JURNAL PENATAAN RUANG Vol. 19, No. 2, (2024) ISSN: 2716-179X (1907-4972 Print)
DOI : http://dx.doi.org/10.12962/j2716179X.v19i2.21560
Received : 20/08/2024, Reviewed: 25/10/2024 , Accepted : 30/11/2024

How Perceived City Livability Impacts Commuting Time in 26 Cities in Indonesia

Nina Yuniar Tantri and Muhammad Halley Yudhistira
Faculty of Economic and Business, Universitas Indonesia
e-mail: nina.yuniar@ui.ac.id

***Abstract*—This study aims to explore the relationship between perceived city livability and individual commuting time in 26 cities in Indonesia. The research is motivated by the rapid urbanization in Indonesia, with an estimated 66.6% of the population projected to live in urban areas by 2035. With the increasing population, there is a potential for a decrease in city livability and longer commuting time for individuals. The length of commuting time can lead to various health and environmental issues. Using logistic regression, the study found that every improvement in city livability is negatively associated with a 0.3% decrease in the probability of individuals commuting for more than 60 minutes. However, if rapid urbanization continues without improvements in city livability, it is likely to increase the probability of individuals commuting for longer durations. These findings emphasize the need for improvements in urban environments, such as the development of compact cities, with the provision of good accessibility.**

***Keywords*—City Livability Index, Commuting Time, Urbanization, Indonesia**

I. INTRODUCTION

Cities are becoming home to around half of the global population. It is projected to reach 5 billion, accounting for almost 55% of the world's population by 2050 [1]. This trend is also occurring in Indonesia, the urbanization rate is predicted to continue increasing to 66.6% by 2035 [2]. Urban areas are crucial for the provision of amenities and services to residents. The urban amenities in a neighborhood play an important role in providing a sense of livability for residents [3].

Urban areas are often seen as catalysts for economic development, this notion motivate many people to move to urban centers at an unprecedented rate causing excessive strain on urban services and resulting in acute housing shortages [4]. As a result, a significant portion of individuals relocating to urban areas find themselves living in informal settlements and encounter difficulties in accessing vital services. Consequently, the rapid urbanization has led to a decline in the livability of cities [5].

As urban populations continue to grow, cities are confronted with escalating problems related to traffic and congestion. Otherwise, people living in urban areas often have to commute due to the imbalance between job locations and housing [6]. Commuting consumes a significant amount of people's valuable time, requiring them to spend a considerable amount of time traveling. According to Schwanen & Dijst [7], a substantial portion of people's daily time is dedicated to commuting. On average, workers spend approximately 10.5% of their available work and travel time on commuting, which translates to a 28-minute one-way trip for an 8-hour workday. Consistently, commuting activity found a negative relationship with well-being or life satisfaction [8], [9].

Despite the burdensome nature of commuting, according to economics, individuals willingly choose this burden when they are compensated through either higher wages or favorable housing market conditions, thereby ensuring that their utility is equalized [10]. Therefore, city livability plays a crucial role in mitigating the negative impacts of urbanization, particularly by addressing challenges such as prolonged commuting times and declining quality of life. The term "livability" goes beyond the physical conditions of a city; it reflects the perceptions of its residents about whether the city meets their needs and is suitable for living [11]. These perceptions often revolve around ease of access [12], as a city's ability to provide efficient transportation networks, proximity to amenities, and seamless connectivity directly shapes how individuals interact with their environment. A city with high livability offers better access to essential services, reducing the need for long commutes and alleviating the pressures of urban congestion. This research seeks to explore how perceived city livability influences individual commuting time decisions, providing insights into the extent to which improvements in livability can encourage shorter commutes and enhance the overall urban experience.

Since there are many studies that explore how commuting time can affect an individual's quality of life, this study aims to capture the reverse relationship. Specifically, it investigates whether city livability can determine how long individuals are willing to spend on commuting. To examine this, a logistic regression model (Logit) is employed.

