Jurnal Ekonomi Pembangunan
Volume 20 (2): 235-246, December 2022
P-ISSN: 1829-5843; E-ISSN: 2685-0788

Research article

Revisiting the Impact of Density on Social Capital: A Study Case in the Capital City of Indonesia

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Article Info: Received: 17 October 2022; Accepted: 07 January 2023; Published: 13 January 2023

Abstract: Density is an important indicator closely related to the rate of urbanisation in cities. Density alters social capital, yet the directions of the association remain an open empirical investigation. This study aims to analyse how density and social capital are related in Jakarta, the capital, and the most populous city in Indonesia. Utilising a simple regression and an entropy balance approach to address the selection issue, this study finds that an increase in density of 10 thousand inhabitants per square kilometre is associated with a 2% higher possibility of societies having high social capital. The result is also robust using another definition of social capital and transformation of density variable. A policy recommendation that can be taken based on this study's results is that the government can design dense urban planning as a model of sustainable urban design, particularly the sustainability in social aspects.

Keywords: Density, social capital, entropy balance method

JEL Classification: O18, O20, R12

Abstrak: Kepadatan penduduk merupakan indikator penting yang terkait dengan laju urbanisasi di kota. Kepadatan dapat mengubah modal sosial, namun arah asosiasi tetap menjadi pertanyaan empiris. Penelitian ini bertujuan untuk menganalisis bagaimana relasi dari kepadatan dan modal sosial di Jakarta, yang mana merupakan ibukota sekaligus kota terpadat di Indonesia. Dengan menggunakan metode regresi sederhana dan pendekatan keseimbangan entropy untuk mengatasi isu bias karena seleksi, penelitian ini menemukan bahwa peningkatan kepadatan sebanyak 10 ribu penduduk dalam 1 kilometer persegi berasosiasi dengan modal sosial yang 2% lebih tinggi. Hasil ini robust dengan menggunakan definisi lain dari modal sosial dan dengan transformasi variabel kepadatan. Rekomendasi kebijakan yang studi ini dapat berikan adalah pemerintah dapat mendesain tata kota yang padat sebagai acuan untuk pembangunan kota yang berkelanjutan, terutama dalam aspek sosial.

Kata kunci: Kepadatan, modal sosial, metode keseimbangan entropy

How to Cite:
Nugraha, U., & Nasrudin, R. (2022). Revisiting the Impact of Density on Social Capital: A Study Case in the Capital City of Indonesia. *Jurnal Ekonomi Pembangunan, 20*(2), 235-246. DOI: 10.29259/jep.v20i2.19214

1. INTRODUCTION

The current urbanisation rate drives many scholars to discuss issues regarding the features of urbanisation and its relation to human welfare. This group of literature emerged due to the importance of urban sustainability (Lloyd et al., 2016; Song et al., 2021; Verma & Raghubanshi, 2018; Wang et al., 2022). The big goal of assembling sustainable cities is also stated in Sustainable Development Goals (SDG) on goal 11 i.e., make cities and human settlements inclusive, safe, resilient, and sustainable. The interesting issue in this topic is how to make a city worth living in evermore as the proportion of urban populations increases. One of the many factors that are often utilised as an indicator of urbanisation is density. Density also becomes the primary measurement

in a stream of literature examining urban sprawl and compactness (Bardhan et al., 2015; Bereitschaft & Debbage, 2013; Hamidi et al., 2015). More specifically, some scholars use population density, employment density or building density (Mazumdar et al., 2018). High density is one of the criteria of compact city development, which is currently acting as an urban development model. For instance, land uses have become more appropriate in high-density areas. In addition, using energy resources, such as electricity, lighting, and water, could also become more efficient in this area. High-density cities also have an excellent effect on the environment, i.e., reducing carbon emissions (Hong et al., 2022). People do not have to drive far to satisfy their necessities (Neuman, 2005; Stevens, 2017). In contrast, low density is associated with sprawl, which tends to be more inefficient in resource use. Thus, high density will have a better sustainability aspect (Aquino & Gainza, 2014; EEA, 2015).

