an urban area that is administratively separate but spatially connected and consists of the city centre and the surrounding area (Heinelt & Kübler, 2005). Through the development of cities, capital accumulation creates an increasingly large and complex variety of activities. Supported by advances in transportation and communication technology and connected with other cities, this accelerates capital accumulation in metropolitan areas (Sheppard, 2019). Thus, metropolitan areas often act as centres of high concentration activities to become an engine of regional growth on a regional, national, and even international scale. This accumulation of capital simultaneously attracts activities and people to engage in activities in the metropolitan area.

Cities have the potential to enhance development and growth, not only internally within their territory but also beyond their territory boundaries (Fan, 1999). The influence of urban growth and its activities increase the benefit distribution effect on the economy through two main types of development, i.e., intensive margin or internal growth and extensive margin or external development (Cordoba, 2008; Eaton & Eckstein, 1997). Studies have shown that average commuting activities reflect a range of socio-economic characteristics and urban forms (Watts, 2009). In the US, 45 of 916 metropolitan areas had gaps wider than the national gap. The average income of the top 1% was at least 35 times greater than the average income of the bottom 99% (Sommeiller & Price, 2018). The extensive studies on metropolitan areas by Ingram (1998) and Suarez-Villa (1988) in various parts of the world found a similar development pattern into metropolitan evolution based on population and economic characteristics. This metropolitan evolution has six phases, categorised as three stages, namely: the rapid development stage consisting of phases one and two; the second stage is maturity consisting of phases three and four, with phase three as the peak of metropolitan growth; and the stability stage, namely in phases five and six which show the stability of the region and the possibility of a decline in development. In this phase, there are two possible developments where the metropolitan area has the opportunity to expand internationally. The other possibility is a decline in growth that depends on the policies implemented in the future development of the metropolitan area.

Although rapid urbanisation has created economic opportunities for many cities, it has also resulted in serious challenges for local governments: increased air

and water pollution, transportation gridlock, deteriorating infrastructure, increased violence and crime, rising poverty and urban slums, and widening income disparities. Another causal-effect problem is that urban transport could contribute to poverty reduction indirectly by boosting the urban activities and directly by meeting the daily needs of poor people. However, urban growth also increases transport costs as efficiency and economies of agglomeration generate urban growth. As these cities grow and become more affluent, vehicle ownership and use grow more rapidly than the available road space, increasing congestion and traffic-generated air pollution (Carruthers et al., 2005). The study proposes to improve transportation affordability by identifying urban income distribution, provision of passes and concessions for targeted groups, and changing fare structure and level.

The above problems are magnified in a larger metropolitan area. The more districts and populations included in a metropolitan area, the more socio-economic challenges, infrastructure and transportation issues, and health problems occur. Recently, Unceta et al. (2020), using spatial analysis, examined socio-economic disparities (economic level, land, and property size) in the metropolitan area in the Global South. The study suggests problems occurring in metropolitan areas became harder to tackle once the metropolitan size and issues expanded and diversified, such as socio-economic, spatial, and health concerns. Studies in US metropolitan areas show that housing for lower-income households is less affordable in metropolitan areas with higher inequality. Thus, average commuting distances and the number of trips have increased between sub-centres. Jobs located in sub-centres are filled by non-residents who generally live quite far from their employment sub-centre. Hence, the average commuting distance has increased regardless of where people live (Aguilera, 2005). In particular, Sandow (2019) statistically confirms long-distance commuters pay high costs as the activity has reduced the relationship quality and increased the risk of separation. However, a more sustainable work-life balance may be more possible if the woman is a persistent long-distance commuter.

Spatial disparities also occurred among metropolitan areas. In Mexico, metropolitans suggest informal work locations may depend, in part, on the distance to the place of residence. Informal work represents close to 57% of the economic activity in the city and is present in all economic sectors and income categories and concentrated in lower-income groups (Suárez et al., 2016). In Germany, less educated people live more commonly outside the core cities of the Central German Metropolitan Region and its respective city regions and are more inclined to commute to their workplaces within one of the city regions (Kauffmann, 2016). These studies show that less educated and informal workers prefer jobs where income is maximised, and transportation costs minimised.

In contrast, skilled labour markets span over larger territories. However, they tend to do this within the

borders of the respective states as found in large cities such as Paris (Aguilera, 2005), Central German Metropolitan Region (Kauffmann, 2016), and London (Manley, 2021), and also cities in developing countries, such as Lima (Fernández-de-Córdova et al., 2021) and Jakarta (Rukmana & Ramadhani, 2021). Furthermore, studies also found further segregation with the most economical resources found in the higher-income community (Hipp & Kim, 2021; Manley, 2021; Sommeiller & Price, 2018).

Inequality is a function of economic forces at the wider metropolitan scale through the strong relationship between levels and changes in income inequality over time in cities and metro areas. A recent study shows that the polycentric urban model could contribute to reducing the commuting distance by allowing people to locate within or close to their employment sub-centre (Watts, 2009). Metropolitan resilience requires comprehensive strategies to tackle significant disparities between rich and poor households in terms of institutions, education and workforce development, transportation, and minimum wages (Berube & Holmes, 2016). In this sense, local governments are demanded by residents to expand and maintain urban services, both infrastructure such as water, sewers, transit, and roads, and socio-economic services such as social services, education, and health (Slack, 2019). Various studies on metropolitan areas have pointed to the importance of multi-level governance as a one-tier consolidated structure struggles to determine the appropriate geographic boundary for the metropolitan government. In addition, geographic boundaries of metropolitan governments rarely coincide with the boundaries of the economic region. These economic boundaries tend to expand over time and may outgrow their local political boundaries.

