Southeast Asian Journal of Economics Vol.13(3), December 2025:
Received: August 16, 2024
Revision: October 7, 2024
Accepted: November 21, 2024

Income Polarization and Crime: Evidence From Indonesia

Alvin Pratama
Universitas Gunadarma, Depok City, West Java, Indonesia.
Corresponding author: alvin@staff.gunadarma.ac.id

Abstract

This paper examines the link between income polarization and crime in 33 provinces in Indonesia from 2010 to 2018. Most previous studies used income inequality as an explanatory variable to explain crime. However, income inequality only captures income gaps, not the clustering of individuals. This paper demonstrates that income polarization is an important predictor of crime in Indonesia, especially property crime. Employing system Generalized Methods of Moment (GMM) models for dynamic panel data, this study finds that provinces with higher income polarization are associated with those with higher property crime. There is no significant effect of income polarization on homicide in the case of Indonesia. Furthermore, this study finds no significant effects of income inequality on property crime or homicide.

Keywords: income polarization, income inequality, crime, property crime, homicide.

1. Introduction

In many countries, persistent crime and violence pose significant challenges to social stability and economic development. The estimated annual cost of crime in the United States has reached $1.7 trillion. These costs are both direct and indirect. Direct crime costs include policing, corrections, criminal justice, and replacing stolen merchandise. Indirect costs of crime include the opportunity costs of time lost to criminal activities, incarceration, crime prevention, and recovery after victimization (Anderson, 2012). In Latin America, the social costs of crime, including the value of stolen properties, represent about 14.3% of the region's GDP, suggesting that crime undermines investment and productivity, labor, and consumption in Latin America. (Fajnzylber, et al., 2000). High costs of crime and violence have hindered sustainable and economic development around the globe (Fajnzylber et al., 2000). In Indonesia, murder has a negative and significant effect on the level of income as proxied by per capita Gross Regional Domestic Product (Palokoto et al., 2020).

Despite these alarming statistics, there is a notable research gap about the relationship between income polarization and crime, particularly in developing countries like Indonesia. Knowing the factors that influence crime is crucial to fighting and reducing crime. This study seeks to address this gap by examining the link between income polarization, a phenomenon characterized by the concentration of income in several distinct groups, and crime. The number of crimes in Indonesia had dropped substantially from 357,197 in 2016 to 294,281 in 2018, a 17.6% decrease. However, there were still significant variations in total crime across provinces, with the top three provinces (DKI Jakarta, North Sumatra, and East Java) accounting for more than a third of the total crime in Indonesia. Property crime was the dominant type within total crime, accounting for around 31%. Although the national property crime number had significantly declined by 23% between 2014 and 2018, the number of property crimes varied greatly across provinces. It tended

to increase in several provinces in the period of study. Those who committed property crimes hoped to receive financial gains by selling their loot. Their motive was likely to be related to their lack of income. This paper argues that property crime is closely linked to a feature in income distribution, particularly income polarization.

The literature suggests that income inequality affects crime, theoretically and empirically. However, these studies show mixed and inconclusive results. From the economic perspective, Becker (1968) argues that as income inequality increases, the gap between the benefits and costs of crime widens. Thus, this provides more significant incentives for an individual to commit a crime. The sociological theory of relative deprivation stresses that the poor feel disadvantaged and in unfair circumstances compared to the rich as income distribution gets more unequal. As a result, they try to reduce this perceived economic injustice through crime (Runciman, 1966). Several studies have shown that higher income inequality results in more crime (e.g., Fajnzylber et al., 2002; Glaeser et al., 2008; Choe, 2008). Other studies find no significant relationship between income inequality and crime (e.g., Kelly, 2000; Brush, 2007).

While income inequality is widely known as an explanatory variable in explaining crime, income polarization has received little attention. Studies examining the effects of income polarization are limited. It is important to note that income inequality only measures income gaps between income groups (i.e., low and high-income groups). Polarization, in contrast, measures not only income gaps or "feeling of alienation" but also within-group alienation or "feeling of identification" (Esteban & Ray, 1994). It describes how income moves from the middle of the income distribution to the end and how income concentrates at two or more distinct poles or groups. This phenomenon, also known as the "disappearing middle class," is closely linked to violence, conflicts, and social tensions (Esteban & Ray, 1994). Rising income polarization leads to higher social tensions, encouraging those at the bottom of the income distribution to commit crimes.

In addition, income polarization captures income gaps and the clustering of individuals, which affects social segregation and income mobility. This means that higher income polarization creates social segregation, which increases the likelihood of those segregated in a society breaking the law. Furthermore, in a highly segregated environment, upward income mobility is likely low for individuals in the lowest income bracket. This increases frustration and encourages those in lower-income groups to engage in illegal activities (Li et al., 2019).

The research question in this study is how income polarization influences property crime and homicide in Indonesia. Using Indonesia's provincial longitudinal data, this study will test the hypothesis that rising income polarization is associated with a higher rate of property crimes and homicides. The system Generalized Method of Moments (GMM) was used to test these hypotheses due to its advantages in efficiency, bias reduction, and handling endogeneity issues. In contrast to many studies about the relationship between income inequality and crime, few studies discuss the relationship between income polarization and crime. To the author's knowledge, this is the first study that employs income polarization as one of the factors influencing crime in Indonesia.