The sustainable element that urban planners desire is not only sustainable in terms of resources and economy but also in social aspects. Indeed, social capital is an important subject in developing countries (Jumirah & Wahyuni, 2018). However, in contrast to the resource element in cities, the impact of density on the social aspect may have two directions. High density causes many spontaneous meets at crossroads, shopping places, worship, and other public places, encouraging people to interact with each other. These recurring occasions will stimulate the growth of social capital in the urban community (Evans, 2003; Muzayanah et al., 2020). On the other hand, high density can also reduce trust between communities because crime risks are also higher in high-density cities. Consequently, neighbours can be suspicious of each other, further worsening social capital (Civelli et al., 2022). Due to that reason, studies on the ideal form of urban planning are still widely discussed and debated.

Putnam (1993) defines social capital as attributes of social institutions that promote action and collaboration for the mutual benefit of society. The shape of social capital in communities can also be examined from the level of trust between neighbours, the number of programs and community groups, and collective actions when neighbours require assistance. In many studies, social capital can act as a catalyst for many development targets, particularly in developing countries, such as poverty reduction (Harrison et al., 2019), mental health resilience (Evans, 2003; Laurence & Kim, 2021), happiness (Rodríguez-Pose & Berlepsch, 2014), farm productivity (Kehinde et al., 2021), and food security (Chen et al., 2014; Kehinde et al., 2021). Therefore, identifying the determinants of social capital is essential to discuss because increasing social capital could accelerate development by improving the quality of human well-being from various dimensions.

This study aims to examine the effect of density on social capital in urban environments. A potential outcomes framework is utilised to overcome endogeneity issues that often arises in research on the effect of urban characteristics. One of the pieces of literature that highlights urban endogeneity is a study by Duranton and Turner (2018). They examine the density effect on travel behaviour. In their study, Duranton and Turner (2018) utilise instrumental variables method to handle the endogenous density. Thus, the treatment effect obtained in their study describes the change in behaviour of random individuals when the surrounding density changes. Handling endogeneity is important because it can obscure the true effect (Duranton & Puga, 2020; Duranton & Turner, 2018). Furthermore, a study by Muzayanah et al. (2020) has identified the association between urban density and social capital in the metropolitan cities of Indonesia. The study suggests that higher density lowers social capital, identified by lower levels of trust and less involvement in the community's actions. However, the study does not explicitly address endogeneity in urban characteristics.

Additionally, Civelli et al. (2022) also examine the impact of density on social capital in Indonesia. Using the approach by Altonji & Mansfield (2018) (which utilises the average of observables to control for sorting on unobservables), the study suggests that high density negatively impacts social capital. Crime risks are suspected to be a mediating factor that causes this occurrence. Compared with the previous studies, this study also wants to notice the effect of density on social capital. Using Jakarta, the capital city of Indonesia, as a case study of the topic that utilised the entropy balance on continuous treatment method by Tübbicke (2022). Our findings highlight that higher density could improve social capital, contrary to the research of Muzayanah et al. (2020) and

Civelli et al. (2022).

This study revisits the impact of density on social capital with several suggestions for improvement as contributions. First, this study uses the entropy balance framework to address the urban endogeneity issue (Schindler et al., 2018). One of the endogeneities is sorting issues, where several studies have not identified this issue in their research (Garrido-Cumbrera et al., 2018). The sorting mechanism in this study are possibilities of different individual and social characteristics between dense and sparse urban villages. Ignoring this issue will bias the estimate of the density effect on social capital that this study observes (Kustanto, 2020). Accordingly, this study fills the gap by utilising the entropy balance framework to reduce the bias caused by sorting through giving weight so that the observations become balanced in dense and sparse areas, based on given covariates (Tübbicke, 2022). Second, although the observations used are not at the individual level (as in the research of Muzayanah et al. (2020) and Civelli (2022), this study uses a relatively small area scale, i.e., at the urban village. On the other hand, the measurement of density is generally measured at the district level. It is expected that the effect of density can be estimated more precisely because the analysis was conducted in a relatively smaller scope. This study also contributes to a group of literature on the big issue of ideal urban forms that can provide better welfare (Evans, 2003; Glaeser & Kahn, 2003; Hankey & Marshall, 2017; Komalawati & Lim, 2021).