2.2. Socio-Economic and Health Inequalities in the Jakarta Metropolitan Area

This article follows the neoliberalism literature on spatialities as proposed by Herlambang et al. (2019). The article argues that neoliberal application from a geographical perspective leads to two implications; first, various spatialities of neoliberalism are interdependent. Thus, neoliberalisation in any territory depends on both local place-based context and relations with other places and across scales. Second, as these spatialities are not fixed contextual features, neoliberalisation would produce spatialities that implicate subsequent spatio-temporal trajectories. In the case of the JMA, urban land transformation is dominated by large real-estate development. Consequently, a new generation of middle-class gated communities was segregated from other parts of the urban area while simultaneously interacting in terms of mobility and other activities.

There are various studies on the variation of socio-economic disparities in metropolitan and urban areas in the JMA. The study by Rukmana and Ramadhani (2021)

suggests that the population in the JMA is dominated by the middle occupational group, which includes clerks, machine operators, industrial workers, technicians, and sellers. However, between 2011 and 2018, the study reveals an increasing share of JMA residents in top occupational groups, such as managers and professionals.

The study by Suryahadi and Marlina (2019) shows that the poverty rate in the JMA only slightly declined from 6% in 2004 to 5.3% in 2014, suggesting high economic growth in the JMA area is insignificant to reduce the poverty rate in the metropolitan area. In particular, poverty rates in the areas within the core metropolis, Jakarta, are lower than in the peripheral areas, with the lowest poverty rate in South Tangerang City (1.7% poverty rate) and the highest in Bogor City (7.7%).

This was confirmed by Rukmana and Ramadhani's (2021) study that focused on occupational and household indexes. The study found that urban transformation in the JMA has led to a homogenous socio-economic area in the peripheral region. Household expenditure inequality is lower than in the core metropolitan area of Jakarta. The high Gini indices in the municipalities of Jakarta province refer to the existence of urban kampongs neighbouring the high-rise building with luxury apartments, offices, and shopping centre. On the other hand, segregation in the periphery occurred because of gated communities developed by the private sector since the 1980s (Winarso et al., 2015). Furthermore, a spatial analysis study by Rukmana and Ramadhani (2021) found a high concentration of the top occupational groups in South Tangerang City, where the development of a new central business district and middle-upper class housing is supported with good accessibility and connected with highways and train routes. Previous studies mapped that these middle-upper class housings include elite real estates such as Bumi Serpong Damai, Gading Serpong, Bintaro Jaya, and Alam Sutera (Herlambang et al., 2019; Winarso et al., 2015).

In the early period of real estate development in the JMA, the housing development sector was dominated by middle-upper class buyers with an average of 3.1 million Indonesia rupiah (IDR), compared to the average Jakarta wage of 255,463 IDR. In addition, it was highly educated, 59% compared to only 2.89% in Jakarta (Winarso & Firman, 2002). However, the figure shifted with the average income in the JMA becoming comparable to the average urban Indonesian income in 2015 (Winarso et al., 2015). A recent study suggests that Central Jakarta City became a concentration area for both the top occupational groups and bottom occupational groups due to the concentration of luxury houses and apartments, shopping malls, and the central business district that are side-by-side with many informal housing areas of urban kampongs. These urban kampongs are residential locations for informal sector workers such as street vendors, cleaning workers, and security guards. Besides central Jakarta, many bottom occupational group workers reside in Tangerang City, which is considered close

to the core metropolitan area. With more than 60% of Jakarta's urban population estimated to live in kampong, this reveals the un-controlled developments in the JMA. The kampong itself has persistently been a source of socio-economic conflicts since the 1990s (Marulanda, 1993; Steinberg, 2007).

Considering the decentralisation structure in Indonesia, it is crucial to strengthen local government level capacities to govern local resources and financial capacity to overcome the implication of being part of a metropolitan area.

3. Data and Methodology

The article uses the commuters 2019 survey raw data collected by the BPS—Statistics Indonesia with a spatial stratified sampling strategy with a two-stage sampling selection method at the subdistrict level. The sampling considers household and population size distribution based on Indonesia's 2010 census data. The survey also employed the 2015 Indonesia inter-census data and the annual Indonesia National Labour Force Survey to determine the sample distribution (Sofiyandi & Siregar, 2020).

The survey consists of comprehensive data on commuters' residential location and economic and social characteristics, including income, job characteristics, education background, health conditions, and their daily commuting activities such as destination and transportation modes. The household data are linked to the questionnaire responses for each individual. There are more than 13,000 respondents from the JMA.

The commuters survey data include samples from the population that resides within the 13 districts in the JMA. These districts are eight municipalities and three regencies from the three provinces; Jakarta Province (Central Jakarta, North Jakarta, South Jakarta, East Jakarta, and West Jakarta districts) as the core metropolitan area and West Java Province (Depok, Bogor, Bogor City, Bekasi, and Bekasi City) and Banten Province (Tangerang, Tangerang City, and South Tangerang) as the peripheral regions.

The following map presents the JMA infrastructure connectivity (highway, primary roads, and railway) and distribution of residential areas (real estate and houses) with its location within the Java Island (inset map; Figure 1). The map suggests a high concentration of infrastructure and residential area in Tangerang Regency (West JMA), Bekasi (East JMA), Depok (South JMA), and leapfrogging development in Bogor City (Far-South JMA). The map is obtained from OpenStreetMap Indonesia, which has been updating and verifying various digital map features of Jakarta and other provinces in Indonesia (OpenStreetMap Indonesia, 2021).