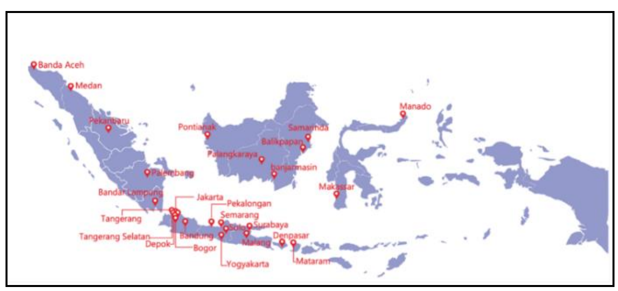

Figure 1. 26 Observed Cities

To observe this relationship, the study focuses on 26 cities in Indonesia (see **Error! Reference source not found.**), including mid-sized cities, large cities, and metropolitan areas. Indonesia, with its diverse characteristics, offers an intriguing context to investigate the influence of city livability on commuting patterns. To capture the variations within the cities, the study will encompass five major islands in Indonesia. The 26 cities that serve as sample observations based on islands include: Sumatra (Banda Aceh, Medan, Pekanbaru, Palembang, and Bandar Lampung), Java (DKI Jakarta, Tangerang, Tangerang Selatan, Depok, Bogor, Bandung, Pekalongan, Semarang, Solo, Yogyakarta, Surabaya, Malang), Bali-Nusa Tenggara (Denpasar and Mataram), Kalimantan (Pontianak, Banjarmasin, Balikpapan, Palangkaraya, and Samarinda), and Sulawesi (Makassar and Manado).

The scope of this research is limited to 26 cities that have been surveyed for their livability index by Indonesian Association of Urban and Regional Planners (IAP). Due to limitations in the data availability of city livability index, which varies in the number of observed cities each year, this study focuses on data from the year 2017 only.

II. LITERATURE REVIEW

Cities have a unique advantage over other types of settlement geographies in that they bring people and activity together. For a city to attract people, it must offer jobs, services and places that fulfil daily needs and improve one's wellbeing [13]. However, as cities continue to grow, they face various problems that can potentially lead to a decline in the quality of life within them. Quality of life can be referred to as "Livability" [11], which is the term we use in this study. Livability can also be seen as a manifestation of the quality of the relationship between individuals and their environment, particularly how well the built environment and available services in a city fulfil the needs and expectations of its residents [14]. Based on that, to become a livable city, it is necessary to provide amenities that are accessible to everyone [15] and attracting people and activity [16]. In this way, livability is influential at multiple scales: individuals and firms often make decisions to relocate on the basis of lifestyle and livability and, as such, they are drivers of urban growth and competitiveness [16].

Urban amenities have the potential to enhance both the physical and mental well-being of individuals. They can reduce air pollution [17]; foster social interaction, build social and community capital [18], [19], [20], [21]; and constitute business and employment opportunities that generate tax revenue for the city [16]. The availability and convenience of amenities have a significant impact on improving the overall quality of life in both the city and its surrounding communities.

With the concentration of population in urban areas, where economic activities are predominantly located, commuting has become a crucial aspect of daily urban life [22]. The journey from home to the workplace, or commuting [23], is influenced by various factors, one of which is city livability. Livability of a city is closely related to ease of access [3]. Cities that are characterized by traffic congestion and spatial disturbances often result in a scarcity of time [24], [25], which drastically impacts people's quality of life. Handy and Niemeier [26], highlight that accessibility makes metropolitan areas attractive to people. Therefore, proximity to facilities, goods and services will reduce the travel time [15].

The relationship becomes cyclical when it is associated with individuals' preferences for residential location [27]. Satisfaction with one's residential location is a good predictor of individual travel preferences [28]. Individuals tend to prefer living in proximity to amenities [29] and are willing to commute longer distances to their workplaces [30]. This is because living close to facilities, goods, and services reduces travel time [15]. On the other hand, there is no such a nice place. Rosen [31] and Roback [32] argue that location offer amenities have higher housing costs and lower wages. Therefore, long commuting tends to compensate with higher wages [33]. Commuting is advantageous for individuals when they travel to their workplace to perform their job or when they can find affordable housing further away from their job [30].

III. RESEARCH METHODOLOGY

This study conducted a cross-sectional analysis using various data sources for the Indonesian city dataset in 2017. The livability index for the 26 cities was derived from the Most Livable City Index (MLCI) 2017, which was published by the Indonesia Association of Urban and Regional Planners (IAP). This index provides a comprehensive measure of urban livability by evaluating 29 criteria designed to capture residents' perceptions and impressions of various aspects of their city. These criteria encompass five key dimensions; (1) safety and security; (2) basic services; (3) public facilities; (4) amenities; (5) urban planning. data were gathered through surveys that captured subjective evaluations from city residents, reflecting their impressions and satisfaction with these five dimensions. The results were then aggregated into a composite score for each city, ranging from 0 to 100, where higher scores indicate better perceived livability.

Furthermore, information on individual commuting time was obtained from the SAKERNAS 2017 data, which consisted of 536,970 samples within the dataset. In this study, the sample was then limited to: the 26 cities included in the MLCI index; respondents within the working age range (15-65 years old); and individuals who commuted on a daily basis. After applying these restrictions, a sample size of 23,381 samples was obtained.