2. RESEARCH METHODS

2.1. Data collection

This study's data source is the Village Potential Statistics (PODES) 2018. The data is obtained from the Statistic Indonesia (BPS). The data period is the most recent data available as the survey is conducted approximately three times every ten years. This study defines density as the average number of inhabitants per square kilometre in an urban village. For the outcome variable, this study utilises a question about the residents' behaviour in society's collective actions. The question is asked to the urban village officials in each region. The outcome variable is a dummy. The value will be one if most of the people in an urban village often participate in collective actions and will be zero if only a minority often participates. The value of the social capital variable equal to one indicates an urban village with a high level of social capital.

Table 1. Definition of variables

Variable	Definition	Source
Social capital in general collective actions	The size of urban village social capital is based on the habits and involvement of residents in collective activities for the common interest. Social capital is equal to one if most of the residents are involved.	PODES 2018
Social capital in helping neighbours	The size of urban village social capital is based on the habits and involvement of residents in collective activities to help locals affected by disasters (such as death, illness, and accidents). Social capital is equal to one if most of the residents are involved.	PODES 2018
Density per square kilometre	Population per square kilometre in each urban village.	PODES 2018
Public space	The availability of open public spaces whose main purpose is as a place for locals to play without paying (such as open fields, squares, parks, etc.). The number will be 1 if there are a managed open public space.	PODES 2018
Safety aspect	Mass fights in the urban village for the past year. Score 1 if it never occurred.	PODES 2018
Squatters	The existence of squatters in the urban village. Score 1 if there are squatters.	PODES 2018
Luxury residence	The number of luxury residences (location).	PODES 2018
Apartment	The number of apartments (location).	PODES 2018

For entropy balances determinants and serves as OLS's control variables, this study utilises urban villages characteristics, i.e., public spaces, safety aspects, squatters, luxury residences, and apartments. The public spaces variable depicts the availability of places for people to meet and interact, and the variable is a dummy. Suppose an urban village has well-maintained public open space so that the value will be one. The safety aspect variable is also a dummy. The value would be one if there were never mass fight incidents (the incidents were examined in 2017). Also, in binary measurement, the squatter variable indicates the existence of squatter environments. The value will be one when an urban village has squatters. In addition, the number of luxury residences and apartments is also used as the control variable. Our control variables are also obtained from the Indonesian Village Potential Statistics (PODES) 2018.

2.2. Empirical Strategy

This study utilises the Entropy Balance on Continuous Treatment (EBCT) approach introduced by Tübbicke (2022). The method is the latest improvement from the initial entropy balance on the binary treatment method by Hainmueller & Xu (2013). Tübbicke (2022) explains that examining treatment effects on potential outcomes framework must fulfil the conditional independence assumption (CIA). This attractive method uses an approach in which the distribution of covariates is expected to be independent of the treatment variable. To obtain this condition, Tübbicke (2022) utilises the balance weight that can eliminate the correlation between covariates and treatment variables. Thus, this method is expected to obliterate the issue of endogeneity (mainly the sorting issues) in our interest variable. People with higher social capital could be attracted in both ways toward more dense or less dense locations. We proxy the determinant of the sorting (element of X_i) to include public space availability, safety, presence of squatters, and luxury residentials. Using the entropy balance weights on the regression model will balance the urban village's characteristics in high and low-density areas. Therefore, the coefficient that emanates from our regression model portrays the causal effect of density on social capital.