Several variables are analysed to examine commuters' socio-economic, spatial, and health aspects. First, socio-economic variables included transportation mode, house size, and income, whereas salary range determines commuters' transportation choice. We also

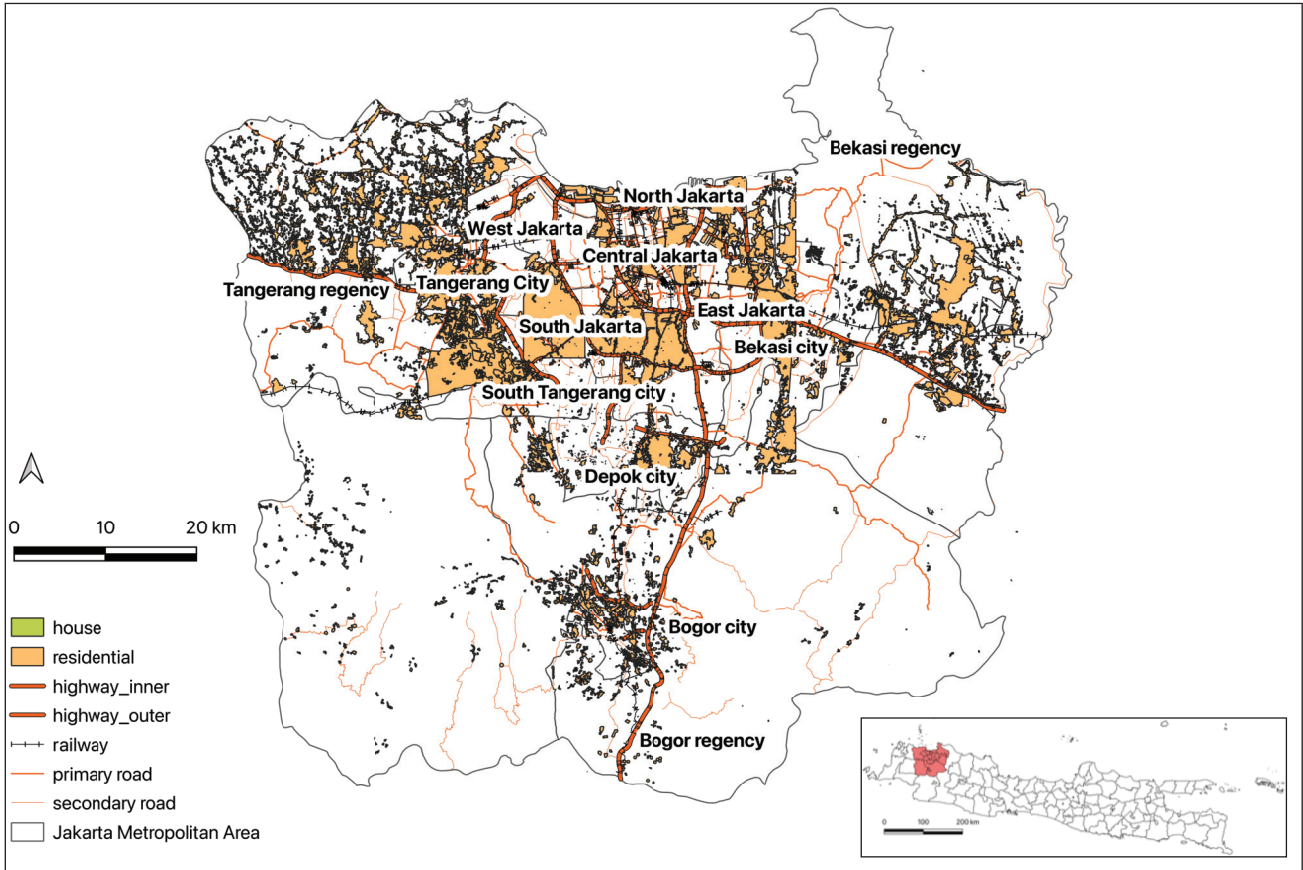


Figure 1. Distribution of infrastructure connectivity and residential areas in JMA.

use the property size to approach socio-economic inequality as privacy in the residence may describe the level of welfare of a household. This variable is reflected in the floor area of the house per capita with a decent size; the minimum is 8 m² per capita (BPS—Statistics Indonesia, 2000). In Jakarta, 72.3% of households occupy a floor area per capita of less than 8 m² (BPS—Statistics Indonesia, 2019). Specifically, more than 33% of households have a 50 m² or 12.5 m² per person (Beritagar, 2015).

Second, spatial commuting is approximated by commuting destination (core or peripheral region), and commuting characteristics are distance, duration, and hours of commuting. Third, health aspects, including mental and physical health, have been widely studied in previous metropolitan commuter studies (Jacob et al., 2021; Tajalli & Hajbabaie, 2017; Wener et al., 2003).

The table below depicts the transportation choice of JMA commuters based on the salary range that captures the transportation choice of more than 2.43 million commuters, calculated from the district-based weighted 13,000 samples (Table 1). Here we define *active transport commuters* as people that favour walking and cycling for daily mobility (Scheepers et al., 2014). The table reveals that the income level of JMA commuters is around the regional minimum wage (between 3.4 and 4.5 million IDR), with more than 78% having a higher income than this threshold. The table further

suggests the importance of motorcycle ride-hailing for JMA commuters. It accounts for more than 33% of total commuters that use motorcycles. A motorcycle is more popular in the lower-income group, with only 0.15% using public transportation (minibus, bus, commuter train, and TransJakarta), compared to 19.5% of the higher-income group.

3.1. Methodology

In this article, we utilised two research methods: summary statistics and logistic regressions. First, summary statistics explore a series of salary range variables conditioned by other variables such as transportation mode choice, area of residents, destination, commuting characteristics, and health conditions.

Second, we also use logistic regression, which is used to model binary outcome variables. In this article, the model attempts to explain the descriptive statistics further. Hence, the model examines the odds of an observation belonging to a particular category, such as choice of transportation mode, commuting characteristics, and health conditions.

4. Analysis and Discussion

To examine the socio-economic and health variation of commuters, we conduct several analyses on

Table 1. Salary range proportion (in million IDR), by transportation mode.