This study will examine two groups of commuting time that will be transformed into binary form, namely commuting time above 30 minutes and commuting time above 60 minutes. The estimation will be conducted using the Logistic Regression (Logit) method with the following specifications:

$$\boldsymbol{Y_{ic} = \alpha + \beta_c + \gamma Z_{ic} + \theta Z_c + \varepsilon_{ic}} \quad (1)$$

On the left side of equation, the variable commuting time ($\boldsymbol{Y_{ic}}$) is the dependent variable. On the right side of equation, the variable city livability ($\boldsymbol{\beta_c}$) is the independent variable. In addition, to control for endogeneity and confounding factors, the control variables include demographic characteristics (gender, age, marital status, and family member), job characteristic (weekly working hours and monthly income), and mode of transportation used. The control variables for individuals are represented by $\boldsymbol{\gamma Z_{ic}}$, while the city-level variables are represented by $\boldsymbol{\theta Z_c}$, which include population density and GDP percapita.

After running the regression analysis mentioned above, the next step is to interact the independent variables with certain control groups. By incorporating interaction terms, we can gain a deeper understanding of the intricate and nuanced relationships within statistical analysis [34][35]. The concept of the interaction term is simple: adding the term comprised of the product of two input variables. First interaction model, as follows:

$$\boldsymbol{Y_{ic} = \alpha + \beta_c + \gamma Z_{ic} + \theta Z_c + \beta_c * \gamma Zincome_{ic} + \varepsilon_{ic}} \quad (2)$$

Equation two (2) represents the interaction of variables achieved by multiplying the city livability index with individual income. It aims to examine the relationship between city livability and commuting time based on the level of income received each month. Second interaction model, as follows:

$$\boldsymbol{Y_{ic} = \alpha + \beta_c + \gamma Z_{ic} + \theta Z_c + \beta_c * \theta Zpopulationdensity_c + \varepsilon_{ic}} \quad (3)$$

Equation three (3) represents the interaction of variables achieved by multiplying the city livability index with individual income. It aims to examine the relationship between city livability and commuting time based on different city density levels.

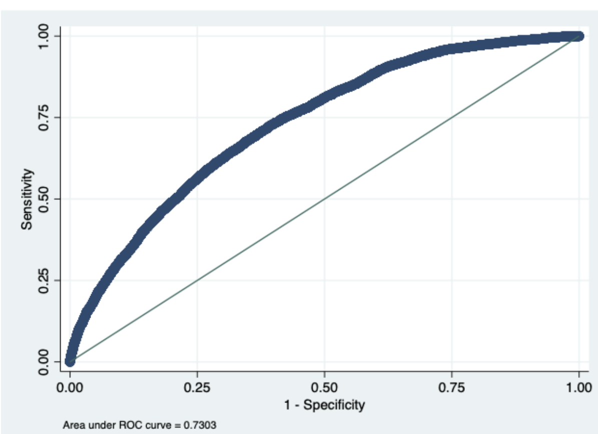

Figure 2. ROC Curve and AUC for commuting time exceeding 30 minutes

To assess the predictive accuracy of the logistic regression model, Receiver Operating Characteristic (ROC) curve and Area Under the Curve (AUC) analyses were used. The ROC curve visualizes model performance by plotting sensitivity against 1-specificity across thresholds, while AUC quantifies overall accuracy, with values from 0.5 (random chance) to 1.0 (perfect discrimination). Following Carrington et al. (2023), AUC is interpreted as a balanced average accuracy, reflecting sensitivity and specificity [36]. This approach validated the model's predictive quality, ensuring practical relevance in classifying commuting times.

The ROC analysis for commuting time exceeding 30 minutes yielded an Area Under the Curve (AUC) value of 0.7303 (see Figure 2). This indicates that the logistic regression model achieves an adequate level of discriminatory ability, as an AUC greater than 0.7 is generally considered acceptable for predictive models. This result demonstrates that the model has a meaningful predictive capacity, validating the city livability index and other explanatory variables in influencing commuting time decisions.

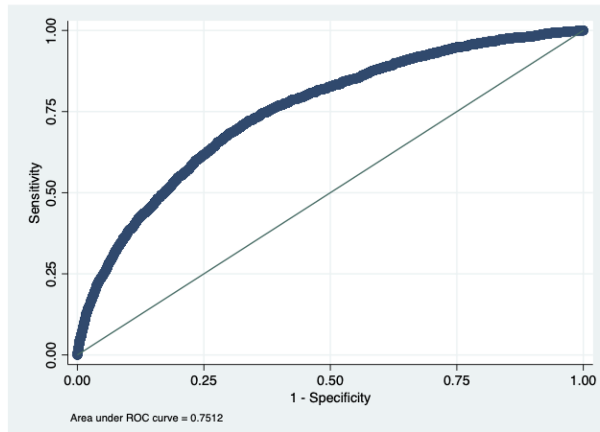

Figure 3. ROC Curve and AUC for commuting time exceeding 60 minutes

The ROC analysis for commuting time exceeding 60 minutes produced an Area Under the Curve (AUC) value of 0.7512 (see Figure 3). This indicates that the logistic regression model demonstrates a good level of discriminatory ability.