This study uses some variables as determinants for the entropy balance process, as mentioned in the data sources section. The determinants are urban villages characteristics associated with the ease of living, which arguably influence the density and social capital. All those dimensions are applied for constructing EBCT weights. This study employs an OLS regression model in Equation (1), given the weights acquired from the entropy balance phase w_i and it is obtained by the inverse probability weighting (IPW):

$$w_i = \frac{f_T(density_i)}{f_{T|X}(density_i|\boldsymbol{X}_i)}$$

with i is urban village index, $soscap$ is social capital, and $density$ is population density, this study pays attention to parameter estimate of β which measure the treatment effect of $density_i$ on $soscap_i$ given that the Conditional Independence Assumption (CIA) *or* the condition of $density_i \perp \boldsymbol{X}_i$ holds when w_i is used. $\boldsymbol{X}_i$ are urban village characteristics that are potentially related to social capital dan density (this study uses public spaces, safety aspect, squatters, luxury residences, and apartments). A positive β indicates that density enhances social capital. In contrast, a negative β means that density lowers social capital.

$$soscap_i = \alpha + \beta\ density_i + \varepsilon_i \quad (1)$$

Nevertheless, EBCT approach that eliminates the association between a treatment variable and covariates to fulfil CIA conditions is not indigenous ideas. The idea is conformable to the use of control variables in main equations. Adding control variables to estimation models aims to obtain the marginal effect of treatment variables by eliminating the variation caused by the control variables. However, the latest approach can have more bias if the distribution of treatment variables does not have a normal distribution. For that reason, this study compares the results of the estimated entropy balance (see Equation 1) and a linear regression model with control variables (see Equation 2).

$$soscap_i = \alpha + \beta\ density_i + \boldsymbol{\gamma X}_i + \varepsilon_i \quad (2)$$

$$soscap_i = \alpha + \beta \ln (density_i) + \varepsilon_i \quad (3)$$

$$soscap_i = \alpha + \beta \ln (density_i) + \boldsymbol{\gamma X}_i + \varepsilon_i \quad (4)$$

Furthermore, this study also conducts a robustness test using different social capital measurements. The measurement used in the main estimate is the participation in general collective action, while for robustness, the participation in helping neighbours who are having difficulties is employed (the source also from the Village Potential Statistics (PODES) Indonesia 2018). This robustness step also employs Equation 1 and Equation 2, but with a different operational definition of the outcome variable. Last, this study examines the effectiveness of the entropy balance method by transforming the treatment variable using a natural logarithm (see Equation 3) and the use of OLS with transformed variable (see Equation 4). This transformation aims to obtain a normalised distribution of density.

3. RESULTS AND DISCUSSION

This section is divided into four, i.e., descriptive statistics, estimation results, robustness tests, and discussion. The descriptive statistics section draws the distribution of the data used. The results section summarises the estimation results of density's effect on the community's social capital. The third section provides some robustness tests using different measurements of social capital indicators and transforming the density variable. Meanwhile, the last section explains this study's findings and comparison with other related studies.

3.1. Descriptive statistic

Table 2 provides an overview of the distribution of the data used in this study. From the data, around 75% of Jakarta's communities have high social capital scores (measured at the urban village level). In other words, 1 of 4 urban villages has a low social capital level. The two methods of calculating social capital produce identical figures because the number of urban villages that have capital scores of one in the general collective actions approach is equal to the number of urban villages that have social capital scores of one in the helping neighbours approach. The correlation between the two approaches is quite high (0.73). Furthermore, the average population density in Jakarta is 25 thousand people per square kilometre, with the most populous urban village of 312 thousand people per square kilometre in Jelambar Baru, West Jakarta, and the least populous urban village of only around one thousand people per square kilometre in Karet, South Jakarta.

For the control variables, this study uses urban village characteristics variables related to the comfort of living, which arguably affect the urban village's density and social capital. The first control variable is the availability and quality of public space. Around 72% of urban villages in Jakarta have open public spaces that can be used to relax or meet residents, such as parks and open fields. The rest urban villages do not own or have but are not maintained. Subsequently, around 79% of urban villages have never had a mass fighting incident, indicating that the urban villages have a better safety aspect. On the other hand, about 21% of the remaining urban villages had incidents of mass fights. The squatter variable shows the presence of squatter settlements. The figure depicts that around 11% of Jakarta's urban villages have squatters (commonly slums). The last two variables are the existence of certain settlements (luxury residences and apartments). On average, each urban villages have 2 luxury residences and 1 apartment building.