Transportation Mode	<1.5 million IDR	1.5 to 3 million IDR	3 to 4.5 million IDR	4.5 to 6 million IDR	6 to 7.5 million IDR	>7.5 million IDR
Active transportation	721	3,126	1,364	0	581	0
Motorcycle	15,881	190,206	811,451	317,061	768,732	146,552
Motor-ride-hailing	336	15,795	37,508	17,354	711,248	14,827
Car	1,689	527,623	9,189	24,572	26,135	170,508
Car-hailing	0	658	0	0	285	4,232
Company car	0	1,753	27,170	11,201	10,347	8,449
Car-sharing	0	785	4,356	733	522	2,513
Minibus (angkutan kota/ <i>angkot</i>)	6,284	27,306	40,527	8,506	4,051	6,151
Bus	0	3,196	17,236	17,347	10,383	14,657
Commuter train	5,360	22,837	88,556	35,865	34,197	48,889
TransJakarta	342	6,708	38,504	15,777	15,922	13,193
Others	593	892	1,407	0	0	0
Total	31,206	279,407	1,077,268	448,416	279,707	429,971

transportation mode, spatial flow, commuting characteristics, job type, and health conditions.

First, we examine the salary range with the choice of transportation mode among JMA commuters. The salary range threshold is 4.5 million IDR as the minimum salary in the JMA (*upah minimum regional* [UMR]). Below the average, the threshold is lower than UMR and vice-versa (Table 2). There is a significantly higher share of commuters in the lower-income group that travel by motorcycle than the higher-income group, 74 and 46%, respectively. In the lower-income group, the following transportation mode is commuter trains, buses, and TransJakarta, suggesting the importance of public transportation for this income group. While in the higher-income group, the next transportation modes are private cars, commuter trains, and buses. The share of commuters from the high-income group is higher than ride-hailing, indicating the higher disposal budget or demand for time-effective transportation, considering JMA's heavy traffic. Overall, the table reveals a relatively

similar share of commuters who travel with a private vehicle, about 73%, in both income groups, with higher-income commuters using motorcycles and cars.

Table 3 presents a cross-analysis of the share of commuters' income level group with the residential area. The table suggests a variation in the socio-economic share of the size of residential areas and the origin of districts in the core and peripheral areas. This table also indicates that commuters from Jakarta have a small residential area, with 68% of commuters living in a residential area of less than the threshold of 8 m² per capita. Thus, the table captures the high share of the small residential area and low-income groups in Jakarta, as suggested by previous studies which suggest that commuter characteristics reflect the Jakarta population, especially in residents in the urban kampong (Herlambang et al., 2019; Winarso et al., 2015).

Furthermore, the table also shows that commuters from South Tangerang City and Bogor Regency are among the wealthiest residents in the JMA with a higher

Table 2. Salary range proportion (%), by transportation mode.

	Above UMR	Below UMR
Active transportation	0.14	0.36
Motorcycle	56.09	73.49
Ride-hailing	5.34	3.78
Private car	17.81	3.61
Car-ride-hailing	0.26	0.05
Public bus	6.57	6.70
Commuter train	10.13	8.51
TransJakarta	3.59	3.34
Others	0.06	0.17

Table 3. Salary range proportion (%) and area of residents (m²), by residential districts.

	Not decent (less than 8 m ²)	Decent (between 8 m ² and 12.5 m ²)	More than decent (more than 12.5 m ²)	Above UMR	Low UMR
South Jakarta	13.78	7.28	5.66	6.66	7.61
East Jakarta	15.05	10.89	9.43	10.3	10.69
Central Jakarta	8.42	4.09	1.74	2.84	3.38
West Jakarta	21.2	9.88	5.79	7.93	9.56
North Jakarta	9.58	3.84	3.21	3.97	4.53
Bogor Regency	4.55	14.31	13.79	10.93	14.42
Bekasi Regency	1.09	5.99	9	8.74	5.77
Bogor City	2.82	2.88	2.29	2.3	2.65
Bekasi City	5.84	6.93	13.68	12.75	9.92
Depok City	10.02	9.18	13.25	13.8	10.17
Tangerang Regency	1.56	9.29	7.95	6.8	7.77
Tangerang City	3.88	8.2	7.63	6.76	7.68
South Tangerang City	2.21	7.25	6.56	6.21	5.86

share of the population in the large residential areas, whilst commuters from Bekasi City and Depok City are among the highest income earners in the JMA. This finding confirms previous studies on the distribution of real estate development and socio-economic distribution in the JMA (Rukmana & Ramadhani, 2021).

Table 4 depicts the comparison of income groups with a destination within the metropolitan area. The table suggests a higher share of commuters to Jakarta, the core metropolitan area, with more than 63% in both income groups. Nevertheless, the figure may suggest the presence of polycentricity in the JMA, with almost one in three commuters travelling daily to the peripheral regions. The table further shows that commuters within Jakarta are higher among the lower-income group with more than 44%, compared to only 37% of commuters that has higher income commute within Jakarta. On the other hand, the table also reveals a higher share of higher-income group commuters that

travel daily between peripheral regions. Furthermore, the table shows that residents from Bekasi and Depok cities are among the highest share of commuters to core cities. In contrast, commuters from Bogor and Tangerang regencies are the highest contributors within peripheral regions.

Table 5 presents the income group and commuting characteristics. The table reveals that commuters in the JMA mainly travel less than 20 km, less than one hour, and during rush hour before 7 am. In particular, the table shows a slightly higher share of the lower-income group that spends less than an hour commuting compared to the higher-income group, 76.72 and 72.44%, respectively. As such, a higher share of the higher-income group commutes early before 7 am. Typically in Indonesian metropolitan areas, due to congestion and school hours, the daily rush hour is before 7 am, which is confirmed by the table with more than half of commuters in the JMA departing during rush hour.

Table 4. Salary range proportion (%), by commuting destination.

