
The Effect of Density on Crime: Evidence from Indonesia

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Abstract

This study aims to contribute to the literature on economic density by finding empirical evidence on whether the effects of density are going higher to affect the crime rate at the district level from 2007-2018 with 440 districts. This study used crime rate as a dependent variable and population density as an independent variable also had average age, married, the proportion of divorce, the proportion of gender, and the proportion of urban as relevant variable control. Density appears to have a small effect on crime rates. The regression result using a fixed effect panel concluded the economic density has a negative association with the probability of becoming a victim of crime. Density positively impacts the environment in terms of crime prevention. The denser an area is correlated, the lower the number of victims of crimes.

Keywords: economic density; victims of crime; panel data.

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I. Introduction

There are many abilities welfare involvement in crime and violence. They have direct consequences to the number of quantities and consistent quality of human existence, such as lifetime reductions, a shared sense of fear, and behavior improvement intended to avoid crime. There is also the community waste from the value of things lost and ruined, the public-private money used for avoidance, and the expense of criminal justice and prison schemes (Soares, 2015). In addition, and far less straightforward, crime has potentially harmful effects on growth through reduced productivity (Detotto and Otranto, 2010).

Intentional homicide data (per 100.000 people) shows a total average in 2012, 2014, and 2015, namely around 8.4, 7.35, and 7.23 for all regions. The homicide rate is a type of crime that is most accurately recorded and internationally comparable, and UNODC uses it as a proxy for global crime and violence (UNODC, 2014). Death rates measure the number of deaths per 100.000 people in a given country. Almost all regions experienced a decline in intentional homicide rates from 2012 to 2015, except for Europe and Central Asia. However, the decline was also insignificant, around 13.9% from 2012 to 2015 (World Bank, 2018). It shows that crime is still becoming a frequent occurrence and a problem for the whole world.

Researchers found evidence of a link between crime rates and urban growth. The growing urban development literature demonstrates the multiple positive and negative externalities of urban density that often function at very different spatial and temporal scales, such that not all urban constituents are inherently involved. Density makes a city relatively more attractive, drawing population from other places and making a city bigger. The productive advantages of the bigger city are evident in the higher productivity of their establishments (Henderson, 2003 & Combes et al., 2012). They are even increasing workers' earnings in developed and developing countries (Chauvin et al., 2017; Bryan et al., 2014). Equally, in Indonesia, Hicks et al. (2017) show that urban workers in Indonesia earn approximately 2.8% more per hour. Urban density also positively correlates with good education because schools teach children skills that facilitate communication, such as reading, writing, and grammar, enabling urban interaction (Psacharopoulos & Patrinos, 2018). The complements of urban density and education also suggest that better education may enable poorer children to take advantage of urban opportunities (Glaeser & Resseger, 2010). So, urban proximity enables the sale of services and spreads ideas more effectively.

At the same time, density also creates social costs due to urban disamenities such as pollution, contagious disease, crime, congestion, limited wealth, and scarce public capacity (Bryan et al., 2020). The air pollution literature by economists has focused on the adverse health consequence of bad air quality, such as increasing asthma, decreasing birth weight, improving multiple mortality children, and also can harm the local economy by repelling skilled high-productivity individuals (Alexander & Schwandt, 2019; Cesur et al., 2017; Khan, 1999). At the same time, research on water infrastructure is also linked to public health, which found that bad water quality decreased health rates and infant mortality (Headey, D., & Palloni, G., 2019). Also, traffic congestion is characterized by excessive travel time compared to uncrowded driving. Economists have valued this wasted time by multiplying the minutes lost by the post-tax wage (Alonso, 1964). Then, most estimates find that urban crime, predictably, produces substantial costs, including increased migration and a decline in tourism (Cullen & Levit, 1999; Biagi & Detotto, 2014).