Table 2. Descriptive statistics

Variables	Obs.	Mean	Std. dev	Min	Max
Social capital in general collective actions (often participate in collective actions=1)	261	0.755	0.431	0	1
Social capital in helping neighbours (helping other residents affected by disasters or accidents=1)	261	0.755	0.431	0	1
Density per square kilometre	261	25,190,5	27,314.8	1,244.8	312,292.8
Public space (has public space=1)	261	0.720	0.450	0	1
Safety aspect (no incidents of mass fighting=1)	261	0.789	0.410	0	1
Squatters (has squatters=1)	261	0.115	0.320	0	1
Luxury residence	261	2.395	3.865	0	30
Apartment	261	0.920	1.563	0	9

Source: Village Potential Survey 2018 (Authors calculation)

3.2. Estimation results

Table 3 shows the regression results from the model in Equation 1 and Equation 2. To facilitate interpretation of the results, this study uses the interest variable definition as density per 10 thousand people. The density coefficient is 0.020 (significant at α=1%). The figure in the entropy balance model suggests that an increase in density of 10 thousand inhabitants per square kilometre is associated with a 2% higher possibility of societies in Jakarta's urban village having high social capital. However, in the OLS model with control variables, density is not correlated with social capital. This difference in results also implies that the entropy balance estimate suggests an upward coefficient correction. In other words, the direction of bias tends to be a negative one such that people with higher social capital prefer places with less density. The indication is indicated from five covariates employed in the OLS with control variables model, the luxury residence has a negative association with social capital (with a coefficient of -0.017 and significant at α=5%). The number shows that luxury residences correlate with lower social capital.

Table 3. The result of model estimation

Dependent variable: **Social capital**				
Variables	**Entropy balance**		**OLS with control variables**	
	Coefficient	**Robust Std. error**	**Coefficient**	**Robust Std. error**
Density (per 10 thousand)	0.020***	0.007	0.014	0.010
Public space	-	-	0.081	0.062
Safety aspect	-	-	-0.078	0.058
Squatters	-	-	0.024	0.078
Luxury residence	-	-	-0.017**	0.007
Apartment	-	-	-0.024	0.018
Constant	0.715***	0.036	0.781***	0.073
Obs.	261		261	
R^2	0.024		0.057	

Note: *, ** and *** represent significance at 10%, 5% and 1% levels respectively
Source: Authors calculations

3.3. Robustness

According to the main result, density could improve people's social capital. In this robustness step, this study utilises another question in the Village Potential Survey as an alternative measurement of social capital. The question is about community involvement in helping other residents affected by disasters or accidents. In line with the main estimate, this study also utilises both approaches, the entropy balance, and OLS with control variables (see Table 4).

Table 4. The different measurement of social capital

Dependent variable: **Social capital**				
Variables	**Entropy balance**		**OLS with control variables**	
	Coefficient	**Robust Std. error**	**Coefficient**	**Robust Std. error**
Density (per100 thousand)	0.020***	0.007	0.014	0.010
Public space	-	-	0.091	0.062
Safety aspect	-	-	-0.105*	0.057
Squatters	-	-	0.050	0.079
Luxury residence	-	-	-0.011	0.008
Apartment	-	-	-0.005	0.017
Constant	0701***	0.037	0.762	0.070
Obs.	261		261	
R^2	0.025		0.040	

Note: *, ** and *** represent significance at 10%, 5% and 1% levels respectively
Source: Authors calculations

The use of the different measurement of social capital gives us similar figures. The coefficient of density is 0.020 (significant at α=1%), affirms that density intensifies social capital. This consistent result indicates that the model used is adequate to support the analysis of the effect of density on social capital. Still, in the second model, the density variable is also not significant. Regardless, safety aspects become the only factor associated with social capital. The magnitude is quite surprising. Urban villages without incidents of mass fighting (assumed as a better safety aspect) have lower social capital levels.