This study contributes to the literature by providing empirical evidence showing the link between income polarization and crime in Indonesia. Two different types of crime, property crime and homicide, were employed in this study. Our results indicate that income polarization is positively and significantly associated with property crime in Indonesia from 2010 to 2018. However, income polarization has no significant effect on homicide. Furthermore, income inequality is not statistically significant in explaining both property crime and homicide. This result confirms that income inequality is not always a good predictor of crime, although the existing theories are appealing. Income polarization, however, is a better predictor of property crime. This is likely because income polarization captures more complete aspects of income distribution, the clustering of individuals, which income

inequality misses. Policymakers can utilize these findings to design targeted interventions to mitigate crime through socioeconomic policies that address income distribution and social cohesion.

The rest of the article is organized as follows. Section 2 reviews existing literature on the link between income distribution and crime. Section 3 outlines the data and models employed. Section 4 presents the results and discusses their implications. Finally, Section 5 concludes with recommendations for future research and policy.

2. Income Inequality, Income Polarization, and Crime

The first part of this section reviews previous studies examining the link between income inequality and crime. The second part discusses the relationship between income polarization and crime. It should be noted that while prior research on the effect of income inequality on crime is abundant, previous studies on the link between income polarization and crime are very limited.

2.1 Income Inequality and Crime

The relationship between income inequality and crime is a topic that has attracted social scientists from various disciplines. However, there is little agreement on the theoretical explanation across the disciplines for this link despite broad consensus for the existence of this association. The economic theory of crime suggests that individuals compare the expected returns from the market and criminal activity and consider the likelihood and severity of punishment. According to these models, areas with increasing income inequality place the poor in proximity with the rich, who own valuable things that are worth taking, giving low-income individuals high incentives to commit a crime.

From economists' perspectives, economic returns for crimes are higher in areas with higher income inequality (see Ehrlich, 1973; Chiu & Madden, 1998;

Bourguignon, 2000). Pioneering the theory of crime, Becker (1968) suggested that crime rates depend on the probability of conviction, punishment if caught, and other variables such as the income available to a person, the frequency of arrest, and willingness to commit a criminal act. He proposed that the differential returns from legitimate and illegitimate activities determine the incentives for individuals to commit the crime. Extending the work of Becker, Ehrlich (1973) suggested that one of the determinants of property crime was income inequality, which was proxied by the percentage of families below one-half of the median income within a US state. He showed that income inequality is positively related to the incidence of property crimes such as robbery, burglary, and theft. Areas with higher income inequality provide more significant incentives for potential offenders to participate in crimes. This is because higher income inequality indicates higher potential payoffs from potential victims of crime and more poor individuals who have higher returns for the time allocated to criminal activities (Ehrlich, 1973).

Several sociological theories on crime are the strain theory, the theory of relative deprivation, and the social disorganization theory. The strain theory states that individuals at the bottom of the social structure feel frustrated and angry when they fail to attain what is considered success by society (Merton, 1938). As a result, these unsuccessful individuals become alienated from society and are involved in illegal activities in response. The relative deprivation theory states that increasing income inequality exacerbates the poor's feelings of disadvantage and unfairness; consequently, the poor attempt to reduce perceived economic injustice through crime (Runciman, 1966). The social disorganization theory focuses on a society's inability to realize its members' common values and exercise effective social control over its members. These factors include poverty, ethnic heterogeneity, residential mobility, and family disruption, leading to social disorganization and increasing crime in communities (see Shaw & McKay, 1942; Bursik, 1984; Kornhauser, 1978).

Each of these theories focuses on different aspects of the relationship between income inequality and crime. They should be seen as complements rather than substitutes (Kelly, 2000). Empirically, it is difficult to differentiate between economic and sociological explanations for the relationship between crime and inequality. However, many empirical studies clearly show that income inequality positively correlates with crime. Examining 34 cross-sectional studies on the relationship between income and violent crime at regional and country levels, Hsieh and Pugh (1993) find that 97% of correlation coefficients are positive, concluding that higher income inequality leads to higher violent crime. Blau and Blau (1982) used data on the 125 largest American metropolitan areas to show that income inequality promotes criminal violence. In Indonesia, the crime rate is higher in a province with higher income inequality due to social jealousy leading to criminal occurrence (Trisnawati et al., 2019). Using the spatial econometrics method and geographically weighted regression (GWR), Hardiawan et al. (2018) show that expenditure inequality has a significant and positive impact on total, property, and violent crime rates at the district level in Indonesia, concluding that the leading cause of criminality in Indonesia is inequality. Furthermore, many cross-country studies find empirical evidence supporting the positive association between income inequality and crime (e.g., Fajnzylber et al., 2002; Messner et al., 2002; Pratt & Godsey, 2003). For example, income inequality, as proxied by the Gini coefficient, has robust, significant positive effects on homicide rates across countries (Messner et al., 2002a).

Other studies, in contrast to the previously discussed studies, showed different results. According to these studies, income inequality has either negative effects or no effects on crime. Brush (2007) finds that income inequality is negatively associated with crime rates in United States counties using time-series data. Using panel cointegration techniques, Chintrakarn and Herzer (2012) find a significant negative effect of income inequality on crime. In Malaysia, Baharom and Habibullah

(2009) show that the effect of income inequality on crime is not statistically significant. Similar to this finding, Zhang et al. (2011) find no evidence that income inequality affects the criminal rate in urban and rural China.