	To Core Regions		To Peripheral Regions	
	Above UMR	Low UMR	Above UMR	Low UMR
South Jakarta	4.55	5.14	2.20	2.48
East Jakarta	7.81	8.03	2.56	2.87
Central Jakarta	2.59	3.24	0.28	0.20
West Jakarta	6.27	7.48	1.81	2.27
North Jakarta	3.83	4.08	0.16	0.54
Bogor Regency	3.73	5.74	7.31	8.66
Bekasi Regency	4.02	3.02	4.20	2.32
Bogor City	0.64	0.48	1.66	2.20
Bekasi City	10.00	7.12	2.83	2.89
Depok City	10.91	7.37	3.08	3.00
Tang Regency	2.50	1.81	3.93	5.42
Tang City	5.55	5.21	1.28	2.47
South Tangerang City	5.29	4.61	1.02	1.34

Table 5. Salary range proportion (%), by commuting characteristics.

	Above UMR	Lower UMR
Distance		
<20 km	55.21	59.19
<40 km	36.85	33.41
>40 km	7.94	7.40
Duration		
<30 minutes	33.93	35.15
<1 hour	38.51	41.57
>1 hour	27.56	23.29
Time		
<7 am	54.66	50.5
Between 7 and 10 am	38.52	43.28
>10 am	6.82	6.22

We also analyse the share of type of job in different income groups. It suggests a relatively higher share of the lower-income group that works as labour and staff in offices. The share of higher-income commuters work as freelance/informal workers and self-employed is about 23.50% of the total number of commuters in this income group. The table may represent the booming share of gig labour and entrepreneurship in the JMA. This variation in the type of job may determine the income level and commuting hours.

We also examined the income group and health conditions among commuters. The analysis reveals a higher share of the lower-income group that experience daily health problems, both physical and mental issues, 27.13 and 24.18%, respectively. Specifically, the analysis shows that both physical health problems such as headaches and sore pain are found higher in the lower-income group, in both private and public transportation commuters. In terms of mental health, the variation among

income groups is indifferent, with about 32–42% among the commuters. This finding also confirms several studies in Europe and the US that long-distance commuters suffer from headaches, backaches, and mental illness, among others, as reported by Schaefer (2005).

Furthermore, the health issue is consistent with a higher share of lower-income commuters that use public transportation. Compared with commuters in the US (Kylstra, 2014), Indonesian commuters have longer daily commute hours, 25.5 minutes and more than 30 minutes, respectively. As such, health threats are much higher to Indonesian commuters, including physical and mental health.

We also examine the socio-economic determinants of peripheral commuting (Table 6). The table suggests that a 1% increase in income would reduce the probability of commuting between peripherals by 0.535. In the service sector, commuting between peripherals is less likely by 0.529 times compared to the manufacturing

Table 6. Odds ratio of logistic regression of commuting between peripheral districts.

	Coefficient	Standard Error	Odd Ratio
Income	-0.625***	0.086	0.535
Economic Sector			
Primary	-0.040	0.270	0.961
Service	-0.638***	0.088	0.529
Formal job	-0.465	0.360	0.628
Private vehicle	0.316**	0.107	1.372
Married	0.224*	0.089	1.251
Constant	8.571	1.337	—
Tests	Coefficient	P > z	
LR	140.97	0.000	
Wald	125.35	0.000	
Hosmer-Lemeshow	7.53	0.480	

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

sector. Furthermore, the table also indicates that commuting between peripherals using a private vehicle is more likely 1.372 times compared to the use of public transportation. This finding indicates that between peripherals, commuters tend to have lower incomes and work in the manufacturing sector. There is also a higher probability that these commuters use a private vehicle and are married.

Table 7 presents socio-economic determinants of transportation mode choice. The table suggests that a 1% increase in income would increase the probability of commuting using a private vehicle by 1.367, while commuters with less duration and shorter distances and having a formal job would have higher odds of commuting using a private vehicle. The odds of using a private vehicle are also lower for peripheral to core commuters compared to other commuters, which may lower private vehicle ownership for peripheral commuters or the presence of alternative commuting transportation modes such as trains and buses. The tests suggest that the fitted model is correct and rejects the null hypothesis.

Table 8 examines the marginal effect of using private vehicle commuting time, distance, duration, and formal worker commuters from peripheral to a core area and between peripheral areas. Early hour commuters (before

10 am) would have about 83% probability of using private vehicles among peripheral commuters. However, there would be around a 74.4% probability of using private vehicles for peripheral-core commuters. In contrast, long-distance commuters (more than 30km) would have about 86.4% probability of using a private vehicle between peripheral areas, but only a 78.7% chance of using a private vehicle for the peripheral-core commuter. Furthermore, shorter duration commuters (less than one hour) would have an 89.2% probability of using private vehicles for peri-peri commuting, compared to only an 85.3% chance of using a private vehicle for peripheral-core commuting. Formal worker commuters would have about an 83.1% probability of using a private vehicle for peri-peri commuting. However, they would have less than a 74.5% probability of using a private vehicle for peri-core commuting.

We also compare the marginal effect of income and job status of using a private vehicle for commuters from the peripheral to the core and between peripherals. High-income formal worker commuters would have about 79.9% probability of using a private vehicle for peri-peri commuting but would have less than 78.8% probability of using a private vehicle for peri-core commuting, while low-income informal worker commuters

Table 7. Odds ratio of logistic regression of transportation mode choices.

	Coefficient	Standard Error	Odd Ratio
Income (ln)	0.312***	0.083	1.367
Duration	0.978***	0.101	2.658
Distance	0.651***	0.106	1.918
Formal job	0.888*	0.399	2.430
Commute			
Between peripherals	0.353**	0.120	1.423
Core-peripheral	0.469**	0.174	1.598
Between cores	0.311**	0.110	1.365
Married	0.515***	0.091	1.674
Constant	-5.768	1.335	—
Tests			
	Coefficient	P > z	
LR test	297.13	0.000	
Wald test	273.05	0.000	
Hosmer-Lemeshow test	9.30	0.317	

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

Table 8. Margins of transportation mode choices of commuters.