IV. RESULTS AND DISCUSSIONS

In the first model (1), the estimated marginal effect for individuals with commuting times exceeding 30 minutes is -0,00306, which is statistically significant at the 1% level. This indicates that the urban livability index is negatively associated with individual commuting time in this group. However, when control variables for individuals and cities are included in the model (5), the results are not statistically significant. Therefore, we cannot estimate the relationship between city livability and the length of individual commuting time in this case.

The estimation (see Table 1) suggests that the impact of the city livability index on individual commuting time is relatively small. Previous research in the United States indicates that living in a large metropolitan area may involve trading time for higher wages, with little change in overall well-being [33]. To further investigate the effect of the urban livability index on commuting time, the analysis focuses on individuals with extreme commuting activities, defined as those with a travel time of 60 minutes or more. The dependent variable, commuting time, is transformed into a binary form to indicate

Table 2. Impact City Livability Index on Commuting Time above 30 minutes

	Dependent Variables: >30 Minutes (1 for >30 Minutes, 0 Otherwise)				
	(1)	(2)	(3)	(4)	(5)
City Livability Index	-0.00306***	-0.00237**	-0.000365	0.000112	-0.00159
	(0.00104)	(0.00104)	(0.00110)	(0.00105)	(0.00111)
Control: Individual					
Gender (ref: male)	NO	YES	YES	YES	YES
Age	NO	YES	YES	YES	YES
Marital Status	NO	YES	YES	YES	YES
Family Member	NO	YES	YES	YES	YES
Worktime/week	NO	NO	YES	YES	YES
Income	NO	NO	YES	YES	YES
Transportation Mode (ref: Public Transportation)					
Shared Transportation	NO	NO	NO	YES	YES
Private Vehicle	NO	NO	NO	YES	YES
Walking	NO	NO	NO	YES	YES
Control: City					
Population Density	NO	NO	NO	NO	YES
GDP per Capita	NO	NO	NO	NO	YES
Constant	0.0977	-0.147	-13.69***	-10.97***	-10.68***
	(0.293)	(0.304)	(0.488)	(0.499)	(0.643)
	0.0977	-0.147	-13.69***	-10.97***	-10.68***
Observations	23,763	23,763	23,763	23,763	23,763

Notes: ***, **, *, represent statistical significance at 1, 5, and 10%, respectively. The dependent variable is commuting time (1 for >30 minutes and 0 otherwise). Control variables include gender, age, marital status, family member, total work time per week, income in a month, transportation mode, population density, and GDP per capita. All subjective characteristics are from SAKERNAS 2017. All cities-related data are from BPS.
"NO" indicates that the respective control variable was not included in the model specification.
"YES" indicates that the respective control variable was incorporated into the model, controlling for its potential influence on commuting time.

Table 1. Impact City Livability Index on Commuting Time above 60 minutes

	Dependent Variables: >60 Minutes (1 for >60 Minutes, 0 Otherwise)				
	(1)	(2)	(3)	(4)	(5)
City Livability Index	-0.00206***	-0.00196***	-0.00130***	-0.00105**	-0.00255***
	(0.000496)	(0.000492)	(0.000469)	(0.000430)	(0.000461)
Control: Individual					
Gender (ref: male)	NO	YES	YES	YES	YES
Age	NO	YES	YES	YES	YES
Marital Status	NO	YES	YES	YES	YES
Family Member	NO	YES	YES	YES	YES
Worktime/week	NO	NO	YES	YES	YES
Income	NO	NO	YES	YES	YES
Transportation Mode (ref: Public Transportation)					
2. Shared Transportation	NO	NO	NO	YES	YES
3. Private Vehicle	NO	NO	NO	YES	YES
4. Walking	NO	NO	NO	YES	YES
Control: City					
Population Density	NO	NO	NO	NO	YES
GDP per Capita	NO	NO	NO	NO	YES
Constant	-0.723*	-1.346***	-14.63***	-13.18***	-9.364***
	(0.395)	(0.414)	(0.718)	(0.744)	(1.053)
Observations	23,763	23,763	23,763	23,763	23,763

Notes: ***, **, *, represent statistical significance at 1, 5, and 10%, respectively. The dependent variable is commuting time (1 for >30 minutes and 0 otherwise). Control variables include gender, age, marital status, family member, total work time per week, income in a month, transportation mode, population density, and GDP per capita. All subjective characteristics are from SAKERNAS 2017. All cities-related data are from BPS.
"NO" indicates that the respective control variable was not included in the model specification.
"YES" indicates that the respective control variable was incorporated into the model, controlling for its potential influence on commuting time.

whether it exceeds 60 minutes or not.