The previous study showed that the impact of population density on crime rates is not specific since the population density impacts and the crime rate are two conflicting influences. In terms of positive effects, cities lead to an escalated return to crime because cities in dense areas have a greater return from crime, such as cheaper transportation costs and greater density of victims, happening quickly in urban fact flows. The same measures of economies that help to create more valuable cities also raise the level of crime (Glaeser, 1999). The criminals must leave the scene of crimes faster, or the difficulties inherent in carrying over long distances of stolen goods and cities can create a connection between the rich and the poor. Also, a dense area will have a much larger stream of potential victims than an empty area, and the return from this type of crime should be higher in urban areas. Then, dense urban areas will lead to better education for offenders about a broad range of victims. More important information flows in cities also make it possible for individuals to acquire knowledge that will reduce the cost of crime to the criminal. The latter can lead to increased returns on offence, as urban economies are created to make the resale of stolen goods or the buying of criminal equipment easier.

In this study, we examine that density appears to have a small effect on the crime rate. The regression result using a fixed effect panel concluded that economic density has a negative association with the probability of becoming a victim of crime. Density positively impacts the environment in terms of crime prevention. The denser an area is correlated, the lower the number of victims of crimes. We contribute to the literature (1) the relation between density and crime in developing countries, (2) make use of victims that is more appropriate than underestimated usual crime rate in developing countries.

The remainder of the paper is organized as follows. Section 2 provides background information on the dynamic of population growth development and crime rate in Indonesia from 2007-2018. Section 3 explains the data and the associated effect of population density and crime rate. Section 4 reports the result and potential underlying mechanism. Then the last, Section 5, presents conclusions.

II. Literature Review

2.1. Population Density in Indonesia

Evidence from Panel of the National Socio-Economic Survey KOR Individual 2007-2018 data allows us to exploit the experiences in densely populated areas at the island level, such as Java, and sparsely populated regions such as Sulawesi, Kalimantan, Maluku, and Papua. More than half of Indonesia's population is concentrated on Java Island, around 56.6 percent of the population, with only 6.8 percent of the total territory of Indonesia. However, lately, there has been a slight change in population concentration. There has been a decrease in the population living on the island of Java by 1.1 percent over the last 12 years. Conversely, there has been an increase in the percentage of other islands such as Sumatra, Kalimantan, and Papua.

Dynamics of population growth development can also be seen from the increase in population density between Java and Non-Java. The most densely populated area is generally on the island of Java, around 1159.66 people/km². In contrast to outside Java Island, the population density on another island is 73,126 people/km². In the future, there is

a tendency for Java to be even denser because, in Java, the density growth is much higher than outside Java.

2.2. Crime Rate in Indonesia

The Criminal Statistic publication shows that the number of victims of crimes in Indonesia is still high. The number of people affected by crime per 100.000 population in 2018 was around 113 (BPS, 2019). This condition improved from the previous year, around 129 and 113 in 2016. The number of crime or criminal acts incidents in Indonesia during 2016-2018 fluctuated. The data shows that the number of total crime incidents in 2016 was as many as 357.197 incidents, decreased to 336.652 incidents in 2017, and decreased again in 2018 to 294.281. The number of crime incidents is based on the number of crimes reported to the police, so the actual figure may be higher because not all crime victims report to the police. According to the 2007 IFLS survey results, only about 30 percent of property crime victim households reported to the police (Ginancar, 2015)

Include the current knowledge, substantive findings, and theoretical and methodological contributions to the topic. A literature review surveys books, scholarly articles, and other sources relevant to a particular issue, area of research, or theory, providing a description, summary, and critical evaluation of these works concerning the investigated research problem.

III. Methodology

3.1. Data and Identification

This study uses panel data for analysis. The panel data used are the nationally representative Indonesian Socio-Economic Survey (Susenas) data from 2007 until 2018. The unit of analysis used is the district within the province level based on Susenas data. From 2007-2018, there was a name for the division of districts within the province, so it needed to merge in the beginning, based on 440 districts observed yearly.

Crime data existed from Susenas 2006, but the type of question of Susenas 2006 is different from the others, so statically, it does not fit for use. Then, the analysis covers 12 years, from 2007-2018, since BPS has been estimating crime incidence. The estimates have been made every year from the core questionnaire that covers questions on numerous data items on crime, population characteristics, and demographics. The annual cross-sectional data drawn from the Susenas represent the district level. They can be used to construct a district panel, yielding a strongly balanced panel of 440 districts.