	Margin commuting time	Margin commuting distance	Margin duration time	Margin formal workers
Peri-peri	0.830*** (0.013)	0.864*** (0.011)	0.892*** (0.010)	0.831*** (0.013)
Peri-core	0.744*** (0.011)	0.787*** (0.012)	0.853*** (0.012)	0.745*** (0.011)

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

would have about 61.7% probability of using a private vehicle for peri-peri commuting but would have less than 60.1% probability of using a private vehicle for peri-core commuting.

Finally, Table 9 presents the socio-economic determinants of health status among commuters. The table suggests that commuters from core to periphery and being married have 1.47 and 1.18 times higher odds of health problems, either physical or stress-related. Nevertheless, the analysis suggests the insignificance of socio-economic statuses such as income level and commuting using a private vehicle to explain the odds of having health issues. However, using a private vehicle may lower the odds of having health issues indirectly, by reducing waiting time for public transportation and, hence, commuting duration.

5. Conclusion

This article contributes to the current literature on socio-economic inequalities among commuters in metropolitan areas. This study examines to what extent uneven cities and suburbs exacerbate socio-economic and health inequalities in the JMA. Our study presents significant socio-economic and health diversity among commuters using the BPS—Statistics Indonesia 2019 commuting data. The empirical study results highlight income level variation in the choice of private transportation mode, with the lower-income group dominated by motorcycle users and the higher-income group varying from using a motorcycle, private cars, and ride-hailing. This may also suggest that the latter group has a higher disposable income for ride-hailing services. On the other hand, there is no significant effect of income level on the choice of public transportation modes, with about 6.6% and 9% of each income group using the bus and commuting train, respectively.

Our subsequent analysis suggests that higher-income peripheral residents commute to the core metropolitan area, Jakarta, and a higher share of lower-income commuters travels between peripheral areas. On the other hand, the analysis suggests that peripheral commuting is less congested as the commuters have longer distances and shorter commuting duration and, on average, have lower incomes. Furthermore, the commuting patterns such as distance, duration, and time of commute are indifferent among income groups. More than 50% of commuters in each income group travel less than 20 km, the mean travel distance, and about 33% travel between 20 and 40 km. Furthermore, our logistic regressions suggest that, as private vehicles are more affordable for high-income groups, their commute time would be shorter. The study also highlights that commuting duration and origin-destination influence physical health. In contrast, there is no evidence that socio-economic status explains health conditions among commuters.

This article contributes to the literature and policy implications in metropolitan studies. First, the study reveals that a large share of lower-income commuters travelled long commutes between peripheral areas leading to higher odds of having health issues in this income group. This finding reflects the importance of local government and urban planners' critical role in expanding the public transport provision between JMA peripherals, as commuters from peripherals have lower incomes and commute long hours. Consequently, expanding public transportation and easing commuting time would improve commuters' health, leading to the promotion of JMA resilience. Alternatively, the government could promote active commuting which has been proven to improve health and wellbeing (Chatterjee et al., 2020; Götschi et al., 2016; Olsson et al., 2013). As Berube and Holmes (2016) suggest, metropolitan resilience needs transportation and institutional strategies to reduce

Table 9. Odds ratio of logistic regression of commuters' health.

	Coefficient	Standard Error	Odd Ratio
Income (ln)	-0.001	0.064	0.999
Commute			
Between peripherals	0.144	0.095	1.155
Core-peripheral	0.388**	0.143	1.474
Between cores	0.074	0.096	1.076
Duration	-0.488***	0.074	0.614
Married	0.169*	0.074	1.184
Transportation mode	0.042	0.086	1.043
Constant	-0.254	0.974	—
Tests	Coefficient	P > z	
LR test	72.50	0.000	
Wald test	71.37	0.000	
Hosmer-Lemeshow test	5.00	0.757	

Note: * p < 0.05; ** p < 0.01; *** p < 0.001.

disparities between rich and poor. On the one hand, local governments are obliged to expand urban infrastructure, and, on the other, multi-level governance is required to operate and maintain these transboundary urban infrastructures.

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Conflict of Interests

The author declares no conflict of interests.