The estimation results (see Table 2) in columns (1) and (2) indicate that individuals with commuting times exceeding 60 minutes have lower estimated probabilities compared to those with commuting times exceeding 30 minutes. This suggests that the estimation for individuals with longer commuting times is less likely to be overestimated. The results show a negative association of approximately 0.2% to 0.19% in the probability of individual commuting time exceeding 60 minutes. In the full model (5), the estimated marginal effect is -0.00264, which is statistically significant at the 1% level. Therefore, the preferred specification model is in column (5), where every 1-point increase in the city livability index is negatively associated with a 0.3% decrease in the probability of individuals commuting for more than 60 minutes.

Thus, the estimation results using a binary dependent variable for commuting time above 60 minutes show a better estimate, indicating a 0,2% effect. This result, when compared to the study conducted by Clark [37] investigating the relationship between life satisfaction and commuting duration using fixed effects, where individuals consistently engaged in long commutes (over 45 minutes) for six observations were compared to those consistently engaged in short commutes (45 minutes or less), consistently shows lower life satisfaction for the former group.

The findings of this study underscore the significant impact of city livability on commuting time, providing valuable insights for policymakers. As demonstrated, improving livability through enhanced public transportation systems, increased accessibility to amenities, and balanced job-housing proximity can effectively reduce the likelihood of prolonged commuting times. This aligns with Morris and Zhou's (2018) observation that enhanced urban conditions often compensate for commuting challenges, as residents may tolerate longer commutes in exchange for better living environments or higher wages [33]. As a result, individuals who engage in extreme commuting are reluctant to change their commuting behavior despite being aware of the adverse impacts they experience [38].

Given that this study was conducted in cities of varying sizes, the next step is to examine the relationship within each city size category and interact the independent variables with selected control variables. This approach allows for a more detailed understanding of the effects, as previous research has indicated that larger metropolitan areas generally have longer commuting times [33]. By considering the specific characteristics and dynamics of different city sizes, we can gain insights into how city livability and other factors interact to influence commuting patterns and durations.

By introducing an interaction variable between commuting time, individual income, density, and GDP per capita. This study introduced an interaction variable to examine how other factors may influence the relationship between commuting time and its effects. The interaction was conducted between city livability and income as well as population density. By incorporating these interaction terms, the study aimed to capture the potential moderating effects of income, population density, and GDP per capita on the association between city livability and commuting time.

Table 3 presents the results of the interaction between the dependent variable and selected control variables. In columns (1) and (4), it shows the interaction results between city livability and income. The significant marginal effect is found in the binary group of commuting times exceeding 60 minutes (4). The interpretation of the results indicates that every improvement in city livability is associated with a decrease in the probability of commuting time exceeding 60 minutes, particularly for individuals with lower monthly income.

In other words, if there is a decrease in the city livability index, the commuting time will become longer, but there is a potential for an increase in the income received each month. These findings align with the findings reported by Landeghem et. al., stating that individual commuting time can be compensated by the wages received [39]. It is also supported by the research of Morris and Zhou [33], which suggests that long commutes tend to be compensated by higher wages. The presence of compensation for commuting costs leads to lower wages being paid in the city where transport costs are compensated [40].

Next, in column (2) and (5), the results show the interaction between city livability and population density. The displayed marginal effect values in both columns are different. In column (2), the marginal effect value is -0.0045 and is significant at the 1% level. This means that in the first binary group, individuals who commute over 30 minutes, for every improvement in city livability, the probability of individuals commuting for a longer time increases, but the population

Table 3. Heterogenous Treatment Effects

	Dependent Variable: Commuting Time					
	>30 Minutes			**>60 Minutes**		
VARIABLES	**(1) Income**	**(2) Density**	**(3) GDP**	**(4) Income**	**(5) Density**	**(6) GDP**
City Livability Index	0.00467 (0.00864)	0.0370*** (0.0131)	-0.237*** (0.0390)	-0.0359*** (0.00977)	-0.0094** (0.00735)	-0.106*** (0.0279)
City Livability * income on >30mins	0.000948 (0.00175)					
City Livability * population density on >30mins		-0.0045*** (0.00151)				
City Livability * GDP per Capita on >30mins			0.0128*** (0.00213)			
City Livability * income on >60mins				0.00224*** (0.000655)		
City Livability * population density on >60mins					0.00078** (0.000833)	
City Livability * GDP per Capita on >60mins						0.00568*** (0.00153)
Observations	23,082	23,082	23,082	23,082	23,082	23,082