The initial panel data consisted of 5.280 observations, but this study retained 5.278 observations after deleting mission values. Among the various surveys in the BPS data collection system, the National Socio-Economic Survey (Susenas) is one of the oldest and the most appropriately used for assessing the improvement in people's social well-being using socio-economic indicators produced by the survey (Friedman & Levinsohn, 2002; Ravallion & Lokshin, 2007). In Indonesia, it is the only one covering the entire archipelago (Pradhan, Suryahadi, Sumarto, & Pritchett, 2002; Biro Pusat Statistik, 2009).

3.2. Estimation Strategy

To estimate the relationship between the density and crime rate, we adapt Boessen and Hipp's (2015) model as follows:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln S_{it} + X_{it} + v_i + \rho_{rt} + \varepsilon_{it}$$

$\ln Y_{it}$ is the crime rate with log, representing the proportion number of victims at district i and time year t . It defined as kinds of victim crime (robbery, burglary, murder, rape, assault, violent) divided by the population size and reported as crimes per 100.000 inhabitants in districts. S_{it} captures the change in density with a log by proxy of population density. This population density variable is common in studies investigating the effects of density. X_{it} are control variables of interest in the district panel, such as average age, the proportion of people married, the proportion of people divorced, the proportion of gender, and the proportion of respondents living in urban areas. It also includes district fixed effects (v_i) and island-year interaction fixed effect (ρ_{rt}). The latter captures an island trend effect that reflect other density progress during the period that may differ across islands (Yudhistira, M.H., & Sofiyandi, Y., 2017). ε_{it} represents a random term error in this estimation at the district level since observations within the district are possibly associated with each other over time.

This study uses panel data to evaluate district heterogeneity to eliminate bias. Besides capturing differences between districts, panel data can also compare the conditions of these districts in one period with other periods.

IV. Results and Discussion

4.1. Economic Density Impact on Victims of Crime

Our estimates of the effect of density on crime rates are presented in Table 1. Table 1 presents the regression results for each crime category in the 440 districts from 2007-2018. This study approximately equation (1) using district fixed effect and a time fixed effect shows the coefficient is -0.498 and statistically significant at the 1% level. The coefficient suggests that density in a district has a 58.0% negative association with the probability of becoming a victim of crime. This estimate does not include other relevant control variables, so, likely, that the estimate is still overestimated. Then, entering the relevant control variables shows that the coefficient equation (5) is -0.387 and still statistically significant at the 1% level. The crime rate rises by 3.8% for every 10% increase in density. The proportion of people married and divorced is also a good control because it reduces the problem of sorting behavior. A person's status affects their preference to live in a dense area, and at the same time, it will also affect whether the crime is high or not in that area.

Table 1. Correlation of Density on Crime Rate (per capita), baseline estimates

Independent Variables	Dependent Variable: Crime rate per capita (in log)				
	(1)	(2)	(3)	(4)	(5)
Log (Density)	-0.580*** (0.116)	- 0.519*** (0.117)	- 0.392*** (0.121)	- 0.394*** (0.121)	- 0.378*** * (0.121)
Observations	5,278	5,278	5,278	5,278	5,278
R-squared	0.296	0.298	0.300	0.300	0.302
Districts	440	440	440	440	440
Controls:					
Age	YES	YES	YES	YES	YES
Divorce	NO	YES	YES	YES	YES
Married	NO	NO	YES	YES	YES
Sex	NO	NO	NO	YES	YES
Urban	NO	NO	NO	NO	YES

Notes: *t* statistics are in parentheses. ***, **, * are statistically significant at 1%, 5%, and 10%, respectively. All regressions control for year and year*island fixed effects. These estimates use a strongly balanced district-year level panel.

Source: Data processed, 2021

Overall, victims of crime are strongly influenced by population density, so when population density increases by 1%, victims of crime decrease by 0.378. It is also statistically significant at 1%, respectively. These findings are much lower than studies conducted by Boessen and Hipp (2015) that also have a negative correlation between population density and all six crime types in the block group models, with an average coefficient of -1.45 in every type of crime, significant at the 5% level. This finding shows that density can create more monitoring, such as more eyes and ears to what is happening, so it will provide social control through guardianship.

4.2. Heterogeneity Analysis

By anticipating the heterogeneity between population density and the level of crime victims in Indonesia, we regress Equation (1) into three subsamples based on geographical, economic, and time variations. Detailed estimation results are presented in tables 2, 3, and 4.