2.2 Income Polarization and Crime

As discussed earlier, income inequality is widely used as an explanatory variable when modeling crime. However, the results of previous studies are mixed and inconclusive. This is probably because income inequality only measures income gaps, one aspect of income distribution. In other words, the mixed results from earlier studies might be due to the limitations of using income inequality as a proxy of income distribution (Li et al., 2019). Unlike income inequality, which only considers income gaps between individuals/groups, polarization describes a process in which a society is divided into two or more internally strong groups based on specific attributes such as income, race, and ethnicity, i.e., the clustering of individuals.

Esteban and Ray (1994) introduced the concept and measure of polarization based on the identification-alienation framework. According to them, individuals who belong to a particular group with similar attributes, e.g., income, feel alienated from those with different attributes. Nevertheless, they feel identified or less alienated from members with similar attributes within the groups. In this case, society is polarized. It is possible that when polarization increases, inequality decreases. For example, inequality and polarization will increase if the distance between high and low-income groups widens. However, when income moves from the middle of the income distribution outward and concentrates at two or more distinct poles or groups, inequality will decline, but polarization will rise. Foster and Wolfson (2014) describe this phenomenon as the "disappearing middle class." This situation would create social tension that leads to violence and crime.

Income polarization captures the clustering of individuals into distinct groups that affect social segregation and mobility. This means increased income polarization

leads to greater social segregation, thereby raising the likelihood of those within these segregated communities to conduct criminal activities. In addition, in high segregation environments, upward income mobility tends to be limited for those in the lowest income bracket. This can increase frustration, encouraging individuals from lower-income groups to engage in unlawful activities (Li et al., 2019).

Despite a growing number of studies discussing the association between income inequality and crime, only a few studies examine the relationship between income polarization and crime. Fajnzylber et al. (2002) find that income polarization positively and significantly affects homicides and robberies across countries. Li et al. (2019) find that income polarization is positively and significantly associated with crime in China.

Income polarization in several Asian countries generally shows an increasing trend with higher urban polarization than rural polarization, and it is positively associated with income inequality in Asian countries (Gochoco-Bautista et al., 2013). Higher economic growth, higher levels of educational attainment of household heads, and higher manufacturing employment rates could lower income polarization in Asian countries. Specifically, South Asian lower-middle-income countries such as India, Pakistan, Bangladesh, and Vietnam experienced much higher GDP per capita growth than upper-middle-income countries such as the Philippines and Thailand.

In summary, numerous studies have examined the relationship between income inequality and crime, most employing income inequality as a determinant factor of crime, both theoretically and empirically. In contrast, the link between income polarization and crime has not been explored extensively. As a result, little is known about the relationship. This paper intends to fill this research gap by modeling crime with income polarization as one of the determinants using Indonesia's provincial data, testing whether higher income polarization is associated with higher rates of property crime and homicide.

3. Model Specifications and Data

Following previous studies such as Glaeser et al. (2008) and Messner et al. (2002), we begin with an Ordinary Least Squares (OLS) model. However, the OLS estimators tend to be biased for the following reasons. First, crime tends to persist over time. The OLS estimators fail to address this issue by ignoring crime in the previous period, leading to omitted bias. Second, there is a possibility that the type of crimes (in our case, property crime and homicide) as dependent variables might have effects on independent variables (i.e., reverse causality or simultaneity). Third, measurement errors of crime variables are likely. These errors and several explanatory variables might be correlated, resulting in biased estimators.

In this study, we employ a system Generalized Methods of Moment (GMM) model for dynamic panel data to address endogeneity issues discussed previously. The system GMM model utilizes the dependent variable's lagged values as "internal" instruments. These instruments are derived from within the dataset and based on the assumption that there are no "good instruments" available externally (Roodman, 2009). As in Arellano and Bond (1991), the GMM model transforms the data by subtracting regressors' present values from their past values, called the "first-difference transform." This transformation eliminates the fixed effects. However, the lagged dependent variables might still be correlated with the error, and the first-difference transform could lead to potential data loss, especially in unbalanced panels (Roodman, 2009).

Arellano and Bover (1995) introduced the second data transformation called "forward orthogonal deviations", meaning the transformation "subtracts the average of all future available observations of a variable" to minimize data loss. Building on Arellano and Bover (1995), Blundell and Bond (1998) made an additional moment condition, assuming that "first differences of instrument variables are uncorrelated with the fixed effects" and the Arrelano-Bover/Blundell-Bond estimator is based on "…a system of two equations, the original equation and the transformed one, and is

known as system GMM". The system GMM assumes the errors are serially uncorrelated, which can be tested, and that "the more efficient optimal GMM" estimators can be obtained using two-step GMM in which the optimal weighting matrix used in the second step is obtained from first-step estimation (Cameron & Trivedi, 2010). Another reason this study employs the system GMM is that it is a suitable model for small samples.

Following Li et al. (2019) and Fajnzylber et al. (2002), we use the dynamic panel data model as follows:

$$PropCrime_{it} = \gamma PropCrime_{i,t-1} + \beta POL_{i,t} + \boldsymbol{x}'_{it}\delta + u_i + \varepsilon_{it} \quad (1)$$

where i and t denote province and year, respectively, $PropCrime$ represents property crime, and POL is the Duclos, Esteban, Ray (DER) income polarization index (Duclos et al., 2004a). The number of provinces considered is 33, and the period is from 2010 to 2018. Notation $\boldsymbol{x}$ is the set of control variables, u_i is province fixed effect, and ε_{it} is unexplained residual. $PropCrime_{i,t-1}$ is the one period lagged property crime. This variable assumes that crime tends to persist over time.