Notes: ***, **, *, represent significance effects at 1, 5, and 10%, respectively. Interaction variables are differentiated based on two commuting groups: above 30 minutes and above 60 minutes. All specifications include control variables as listed in tables (4.1) and (4.2).

density decreases. These findings support Nicholas' research [41], which proposes that high-density environments have the potential to enhance the quality of life and foster the development of sustainable and vibrant communities.

In column (5), the marginal effect value for the second binary group, which consists of individuals with commuting time above 60 minutes, is 0.00078 with a significance level of 5%. This means that for every improvement in city livability, the probability of individuals commuting for more than 60 minutes decreases, but the population density increases. These findings support Nicholas' statement [41], but it is important to note that ensuring access and economic vitality are crucial in this case [42]. Rapid urbanization in developing countries often leads to a decrease in city livability, accompanied by socio-economic disparities among different neighborhoods [5].

Lastly, in column (3) and (6), the results show the interaction between city livability and GDP per Capita. The marginal effect values for both the first and second binary groups are negative, with values of 0.0128 and 0.0058, respectively, at a significance level of 1%. Therefore, the interpretation of the results can be summarized as follows: every improvement in city livability is associated with a decrease in commuting time and has the potential to increase GDP per capita. GDP per capita, which reflects economic competitiveness, establishes a relationship that improvements in the provision of amenities and basic services that enhance city livability contribute to the increased productivity of the city's economy.

V. CONCLUSIONS

Based on the findings that every improvement in livability is associated with a 0.3% reduction in the probability of individuals commuting for more than 60 minutes. However, if rapid urbanization continues without improvements in city livability, it will likely increase the probability of individuals commuting for longer durations. This approach has been advocated by previous studies [18] as a means to improve overall commuting experiences and enhance the livability of urban areas.

In the context of Indonesia, policymakers are encouraged to prioritize the development of compact, accessible, and well-connected urban environments. Investments in public transportation infrastructure, such as expanding reliable transit networks and integrating various modes of transportation, can significantly reduce commuting times while also promoting sustainable mobility. Enhancing walkability and cycling infrastructure is equally important, as it supports shorter commutes and fosters healthier lifestyles.

Furthermore, promoting mixed-use development that balances residential, commercial, and recreational spaces can help reduce the spatial mismatch between jobs and housing. Decentralizing employment centers and incentivizing businesses to operate in suburban or satellite areas may also alleviate congestion in city centers and minimize long-distance commutes.

Lastly, policies that improve urban livability should address both physical infrastructure and subjective aspects, such as safety, cleanliness, and access to green spaces, which shape residents' perceptions of their living environment. By focusing on these measures, cities can not only mitigate the negative impacts of commuting but also enhance overall urban resilience and the quality of life for their residents.

Future research could expand the scope to include more cities across Indonesia and employ longitudinal models to capture temporal dynamics and assess long-term trends. Such studies would provide broader insights into the interplay between urban livability, commuting patterns, and policy interventions, enabling a more comprehensive understanding of urban challenges in rapidly urbanizing countries.

REFERENCES

[1] World Bank, "Urban Development," https://www.worldbank.org/en/topic/urbandevelopment/overview.

[2] *Proyeksi penduduk Indonesia 2010-2035 = Indonesia population projection 2010-2035*. Badan Perencanaan Pembangunan Nasional : Badan Pusat Statistik : United Nations Population Fund, 2013.

[3] N. Allen, "Understanding the Importance of Urban Amenities: A Case Study from Auckland," *Buildings*, vol. 5, no. 1, pp. 85–99, Jan. 2015, doi: 10.3390/buildings5010085.

[4] B. R. K. Sinha, "Multidimensional Approach to Quality of Life Issues: A Spatial Analysis," *Multidimensional Approach to Quality of Life Issues: A Spatial Analysis*, pp. 1–457, 2019, doi: 10.1007/978-981-13-6958-2.

[5] Lotfi, "A Study of Urban Quality of Life in a Developing Country," *Journal of Social Sciences*, vol. 7, no. 2, pp. 232–240, Apr. 2011, doi: 10.3844/jssp.2011.232.240.

[6] L. Han, C. Peng, and Z. Xu, "The Effect of Commuting Time on Quality of Life: Evidence from China," *Int J Environ Res Public Health*, vol. 20, no. 1, p. 573, Dec. 2022, doi: 10.3390/ijerph20010573.