In subsample analysis based on density between Java Island and Outside Java Island, economic density consistency was statistically, significantly, and negatively correlated with the probability of becoming the victims of crime but with a different coefficient. Java island has a coefficient of -1.098, and Outside Java has a coefficient of -0.294. The coefficient suggests that economic density in a district in Java has a 109.8% negative association with

the probability of becoming a victim of crime, and economic density in a district outside Java has a 29.4% negative association with the probability of becoming victims of crime. It means that economic density in Java has a bigger positive impact than outside Java on the environment in terms of crime prevention. A criminal will commit a crime if the benefits exceed the resulting costs (Glaeser, E.L., 2019). For the island of Java, which is relatively densely populated due to higher economic activity, the opportunity cost of time lost in incarceration is relatively higher compared to outside Java, which is not too dense, with lower economic activity. This condition should create fewer crimes. Then, Jacob, J., (1961) mentioned the existence of guardians who can prevent crime in crowded areas if they do not lose their traditional social structures.

Table 2. Heterogeneity subsample analysis based on density between Java Island and outside Java Island

Independent Variables	Dependent variable: Crime rate per capita (in log)	
	Island	
	Java	Outside-Java
	(1)	(2)
Log (Density)	-1.098*** (0.303)	-0.294** (0.138)
Observations	1,380	3,898
Number of obsid	115	325
R-squared	0.504	0.280

Notes: *t* statistics are in parentheses. ***, **, * are statistically significant at 1%, 5%, and 10%, respectively. All regressions control for year and year*island fixed effects. These estimates use a strongly balanced district-year level panel.

Source: Data processed, 2021

This subsample uses GDRP 2007 as a baseline and assumes the district with GDRP above the average GDRP will be wealthier than the district with GDRP below the average GDRP. Not the same as the subsample before, the subsample analysis using GDRP shows that economic density consistency is statistically significant and negatively correlated with the probability of crime victims just for the poorer district. However, for wealthier districts, the consistency is not statistically significant, although it has a negative correlation. The poorer district has a coefficient of -0.309, suggesting that economic density in poorer districts has a 30.9% negative association with the probability of becoming a crime victim. We can also mention that economic density in poorer districts positively impacts the environment more than in wealthier districts in crime prevention. It may cause poorer people to have better social capital than rich people, so they work more together to protect their environment from crime by holding night patrols.

Table 3. Heterogeneity subsample analysis based on density using GDRP
(based on 2007)

Independent Variables	Dependent variable: Crime rate per capita (in log)	
	Average GDRP	
	>7729 (1)	<7729 (2)
Log (Density)	-0.0286 (0.216)	-0.309*** (0.137)
Observations	1,140	4,138
R-squared	0.502	0.266
Number of obsid	95	345

Notes: *t* statistics are in parentheses. ***, **, * are statistically significant at 1%, 5%, and 10%, respectively. All regressions control for year and year*island fixed effects. These estimates use a strongly balanced district-year level panel.

Source: Data processed, 2021

The result is that when it loses some observations in the estimations, the coefficients are not comparable. The Standard error in equation (1) is significant at the 1% level, the standard error in equation (2) is significant at the 5% level, and the standard error equation (3) is significant at the 10% level. Observation in 2011-2014 has a coefficient of -0.999 and in 2015-2018 has a coefficient -1.213. The coefficient suggests that economic density in the district from 2011-2014 had a 99.9% negative association with the probability of becoming a victim of crime, and economic density in the district from 2015-2018 had a 121.3% negative association with the probability of becoming the victim of crime. It concludes that, over time, the relation of density to crime rate is relatively higher, with 2015-2018 having the greatest positive impact on the environment in terms of crime prevention, followed by the district in 2011-2014 and the district in 2007-2010.

Table 4. Heterogeneity subsample analysis based on density using year of observations

Independent Variables	Dependent variable: Crime rate per capita (in log)		
	Year of Observations		
	2007-2010 (1)	2011-2014 (2)	2015-2018 (3)
Log (Density)	-0.309* (0.178)	-0.999** (1.30)	-1.213*** (0.209)
Observations	1,758	1,760	1,760
R-squared	0.406	0.071	0.081
Number of district	440	440	440

Notes: *t* statistics are in parentheses. ***, **, * are statistically significant at 1%, 5%, and 10%, respectively. All regressions control for year and year*island fixed effects. These estimates use a strongly balanced district-year level panel.