Income polarization is our variable of interest, and we test whether there is a positive association between income polarization and two types of crimes: property crime and homicide. Unlike the income inequality measure that only considers the income gap between groups, the income polarization index measures the "feeling of identification" and the "feeling of alienation" in society. An individual feels identified or comfortable with those with similar income and feels alienated from those from other income groups. Therefore, polarization is "the sum of all of antagonism," and polarization may lead to rebellions, civil wars, and social tensions (Esteban & Ray, 1994). Heightened social tensions could lead to higher rates of property crime and homicide.

The DER income polarization index is estimated by province based on household expenditure data from the National Socio-Economic Household Survey (Susenas). Indonesia's household expenditures are proxies for household income

since household income data is unavailable. The DER index ranges from 0 to 1, with higher numbers indicating higher income polarization. The DER polarization index (Duclos et al., 2004b) is as follows:

$$P_\alpha(f) = \iint f(x)^{1+\alpha} f(y)|y - x|dydx \quad (2)$$

where $f(x)$ is the density function, and α is a parameter describing the sensitivity index to the local identification, ranging from 0.25 to 1. This polarization index captures the alienation and identification components. An individual at x feels alienated from another individual located at y. This alienation can be described in distance $|y - x|$. Furthermore, an individual also feels identified with other individuals with similar income. In equation (2), this sense of identification depends on the density at $x, f(x)$. Therefore, polarization is the "sum of all effective antagonisms" (Duclos et al., 2004b).

The dependent variables in this study are property crime and homicide. These annual data are taken from the Crime Statistics published by Statistics Indonesia from 2010 to 2018, with police reports as the primary data source. The property crime variable is obtained from the Criminal Statistics yearly publication by adding up the number of property-related crimes, such as robberies with guns and non-gun weapons, motor vehicle theft, and property destruction. The property crime classification is based on the Crime Statistics. All variable descriptions and data sources can be found in Appendix 1.

Property crime is chosen as one of the dependent variables based on the notion that income inequality influences the occurrence of property crime within the area. As suggested by Ehrlich (1973), those who participate in property crime choose to be a criminal as their occupation since they expect that the material gains exceed the opportunity costs. They are likely at the bottom of the income distribution and decide to engage in criminal activity after weighing the benefits and costs. This view is consistent with many empirical works showing a positive association between

income inequality and property crime within countries (e.g., Choe, 2008; Doyle et al., 1999; Portnov & Rattner, 2003).

Another dependent variable used is the total number of homicides, a proxy for violent crime. Fajnzylber et al. (2002) found a robust and consistent relationship between income inequality and violent crime using international data. They also showed a positive link between income polarization and violent crime. Several previous empirical studies also show that a widening income distribution leads to an increase in the incidence of homicide within countries (see Doyle et al., 1999; Saridakis, 2004).

Control variables in this study include socioeconomic and demographic variables. The data source for all control variables is Statistics Indonesia, published annually. These selected variables are based on previous studies. Economic factors considered in the model are gross regional domestic product per capita (GRDP) and unemployment rate. GRDP is a measure of average regional income and a proxy for regional development. Several studies show that well-developed regions are associated with more crimes since more wealth within the regions could mean more potential loot from crime (Fajnzylber et al., 1998).

Furthermore, the unemployment rate is positively related to criminal activities since it decreases the opportunity cost of crime as predicted by the economic theory of crime (Becker, 1968; Ehrlich, 1973). Some empirical studies support the positive link between unemployment and crime rates. For example, the effect of unemployment on property crime is positive and significant in the U.S. (Raphael & Winter-Ebmer, 2001). However, Trumbull (1989) found that the effect of an increase in the unemployment rate on the crime rate is negative. Lee (2016) found that the relationship between unemployment and crime is ambiguous and depends on the apprehension rate. This article does not use the level of education variable since the unemployment rate is highly correlated with the level of education (Mincer, 1991).

Population density and urbanization are demographic factors explaining crime. Previous studies found that population density and urbanization contribute to crime rates. For example, counties and cities in the U.S. with high population density have high crime rates (Brush, 2007; Kelly, 2000). Several studies show a positive relationship between crime and urbanization (Brennan-Galvin, 2002; Gaviria & Pagés, 2002). Urbanization is, however, found to be negatively associated with homicide rates across countries (Fajnzylber et al., 2002a).