References

- Adhi, R. P. (2012). Preferensi Pemilihan Moda Dalam Pergerakan Penglaju Koridor Bogor-Jakarta Terkait Dengan Pemilihan Tempat Tinggal (Studi Kasus: Moda Bus AC Dan Moda KRL Ekspres) [Mode selection preferences in the mobility of Bogor-Jakarta corridor commuters related to residence selection (Case study: Bus and express electrical train)]. *Jurnal Perencanaan Wilayah Dan Kota*, 23(1), 67–84.
- Aguilera, A. (2005). Growth in commuting distances in French polycentric metropolitan areas: Paris, Lyon and Marseille. *Urban Studies*, 42(9), 1537–1547.
- Aritenang, A. F. (2020). The effect of intergovernmental transfers on infrastructure spending in Indonesia. *Journal of the Asia Pacific Economy*, 25(3), 571–590.
- Aritenang, A. F. (2021). The contribution of foreign investment and industrial concentration to firm competitiveness in Jakarta megacity. *Cities*, 113, Article 103152.
- Beritagar. (2015). Persentase rumah tangga Jakarta menurut luas lantai rumah [Percentage of Jakarta households by floor area]. *Lokadata*. <https://lokadata.beritagar.id/chart/preview/persentase-rumah-tangga-jakarta-menurut-luas-lantai-rumah-1486740052>
- Berube, A., & Holmes, N. (2016). *City and metropolitan inequality on the rise, driven by declining incomes*. The Brookings Institution. <https://www.brookings.edu/research/city-and-metropolitan-inequality-on-the-rise-driven-by-declining-incomes>
- BPS—Statistics Indonesia. (2000). *Studi penentuan kriteria penduduk miskin* [The study of determining poverty criteria]. <https://sirusa.bps.go.id/sirusa/index.php/kuesioner/220>
- BPS—Statistics Indonesia. (2019). *Profil kemiskinan DKI Jakarta* [DKI Jakarta poverty profile]. <https://jakarta.bps.go.id/indicator/23/645/1/garis-kemiskinan-jumlah-dan-persentase-penduduk-miskin-di-daerah-menurut-kabupaten-kota-di-provinsi-dki-jakarta.html>
- Carruthers, R., Dick, M., & Saurkar, A. (2005). *Affordability of public transport in developing countries* (Transport Paper No. 33900). World Bank Group. <https://openknowledge.worldbank.org/handle/10986/17408>
- Chatterjee, K., Chng, S., Clark, B., Davis, A., De Vos, J., Ettema, D., Handy, S., Martin, A., & Reardon, L. (2020). Commuting and wellbeing: A critical overview of the literature with implications for policy and future research. *Transport Reviews*, 40(1), 5–34. <https://doi.org/10.1080/01441647.2019.1649317>
- Cordoba, J. C. (2008). On the distribution of city sizes. *Journal of Urban Economics*, 63, 177–197.
- Eaton, J., & Eckstein, Z. (1997). *Cities and growth: Theory and evidence from France and Japan* (Working Paper No. 4612). National Bureau of Economic Research. <https://www.nber.org/papers/w4612>
- Fan, C. C. (1999). The vertical and horizontal expansions of China’s city system. *Urban Geography*, 20(6), 493–515.
- Fernández-de-Córdova, G., Moschella, P., & Fernández-Maldonado, A. M. (2021). Changes in spatial inequality and residential segregation in metropolitan Lima. In M. van Ham, T. Tammaru, R. Ubarevičienė, & H. Janssen (Eds.), *Urban socio-economic segregation and income inequality* (pp. 471–490). Springer.
- Firman, T. (1998). The restructuring of Jakarta metropolitan area: A “global city” in Asia. *Cities*, 15(4), 229–243.
- Firman, T., & Fahmi, F. Z. (2017). The privatization of metropolitan Jakarta’s (Jabodetabek) urban fringes: The early stages of “post-suburbanization” in Indonesia. *Journal of the American Planning Association*, 83(1), 68–79.
- Götschi, T., Garrard, J., & Giles-Corti, B. (2016). Cycling as a part of daily life: A review of health perspectives. *Transport Reviews*, 36(1), 45–71.
- Heinelt, H., & Kübler, D. (Eds.). (2005). *Metropolitan governance: Capacity, democracy and the dynamics of place*. Routledge.
- Herdayati, M., & Eryando, T. (2020). Commuting patterns and health problems of commuters in regional tourist destination: Case study in Denpasar Greater Area. *Media Kesehatan Masyarakat Indonesia*, 16(3), 346–354.
- Herlambang, S., Leitner, H., Tjung, L. J., Sheppard, E., & Anguelov, D. (2019). Jakarta’s great land transformation: Hybrid neoliberalisation and informality. *Urban Studies*, 56(4), 627–648.
- Hidayati, I., Yamu, C., & Tan, W. (2019). The emergence of mobility inequality in Greater Jakarta, Indonesia: A socio-spatial analysis of path dependencies in transport–land use policies. *Sustainability*, 11(18), Article 5115.
- Hipp, J. R., & Kim, J. H. (2021). Income inequality and economic segregation in Los Angeles from 1980 to 2010. In M. van Ham, T. Tammaru, R. Ubarevičienė,