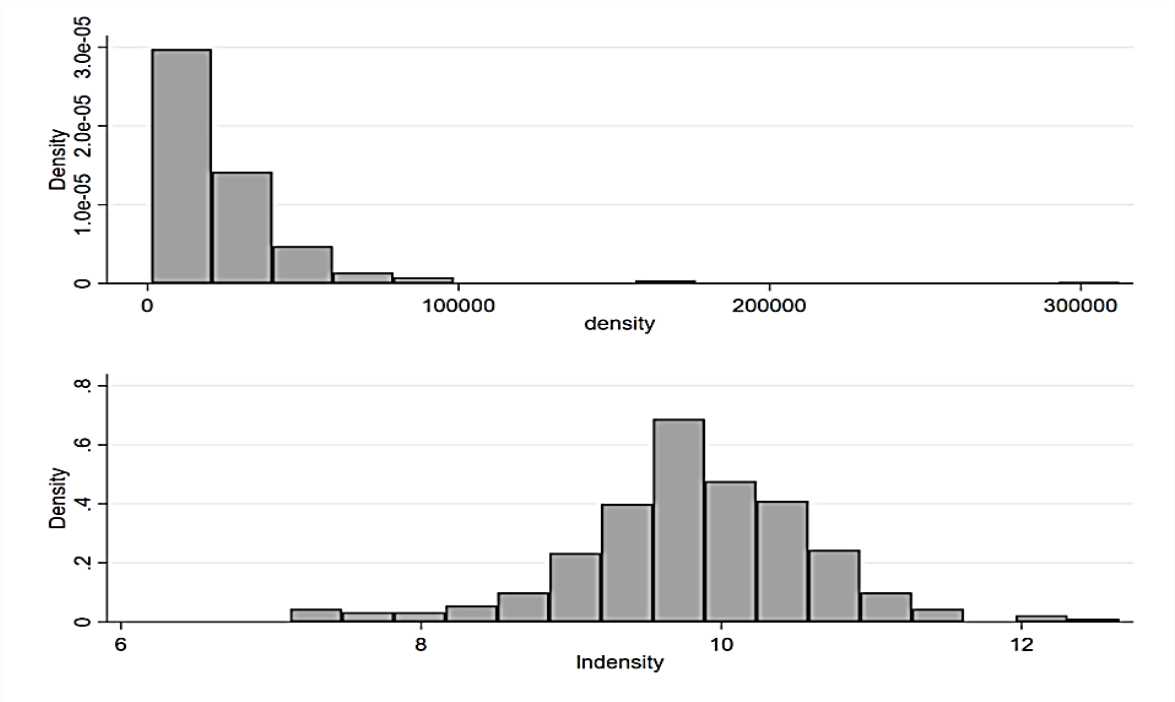

Figure 1. Distribution of density and ln(density)
Source: Authors calculations

Moreover, based on the data description, our density variable has more intensity at a lower value of density (see Figure 1). This study intends to clarify Tübbicke's statement about the effectiveness of entropy balance when data have no normal distribution. This study runs the data using a natural logarithm transformation on the density variable. Then, the distribution of ln (density) has a bell-shaped curve. This step also gauges the robustness of the density effect on social capital. After the log transformation of density, this study gets significant results in both approaches. Both models have positive and influential figures, 0.133 for the entropy balance and 0.091 for OLS with control variables. The former method gives a higher magnitude than the latest.

Table 5. Transforming the density variable

Dependent variable: **Social capital**				
Variables	**Entropy balance**		**OLS with control variables**	
	Coefficient	**Robust Std. error**	**Coefficient**	**Robust Std. error**
ln (Density)	0.133***	0.035	0.091**	0.038
Public space	-	-	0.091	0.062
Safety aspect	-	-	-0.057	0.059
Squatters	-	-	-0.024	0.076
Luxury residence	-	-	-0.014*	0.007
Apartment	-	-	-0.019	0.018
Constant	-0.544	0.352	-0.092	0.400
Obs.	261		261	
R^2	0.062		0.076	

Note: *, ** and *** represent significance at 10%, 5% and 1% levels respectively
Source: Authors calculations