Table 1 provides descriptive statistics for variables used in the models. All variables except polarization are in log form. Income polarization has the highest standard deviation compared to other independent variables, as shown in Table 1. Appendix 2 provides a pairwise correlation coefficient between variables.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Property Crime	297	7.76	0.99	4.62	9.98
Homicide	297	3.26	0.95	0.00	5.41
Polarization	297	21.68	1.75	17.89	27.19
Inequality	297	36.94	3.78	27.47	45.90
GRDP	297	10.29	0.56	9.14	12.02
Population Density	297	4.78	1.59	1.79	9.64
Unemployment	297	1.56	0.46	-0.15	2.65
Urbanization	297	3.74	0.38	2.96	4.61

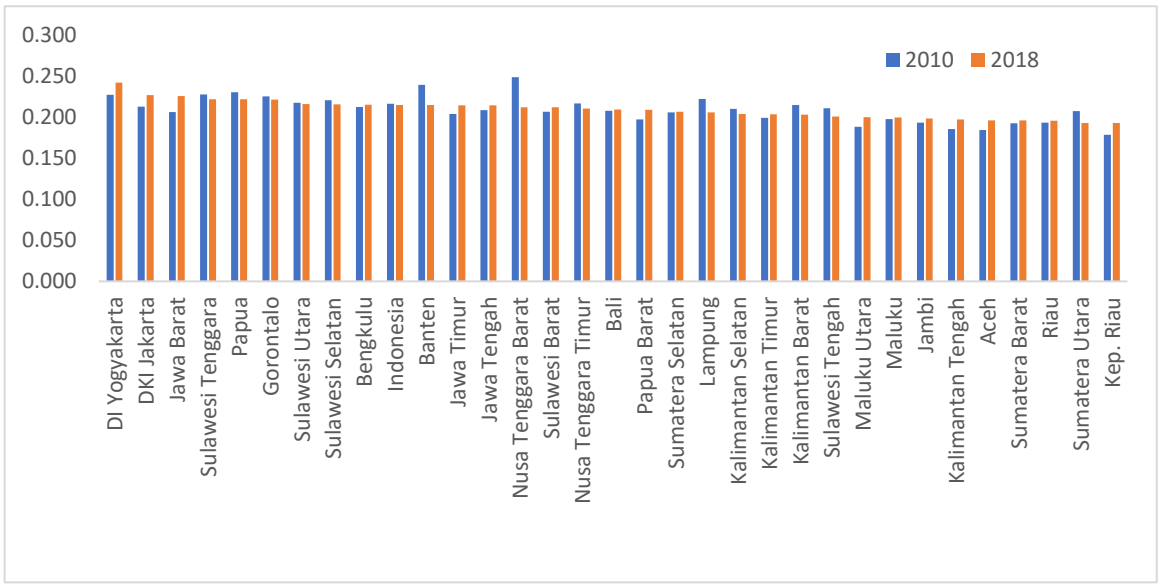
4. Results and Discussion

4.1 Descriptive Analyses

Figure 1 shows provincial income polarization in 2010 and 2018. As can be seen in Figure 1, DI Yogyakarta had the highest income polarization, while Kep. Riau had the lowest in 2018. Almost 60% of the total provinces experienced increases in polarization between 2010 and 2018. Many provinces above the national

average were located in eastern Indonesia (i.e., Sulawesi Island and Papua). Furthermore, three out of those above-average provinces were regions with special autonomy and received a large allocation budget from the central government. Special autonomy provinces include DI Yogyakarta, DKI Jakarta (the capital city of Indonesia), and Papua.

Figure 1. Income polarization by province: 2010 and 2018



As shown in Figure 2, on average, the number of property crimes in Indonesia increased by 81% from 2010 to 2018, with most provinces experiencing various increases in property crimes. The number of property crimes drastically increased in several provinces located in the eastern part of Indonesia. For example, Papua and Papua Barat (West Papua) experienced a 258% and 377% increase in property crimes, respectively. In contrast, DKI Jakarta, Indonesia's capital, had significantly dropped property crimes during the period. DI Yogyakarta experienced the highest decline between 2010 and 2018.