- & H. Janssen (Eds.), *Urban socio-economic segregation and income inequality* (pp. 371–387). Springer.
- Hudalah, D. (2017). Governing industrial estates on Jakarta's periurban area: From shadow government to network governance. *Singapore Journal of Tropical Geography*, 38(1), 58–74.
- Hudalah, D., & Aritenang, A. F. (2017). Industrial economies on the edge of Southeast Asian metropolises: From gated to resilient economies. In A. McGregor, L. Law, & F. Miller (Eds.), *Routledge handbook of Southeast Asian development* (pp. 120–130). Routledge.
- Hudalah, D., & Firman, T. (2012). Beyond property: Industrial estates and post-suburban transformation in Jakarta Metropolitan Region. *Cities*, 29(1), 40–48.
- Hudalah, D., Viantari, D., Firman, T., & Woltjer, J. (2013). Industrial land development and manufacturing deconcentration in Greater Jakarta. *Urban Geography*, 34(7), 950–971.
- Ilahi, A., Belgiawan, P. F., Balac, M., & Axhausen, K. W. (2021). Understanding travel and mode choice with emerging modes: A pooled SP and RP model in Greater Jakarta, Indonesia. *Transportation Research Part A: Policy and Practice*, 150, 398–422.
- Indraprahasta, G. S., & Derudder, B. (2017). Probing the position of the Jakarta metropolitan area in global inter-urban networks through the lens of manufacturing firms. *Asian Geographer*, 34(2), 147–167. <https://doi.org/10.1080/10225706.2017.1387161>
- Indraprahasta, G. S., & Derudder, B. (2019). The geographically variegated connections of the Jakarta metropolitan area as produced by manufacturing firms. *Growth and Change*, 50, 705–724.
- Ingram, G. K. (1998). Patterns of metropolitan development: What have we learned? *Urban Studies*, 35(7), 1019–1035.
- Jacob, N., Munford, L., Rice, N., & Roberts, J. (2021). Does commuting mode choice impact health? *Health Economics*, 30, 207–230.
- Kauffmann, A. (2016). Is the “Central German Metropolitan Region” spatially integrated? An empirical assessment of commuting relations. *Urban Studies*, 53(9), 1853–1868. <https://www.jstor.org/stable/26151160>
- Kusmawan, D., Andari, S., Gustina, I., Susilowati, I., & Wirawan, M. (2021). A path analysis model for explaining the factors influencing wearing a mask among commuting workers using commuter line Bogor-Jakarta. *Kesmas: Jurnal Kesehatan Masyarakat Nasional*, 16(2), 78–83.
- Kusmawan, D., & Susilowati, I. H. (2020). Studi kualitas hidup pekerja komuter pengguna krl commuter line dan busway Transjakarta dari bogor ke Jakarta [Study of the quality of life of commuter workers using the commuter train line and Transjakarta busway from Bogor to Jakarta]. *Jurnal Kedokteran Dan Kesehatan*, 8(2), 180–190.
- Kylstra, C. (2014, February 26). 10 things your commute does to your body. *Time Magazine*. <https://time.com/9912/10-things-your-commute-does-to-your-body>
- Manley, D. (2021). Segregation in London: A city of choices or structures? In M. van Ham, T. Tammaru, R. Ubarevičienė, & H. Janssen (Eds.), *Urban socio-economic segregation and income inequality: A global perspective* (pp. 311–328). Springer.
- Marulanda, L. (1993). Relocation: Sufficiently dealt with? An analysis of four cases in Jakarta. In F. Davidson, M. Zaaijer, M. Peltenburg, & B. Fritschi (Eds.), *Urban relocation policy and practice: Proceedings of an expert meeting in urban relocation* (pp. 79–88). Institute for Housing and Urban Development Studies.
- Olsson, L. E., Gärling, T., Ettema, D., Friman, M., & Fujii, S. (2013). Happiness and satisfaction with work commute. *Social Indicators Research*, 111(1), 255–263.
- OpenStreetMap Indonesia. (2021). *Validation data*. <https://openstreetmap.id/en/tag/validasi-data>
- Rizki, M., Joewono, T. B., & Belgiawan, P. F. (2019). Travel experience and multitasking of toll road users in Jakarta Metropolitan Area, Indonesia: An investigation for passenger of private car, taxi, and ride-sourcing. *Journal of the Eastern Asia Society for Transportation Studies*, 13, 523–541.
- Rosida, I., Sari, D. W., & Irijayanti, A. D. (2019). The mode choices and commuting stress: Empirical evidence from Jakarta and Denpasar. *Jurnal Pengembangan Kota*, 7(1), 68–76.
- Rukmana, D., & Ramadhani, D. (2021). Income inequality and socio-economic segregation in Jakarta. In M. Van Ham, T. Tammaru, R. Ubareviciene, & H. Janssen (Eds.), *Urban socio-economic segregation and income inequality: A global perspective* (pp. 135–152). Springer.
- Salim, W., & Hudalah, D. (2020). Urban governance challenges and reforms in Indonesia: Towards a new urban agenda. In B. Dahiya & A. Das (Eds.), *New urban agenda in Asia-Pacific: Governance for sustainable and inclusive cities* (pp. 163–181). Springer.
- Sandow, E. (2019). Til work do us part: The social fallacy of long-distance commuting. In C. L. Scholten & T. Joelsson (Eds.), *Integrating gender into transport planning: From one to many tracks* (pp. 121–144). Palgrave Macmillan.
- Schaefer, A. (2005, October 1). Commuting takes its toll. *Scientific American*. <https://www.scientificamerican.com/article/commuting-takes-its-toll>
- Scheepers, C. E., Wendel-Vos, G. C. W., Den Broeder, J. M., Van Kempen, E. E. M. M., Van Wesemael, P. J. V., & Schuit, A. J. (2014). Shifting from car to active transport: A systematic review of the effectiveness of interventions. *Transportation Research Part A: Policy and Practice*, 70, 264–280.
- Sheppard, E. (2019). Globalizing capitalism's raggedy fringes: Thinking through Jakarta. *Area Development and Policy*, 4(1), 1–27.
- Slack, E. (2019). *Metropolitan governance: Principles and*

- practice* (Discussion Paper No. IDB-DP-659). Inter-American Development Bank.
- Sofiyandi, Y., & Siregar, A. A. (2020). *Exploring the changes of commuting patterns, commuting flows, and travel-to-work behaviour in the Jakarta Metropolitan Area from 2014 to 2019: A comparative analysis of two cross-sectional commuting surveys* (Report No. 202054). LPEM FEB UI.
- Sommeiller, E., & Price, M. (2018). *The new gilded age: Income inequality in the US by state, metropolitan area, and county*. Economic Policy Institute.
- Steinberg, F. (2007). Jakarta: Environmental problems and sustainability. *Habitat International*, 31, 354–365.
- Suárez, M., Murata, M., & Delgado Campos, J. (2016). Why do the poor travel less? Urban structure, commuting and economic informality in Mexico City. *Urban Studies*, 53(12), 2548–2566.
- Suarez-Villa, L. (1988). Metropolitan evolution, sectoral economic change, and the city size distribution. *Urban Studies*, 25(1), 1–20.
- Suryahadi, A., & Marlina, C. (2019). *Understanding metropolitan poverty: The profile of poverty in Jabodetabek Area* (SMERU Working Paper). SMERU.
- Tajalli, M., & Hajbabaie, A. (2017). On the relationships between commuting mode choice and public health. *Journal of Transport & Health*, 4, 267–277.
- Unceta, P. M., Hausleitner, B., & Dąbrowski, M. (2020). Socio-spatial segregation and the spatial structure of “ordinary” activities in the Global South. *Urban Planning*, 5(3), 303–318.
- Watts, M. J. (2009). The impact of spatial imbalance and socio-economic characteristics on average distance commuted in the Sydney metropolitan area. *Urban Studies*, 46(2), 317–339.
- Wener, R. E., Evans, G. W., Phillips, D., & Nadler, N. (2003). Running for the 7:45: The effects of public transit improvements on commuter stress. *Transportation*, 30, 203–220.
- Winarso, H., & Firman, T. (2002). Residential land development in Jabotabek, Indonesia: Triggering economic crisis? *Habitat International*, 26(4), 487–506.
- Winarso, H., Hudalah, D., & Firman, T. (2015). Peri-urban transformation in the Jakarta metropolitan area. *Habitat International*, 49, 221–229.

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