Source: Data processed, 2021

4.3. Robustness Check

This study also found (Table 5) a relationship between density and the level of crime rate per km. The coefficient suggests that density in a district has a 1.3 % negative association with the probability of becoming the victims of crime. This estimate does not include other relevant control variables, so, likely, that the estimate is still overestimated. Then, entering the relevant control variables shows that the coefficient equation (5) is -0.012 and is still statistically significant at the 1% level. The coefficient suggests that economic density in a district has a 1.2% negative association with the probability of becoming the victims of crime. Overall, victims of crime decreased by 0.012. It is also statistically significant at 1%, respectively.

Table 5. Effects of density on crime rate (per km), baseline estimates

Independent Variables	Dependent Variable: Crime per Km				
	(1)	(2)	(3)	(4)	(5)
Density	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)	-0.013*** (0.002)	-0.012*** (0.002)
Observations	5,278	5,278	5,278	5,278	5,278
R-squared	0.099	0.100	0.101	0.101	0.102
Districts	440	440	440	440	440
Controls:					
Age	YES	YES	YES	YES	YES
Divorce	NO	YES	YES	YES	YES
Married	NO	NO	YES	YES	YES
Sex	NO	NO	NO	YES	YES
Urban	NO	NO	NO	NO	YES

Notes: *t* statistics are in parentheses. ***, **, * are statistically significant at 1%, 5%, and 10%, respectively. All regressions control for year and year*island fixed effects. These estimates use a strongly balanced district-year level panel.

Source: Data processed, 2021

This result shows that there is still a negative correlation between the effects of density on crime rate, but it is much lower than above. Because many researchers use crime per capita, this study prefers to use crime per capita as a variable to measure the crime rate.

4.4. Quantifying the Benefit

The average population density level increased by 11.79 percent between 2007 and 2018, resulting in a 4.23 percent decrease in the crime rate. Based on the data, 4.23 percent is equivalent to 5.437.981 cases of crime. With the assumption that the cost for the investigation and investigation process is IDR 25.976.000, - per case of crime (tempo.co.id), the benefit of density in crime prevention is IDR (in million rupiah). So, over the period 2007-2018, the value of the externality of the crime density rate is IDR 141.256,99 (in million rupiah), or equivalent to 0.16 percent of Indonesia’s GDP per year.

Using confidence interval over the period 2007-2018, the value of externality of density on crime rate is between IDR 53.731.088, 18 (in million rupiah) to IDR

242.240.717,98 (in million rupiah) or equivalent between 0.06 to 0.29 percent of GDP Indonesia per year.

V. Conclusion and Recommendation

Economic density appears to have a small correlation effect on crime rates. The approximate estimate of the economic density has a negative association with the probability of becoming a victim of crime. Economic density positively impacts the environment in terms of crime prevention, which is the denser an area is correlated with, the lower the number of victims of crime. The literature on this topic is large. This study estimates improvement on those in the literature in two strategies. First, this study uses greater data. This study uses a large dataset Susenas KOR 2007-2018, to estimate the effect of economic density on crime using microdata describing individuals and procession into district data. Second, our econometric model is motivated by a theoretical foundation. It means that this study can recover the structural parameters governing how victims of crime behave in response to density.

According to this study, population density provides an advantage for reducing the crime rate in an area. Population density is driven by high economic activity. Therefore, it is recommended that the government can support and strive for economic growth in a region, especially for areas still below the national GDRP average, because development in Indonesia also positively impacts crime prevention.

An investigation based on both criminals' and victims' perspectives would provide a complete explanation of the effects of economic density on crime. However, detailed criminal level data in Indonesia is not yet accessible, so this limitation suggests an avenue for future research that accounts for both victims and criminals simultaneously in analyzing the impact of economic density on crime.

The estimation of this research is that one of the components of externality if we build a city, is to increase the density. These estimates suggest that if we increase density, one of the benefits of density is from here. We can calculate that density adds between 0.06 to 0.29 percent of Indonesia's GDP per year.

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