Figure 2. Property crime by province: 2010 and 2018

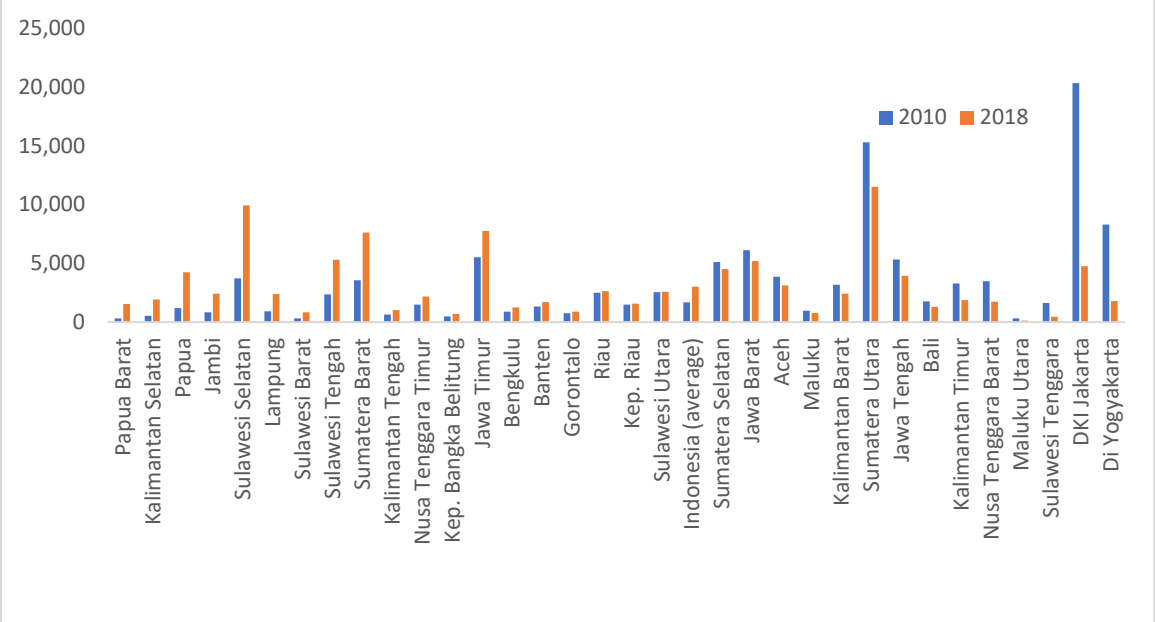


Figure 3 indicates the number of homicides by province. More than 40% of all provinces had experienced an increase in homicides between 2010 and 2018. Papua Barat (West Papua) had the highest increase in homicides, which jumped from only one homicide in 2010 to 13 homicides in 2018, a 1,200% increase. Kalimantan Selatan (South Kalimantan) and Gorontalo ranked in second and third place, with a 330% and 275% increase, respectively. The majority of provinces had seen a decline in their number of homicides. For example, DI Yogyakarta's homicide number dropped by 90%. Nonetheless, the number of homicides in many provinces remained high, and they were substantially higher than the national average, indicating many provinces were still struggling to deal with homicide.

Figure 3. Homicide by province: 2010 and 2018

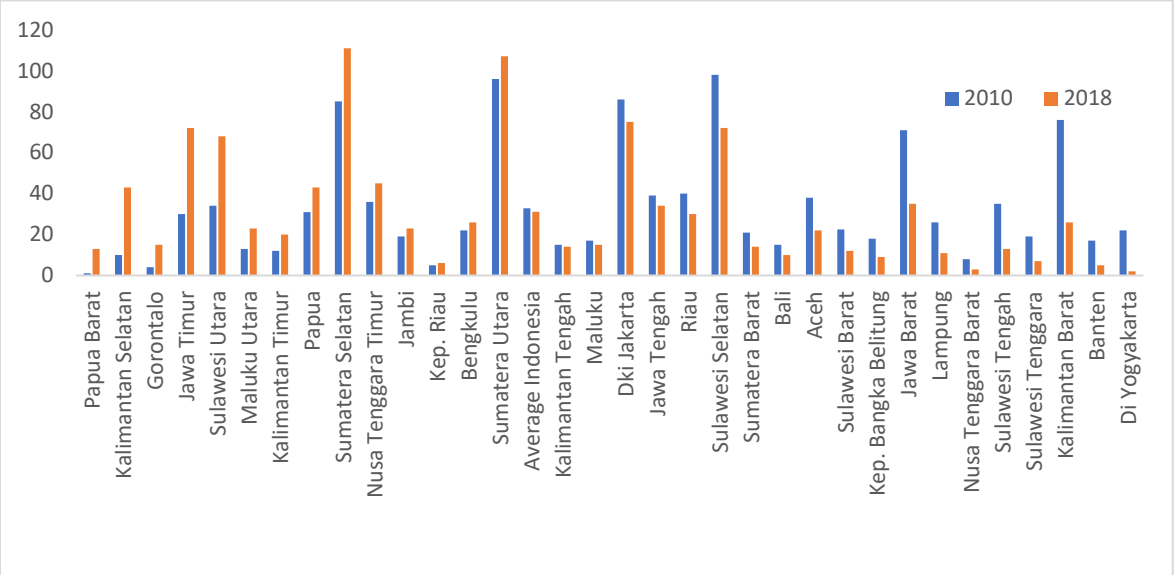
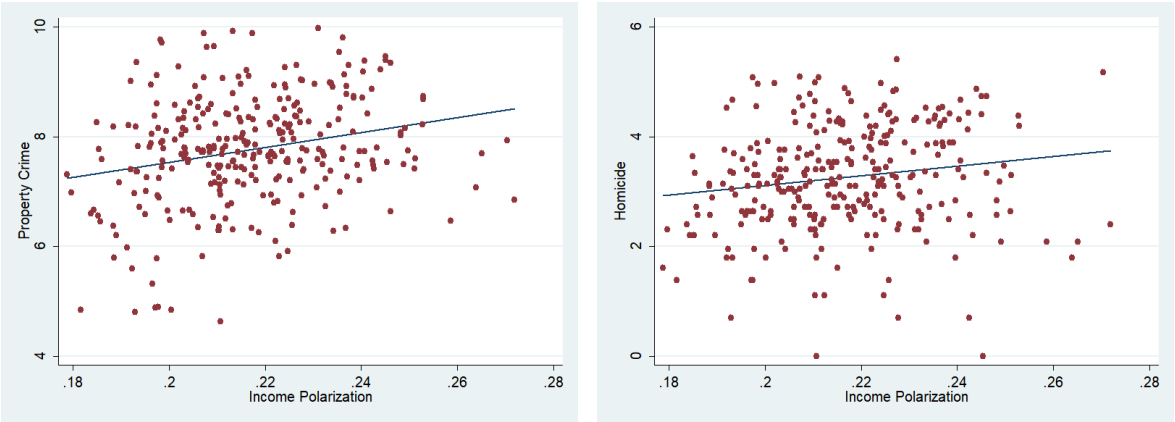


Figure 4(a) shows a scatter plot with a regression line of income polarization and property crime. Two variables show a positive correlation, and Figure 4(b) demonstrates that income polarization and homicide have a positive association as well.