3.3. Discussions

Many aspects of density favouring economic activities, such as increasing productivity, shortening travel time, and abridging length of commodity access. Moreover, for the environment aspect, density drive more efficient use of energy and resources. Thus, dense environments induce larger economic sizes (Duranton & Puga, 2020). Interestingly, the advantages of density in the economic aspect are not clear on the social aspect. Indeed, the effect of density on social indicators is often the opposite. Especially in crowding areas in cities, people live more individually. It causes people to have low concern for neighbours and rarely be involved in social activities in local communities. Though on the other hand, living in dense circumstances could promote social capital levels. It caused by interactions between residents are more frequent (Evans, 2003; Lloyd et al., 2016).

Our results highlight that density could promote social capital in Jakarta. It indicates that people live in denser areas have better social cohesiveness. Moreover, from the complete specifications of our model, the presence of luxury housing is the cause of lower social capital in an urban village. Consequently, zones with fewer luxurious housing will have higher levels of social capital, *cateris paribus*. As a preliminary analysis, our result shows that the edifice of luxury apartments or housing in the middle of settlements tends to have the potential to provoke friction between residents in luxury housing and existing settlements. In addition, perilous environmental conditions are also associated with low social capital, *cateris paribus*. The result implies that securer environmental conditions will produce trust and social cohesion between neighbours.

The effect of high density which improves social capital can emerge due to several reasons. First, a dense environment will lead to more interactions, either intentionally or unintentionally, between locals. This argument can be supported by the portrait of residentials in Jakarta that have many alleys in dense areas, increasing the chance for locals to meet each other. The interactions will deliver rise to many small communities (friendships) which will increase social cohesion among locals (Hawley, 2012). Second, denser area tends to have more public meeting places. The quantity of public meeting places correlates with more community activities in better quantity and quality, especially collective action in dealing with hazards (Bott et al., 2019). Our result is also in line with

general belief that density boosts social capital and urban quality of life in cities in developing countries (Hawley, 2012; Komalawati & Lim, 2021).

In wider context, density interestingly has a positive and negative effect on social capital (Hawley, 2012; Lloyd et al., 2016). Both opposite effects have led to differences of thought regarding the form of sustainable urban design, especially on social aspects. The discussions focus to the question of whether a dense city model is proper to serve as a measure of sustainable urban planning. Although other studies found a more dominant in the harmful effect (Muzayanah et al., 2020), the favourable effect of density is more prevalent in this study. Thus, based on this study's finding, we recommend dense urban design development policies as a standard of urban planning that is socially sustainable.

Nevertheless, this result should be viewed with caution. First, the measurement of social capital used in this study is straightforward and only measured based on the answers of one urban village officer who are the survey respondents. Their answers are then claimed as a portrayal of conditions for one urban village. This study has tried to overcome the issue using different social capital measurements. However, this measurement approach is still taken from the same survey. Despite these drawbacks, this study deduces that the effect of density is robust because the magnitude and direction of the density coefficient are analogous. Second, this study uses Jakarta as the case study, which is the most populous city in Indonesia. Jakarta is also a city with various population backgrounds (based on ethnicity, occupation, and income). This particularity may lead the density effect observed in Jakarta to be different from other cities in Indonesia.

4. CONCLUSIONS

This study examines the relationship between density and social capital. This study utilises an entropy balance framework to limit the selection bias due to sorting issue. This study concludes that living in densely residential areas is associated with high levels of social capital. Our results are robust, as evidenced by different social capital measurements and transforming the density variable. However, this study's validity of finding is limited to the context of Jakarta as the study location, which is the most populous city in Indonesia and has unique attributes compared to other cities in Indonesia. Thus, the externality of our findings should be tested in further studies. The results add empirical evidence of the positive direction implication from city density to social capital. Based on this study's result, we recommend that urban planners can design dense urban planning as a model of sustainable urban design, particularly the sustainability in social aspects.

ACKNOWLEDGMENTS

Authors thank BPS-Statistics Indonesia for the support in providing the data used in this research.

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