[7] T. Schwanen and M. Dijst, "Travel-time ratios for visits to the workplace: the relationship between commuting time and work duration," *Transp Res Part A Policy Pract*, vol. 36, no. 7, pp. 573–592, Aug. 2002, doi: 10.1016/S0965-8564(01)00023-4.

[8] E. Hansson, K. Mattisson, J. Björk, P.-O. Östergren, and K. Jakobsson, "Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden," *BMC Public Health*, vol. 11, no. 1, p. 834, Dec. 2011, doi: 10.1186/1471-2458-11-834.

[9] P. Nie and A. Sousa-Poza, "Commute time and subjective well-being in urban China," *China Economic Review*, vol. 48, pp. 188–204, Apr. 2018, doi: 10.1016/j.chieco.2016.03.002.

[10] B. S. Frey and A. Stutzer, "Happiness Research: State and Prospects," *SSRN Electronic Journal*, 2004, doi: 10.2139/ssrn.559427.

[11] N. O. Ahmed, A. M. El-Halafawy, and A. M. Amin, "A Critical Review of Urban Livability," *European Journal of Sustainable Development*, vol. 8, no. 1, Jan. 2019, doi: 10.14207/ejsd.2019.v8n1p165.

[12] M. Tennakoon and U. Kulatunga, "Liveable Communities: A Case Study of Availability, Proximity, and The Quality of Critical Infrastructure in Colombo, Srilanka," *CSID Journal of Infrastructure Development*, vol. 7, no. 1, Apr. 2024, doi: 10.7454/jid.v7.i1.1105.

[13] D. B. Audretsch and M. P. Feldman, "R&D Spillovers and the Geography of Innovation and Production," *Am Econ Rev*, vol. 86, no. 3, pp. 630–640, 1996, [Online]. Available: http://www.jstor.org/stable/2118216

[14] A. Kovacs-Györi, P. Cabrera-Barona, B. Resch, M. Mehaffy, and T. Blaschke, "Assessing and Representing Livability through the Analysis of Residential Preference," *Sustainability*, vol. 11, no. 18, p. 4934, Sep. 2019, doi: 10.3390/su11184934.

[15] T. Sanguinetti and S. John, "REACHING LIVABILITY: DESIGNING ACCESSIBLE CITIES FOR ALL," 2017.

[16] E. L. Glaeser, J. Kolko, and A. Saiz, "Consumer city," *J Econ Geogr*, vol. 1, no. 1, pp. 27–50, Jan. 2001, doi: 10.1093/jeg/1.1.27.

[17] D. J. Nowak, D. E. Crane, and J. C. Stevens, "Air pollution removal by urban trees and shrubs in the United States," *Urban For Urban Green*,

vol. 4, no. 3–4, pp. 115–123, Apr. 2006, doi: 10.1016/j.ufug.2006.01.007.

[18]J. Francis, B. Giles-Corti, L. Wood, and M. Knuiman, "Creating sense of community: The role of public space," *J Environ Psychol*, vol. 32, no. 4, pp. 401–409, Dec. 2012, doi: 10.1016/j.jenvp.2012.07.002.

[19]V. Cattell, N. Dines, W. Gesler, and S. Curtis, "Mingling, observing, and lingering: Everyday public spaces and their implications for well-being and social relations," *Health Place*, vol. 14, no. 3, pp. 544–561, 2008, doi: 10.1016/j.healthplace.2007.10.007.

[20]A. Duany, E. Plater-Zyberk, and J. Speck, *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. 2000.

[21]R. Oldenburg, "The great good place : cafés, coffee shops, community centers, beauty parlors, general stores, bars, hangouts, and how they get you through the day," *Social Forces*, vol. 20, p. 931, 1991, [Online]. Available: https://api.semanticscholar.org/CorpusID:145354580

[22]K. Mouratidis, "Urban planning and quality of life: A review of pathways linking the built environment to subjective well-being," *Cities*, vol. 115, p. 103229, Aug. 2021, doi: 10.1016/j.cities.2021.103229.

[23]M. Koslowsky, A. N. Kluger, and M. Reich, *Commuting Stress*. Boston, MA: Springer US, 1995. doi: 10.1007/978-1-4757-9765-7.

[24]P. J. Mackie, S. Jara-Díaz, and A. S. Fowkes, "The value of travel time savings in evaluation," *Transp Res E Logist Transp Rev*, vol. 37, no. 2–3, pp. 91–106, Apr. 2001, doi: 10.1016/S1366-5545(00)00013-2.