Figure 4. Income polarization, property crime, and homicide

(a) Income polarization and property crime (b) Income polarization and homicide



4.2 Estimation Results

Table 2 presents OLS and system GMM estimates for the set of determinants of property crime and homicide. Results from the OLS models in columns (1) and (3) show that income polarization is positive and statistically significant in explaining property crime and homicide, respectively. Furthermore, all control variables, except urbanization, show expected results in these OLS models. For example, per capita Gross Regional Domestic Product (GRDP), as a proxy for the level of development, is positive and significant, implying provinces with a higher level of development experience higher property crime and homicide.

Table 2. Crime and income polarization: OLS and system GMM estimations

	DV: Property Crime		**DV: Homicide**	
	OLS	**SYS-GMM**	**OLS**	**SYS-GMM**
Independent Variables	(1)	(2)	(3)	(4)
Lagged Dependent Variable		0.235		0.229
		(0.324)		(0.145)
Polarization	0.0866***	0.0954**	0.0679**	0.0593
	(0.0294)	(0.0470)	(0.0340)	(0.0646)
GRDP	0.487***	0.568	0.499***	-0.391
	(0.108)	(0.860)	(0.0998)	(0.751)
Population Density	0.271***	-0.0722	0.230***	-0.0155
	(0.0394)	(0.238)	(0.0364)	(0.255)
Unemployment	0.425***	0.245	0.379***	0.209
	(0.0979)	(0.604)	(0.109)	(0.394)
Urbanization	-0.413**	-0.161	-1.287***	-0.117
	(0.185)	(1.362)	(0.213)	(1.369)
Constant	0.454	-1.353	-0.233	5.493
	(1.171)	(7.377)	(1.033)	(9.111)
Observations	297	264	297	264
R-squared	0.306		0.138	
Sargant test (Prob > chi2)		0.673		0.7076
Arellano-Bond test				
AR(1) p-value		0.0037		0.0037

AR(2) p-value	0.5636	0.5497

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

However, these OLS estimates are biased due to reasons discussed previously in the model specification and data section. One primary reason is that crime tends to persist over time. On the other hand, the GMM model considers the crime of the previous period and employs instrumental variables to deal with endogeneity. Thus, two-step system GMM (SYS-GMM) regressions with robust standard errors were performed, as suggested by Arellano and Bond (1991) and Blundell and Bond (1998). In addition, this study employs the system GMM because it is more efficient, especially when the dependent variable is highly persistent (Roodman, 2009). Clearly, the system GMM is a suitable model since the dependent variables in this study are property crime and homicide, which are highly persistent.

Results for the system GMM estimations are shown in Table 2, columns (2) and (4). As indicated in column (2), income polarization is positively and significantly associated with property crime and is the only variable statistically significant in the model. This result demonstrates that those provinces with higher income polarization are the ones experiencing higher property crime. For a 1% increase in income polarization, we expect a 9.5% increase in property crime, holding other things constant.

In contrast to previous results, income polarization is not a statistically significant predictor of homicide in Indonesia, as shown in Table 2, column (4). Furthermore, the system GMM estimations in columns (2) and (4) use Windmeijer's robust standard errors to avoid downward bias. As the literature suggests, we perform two specification tests: the Sargan and the Arellano Bond tests. The Sargan test of over-identifying restrictions shows that all instruments used in models (2) and (4) are valid since the p-values for both models are greater than 0.05. The Arellano Bond test in models (2) and (4) indicates that the error terms are not serially correlated, which the system GMM estimators require for consistent estimation.

As discussed extensively in the literature, income inequality is one of the critical predictors of crime. Table 3 presents the OLS and system GMM regression results with the Gini index as a variable of interest in modeling property crime and homicide, respectively. As shown in Table 3, columns (1) and (2), income inequality has no significant effect on property crime based on estimates from OLS and system GMM models. In addition, results show that income inequality is not significant in explaining homicide in Indonesia, as shown in Table 3, columns (3) and (4). Income polarization is not in these models since income polarization and inequality are highly correlated (Gochoco-Bautista et al., 2013). Therefore, income polarization and inequality should be separate in models to avoid collinearity issues.

Table 3. Crime and income inequality: OLS and GMM estimation

	DV: Property Crime		**DV: Homicide**	
	OLS	**SYS-GMM**	**OLS**	**SYS-GMM**
Independent Variables	(1)	(2)	(3)	(4)
Lagged Dependent Variable		0.233		0.243
		(0.511)		(0.206)
Inequality	0.0126	0.0562	0.0109	0.0478
	(0.0140)	(0.0952)	(0.0153)	(0.0952)
GRDP	0.477***	0.478	0.491***	-0.592
	(0.107)	(0.922)	(0.100)	(0.859)
Population Density	0.302***	-0.0393	0.254***	0.0360
	(0.0388)	(0.173)	(0.0354)	(0.326)
Unemployment	0.403***	0.181	0.362***	0.222
	(0.0990)	(0.664)	(0.109)	(0.611)
Urbanization	-0.466**	-0.423	-1.328***	0.0987
	(0.185)	(2.049)	(0.210)	(2.210)
Constant	2.057**	0.491	0.993	0.243
	(1.043)	(11.14)	(0.851)	(0.206)
Observations	297	264	297	264
R-squared	0.287		0.126	
Sargant test (Prob > chi2)		0.689		0.634
Arellano-Bond test				

AR(1) p-value	0.003	0.002
AR(2) p-value	0.527	0.579

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

4.3 Robustness Check

Table 4 presents the results of the Arellano-Bond GMM (AB-GMM) estimations with property crime and total crime as dependent variables, respectively. Generally, system GMM estimation is more efficient than AB-GMM estimation when the data is highly persistent. Additionally, system GMM is better than AB-GMM in reducing sample bias (Roodman, 2009). In other words, system GMM is an extension of AB-GMM that is more efficient and can reduce bias. This robustness check intends to ensure that previous results from system GMM are consistent with those from AB-GMM.