[25]P. J. Mackie, M. Wardman, A. S. Fowkes, G. Whelan, J. Nellthorp, and J. Bates, "Values of Travel Time Savings in the UK-Summary Report Report to Department for Transport," 2003. [Online]. Available: www.its.leeds.ac.uk

[26]S. L. Handy and D. A. Niemeier, "Measuring Accessibility: An Exploration of Issues and Alternatives," *Environment and Planning A: Economy and Space*, vol. 29, no. 7, pp. 1175–1194, Jul. 1997, doi: 10.1068/a291175.

[27]J. De Vos and F. Witlox, "Travel satisfaction revisited. On the pivotal role of travel satisfaction in conceptualising a travel behaviour process," *Transp Res Part A Policy Pract*, vol. 106, pp. 364–373, Dec. 2017, doi: 10.1016/j.tra.2017.10.009.

[28]G. D. Deane, "Mobility and adjustments: Paths to the resolution of residential stress," *Demography*, vol. 27, no. 1, pp. 65–79, Feb. 1990, doi: 10.2307/2061553.

[29]C. F. Ng, "Commuting distances in a household location choice model with amenities," *J Urban Econ*, vol. 63, no. 1, pp. 116–129, Jan. 2008, doi: 10.1016/j.jue.2006.12.008.

[30]A. Stutzer and B. S. Frey, "Stress that Doesn't Pay: The Commuting Paradox*," *Scand J Econ*, vol. 110, no. 2, pp. 339–366, Jun. 2008, doi: 10.1111/j.1467-9442.2008.00542.x.

[31]S. Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy*, vol. 82, no. 1, pp. 34–55, 1974, [Online]. Available: http://www.jstor.org/stable/1830899

[32]J. Roback, "Wages, Rents, and the Quality of Life," *Journal of Political Economy*, vol. 90, no. 6, pp. 1257–1278, 1982, [Online]. Available: http://www.jstor.org/stable/1830947

[33]E. A. Morris and Y. Zhou, "Are long commutes short on benefits? Commute duration and various manifestations of well-being," *Travel Behav Soc*, vol. 11, pp. 101–110, Apr. 2018, doi: 10.1016/j.tbs.2018.02.001.

[34]J. M. Cortina, "What is coefficient alpha? An examination of theory and applications.," *Journal of Applied Psychology*, vol. 78, no. 1, pp. 98–104, Feb. 1993, doi: 10.1037/0021-9010.78.1.98.

[35]J. Jaccard, C. K. Wan, and R. Turrisi, "The Detection and Interpretation of Interaction Effects Between Continuous Variables in Multiple Regression," *Multivariate Behav Res*, vol. 25, no. 4, pp. 467–478, Oct. 1990, doi: 10.1207/s15327906mbr2504_4.

[36]A. M. Carrington *et al.*, "Deep ROC Analysis and AUC as Balanced Average Accuracy, for Improved Classifier Selection, Audit and Explanation," *IEEE Trans Pattern Anal Mach Intell*, vol. 45, no. 1, pp. 329–341, Jan. 2023, doi: 10.1109/TPAMI.2022.3145392.

[37]B. Clark, K. Chatterjee, A. Martin, and A. Davis, "How commuting affects subjective wellbeing," *Transportation (Amst)*, vol. 47, no. 6, pp. 2777–2805, Dec. 2020, doi: 10.1007/s11116-019-09983-9.

[38]K. Chatterjee, B. Clark, A. Davis, and D. Toher, "Project team Researchers at UWE Bristol," 2016. [Online]. Available: www.travelbehaviour.com.

[39]B. Van Landeghem, T. Dohmen, A. R. Hole, and A. Künn-Nelen, "The value of commuting time, flexibility, and job security: Evidence from current and recent jobseekers in Flanders," *Labour Econ*, vol. 91, p. 102631, Dec. 2024, doi: 10.1016/j.labeco.2024.102631.

[40]A. Dickerson, A. R. Hole, and L. A. Munford, "The relationship between well-being and commuting revisited: Does the choice of methodology matter?," *Reg Sci Urban Econ*, vol. 49, pp. 321–329, Nov. 2014, doi: 10.1016/j.regsciurbeco.2014.09.004.

[41]N. Martino, C. Girling, and Y. Lu, "Urban form and livability: socioeconomic and built environment indicators," *Buildings and Cities*, vol. 2, no. 1, pp. 220–243, Mar. 2021, doi: 10.5334/bc.82.

[42]E. Macdonald, "Street-facing Dwelling Units and Livability: The Impacts of Emerging Building Types in Vancouver's New High-density Residential Neighbourhoods," *J Urban Des (Abingdon)*, vol. 10, no. 1, pp. 13–38, Feb. 2005, doi: 10.1080/13574800500062320.