In column (1), income polarization is positively and significantly associated with property crime, similar to the findings in Table 2, column (2). However, the income polarization coefficient of system GMM in Table 2 is more significant than that of AB-GMM. This suggests the superiority of system GMM over AB-GMM in terms of efficiency and bias reduction.

Moreover, column (2) shows a positive and significant association between income polarization and crime total in the province. Table 4 indicates that the Sargan tests show that all instruments used in models (1) and (2) are valid. Additionally, the Arellano Bond tests indicate that the error terms are not serially correlated in models (1) and (2). In contrast to the previous model in Table 2, column (2), population density is negative and significant. Another difference is that the lagged crime total is positive and significant in Table 4, column (2).

Table 4. Crime and income polarization: Arellano-Bond GMM estimations

	DV: Property Crime	**DV: Crime**
	AB-GMM	**AB-GMM**
Independent Variables	(1)	(2)

Lagged Dependent Variable	-0.0537	0.482**
	(0.133)	(0.213)
Polarization	0.0461*	0.0449*
	(0.0237)	(0.0259)
GRDP	-0.905	-0.844
	(1.773)	(1.000)
Population Density	-0.0695	-0.232***
	(0.101)	(0.0572)
Unemployment	0.0126	-0.142
	(0.140)	(0.176)
Urbanization	0.673	0.739
	(3.748)	(1.698)
Constant	14.36**	8.960*
	(5.634)	(4.859)
Observations	231	227
Sargant test (Prob > chi2)	0.3402	0.2924
Arellano-Bond test		
AR(1) p-value	0.0417	0.0824
AR(2) p-value	0.5638	0.6847

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

4.4 Discussion

The findings in this study support the hypothesis that higher income polarization regions are associated with higher property crime in Indonesia. Unlike income inequality, income polarization considers the distance between various income groups, i.e., feeling of alienation, and the homogeneity of income within groups, i.e., feeling of identification. A region with high polarization may experience heightened social tension, increasing the likelihood of property crime. Another explanation is that provinces with worsening income distribution incentivize people to commit property crimes since higher income polarization creates social segregation, which increases the likelihood of those segregated in a society breaking the law. Moreover, upward income mobility is likely low for individuals within low-income groups in a highly polarized region. This creates frustration and encourages

the poor to conduct illegal activities. This result aligns with the findings of (Li et al., 2019), who found that provinces in China with higher income polarization are associated with higher criminal prosecutions and arrests. This study's results also confirm findings from Fajnzylber et al. (2002a), who found that the effect of income polarization was positive and significant for robberies, a proxy for property crime, across countries in several periods.

Results indicate that the effect of income polarization on homicide is not statistically significant, implying that income polarization is not a significant factor explaining homicide in Indonesia. This is probably because most homicide cases were driven by non-economic motives such as revenge, hate, and jealousy. This result is not in line with findings from a prior cross-country study (Fajnzylber et al., 2002a), in which the relationship between income polarization and homicides was found to be positive and significant. The different results between this current study and that of Fajnzylber et al. (2002a) could be due to different definitions of homicide or different units of analysis (countries vs. provinces in this study).

Furthermore, this study's results found no evidence of a significant association between income inequality and property crime. This result is consistent with Entorf and Spengler (2000), who found no significant association between income inequality and property crime in Germany. However, the results of this study are not in line with findings from several studies (Dahlberg & Gustavsson, 2008; Doyle et al., 1999). This paper also found that income inequality has no significant effect on homicide. This is not in line with previous studies (Daly & Wilson, 1997; Messner et al., 2002b; Rufrancos & Power, 2013). This study's results are also inconsistent with those of a study that examines the effects of income inequality and crime in Indonesia (Hardiawan et al., 2019). However, unlike previous studies, this study employs the system GMM model, which takes into account endogeneity, measurement errors, and efficiency of estimators (Fukase, 2010). It is safe to conclude that parameter estimates in this study, including income inequality, are

more efficient than those in previous studies. These results also suggest that income polarization is a better and more complete explanatory variable of property crime than income inequality since income polarization captures what income inequality does not, that is, the clustering of individuals into distinct income groups.

5. Conclusion

The primary goal of this article is to examine the relationship between income polarization and crime. More specifically, this study tests the hypothesis that regions with higher income polarization are associated with higher crime (in this case, property crime and homicide). Empirical evidence in this study indicates that income polarization is positively and significantly associated with property crime but not with homicide. Results from this study highlight the importance of looking at income polarization at the regional level when one examines regional property crime.

However, this study shows that income inequality is not associated with property crime and homicide, suggesting that income polarization and income inequality measure two different features of income distribution, as the literature suggests. This different result is primarily because income polarization does not measure gaps between income groups, i.e., feeling of alienation, and clustering of individuals, i.e., feeling of identification, while income inequality only measures income gaps between individuals.

The findings in this study demonstrate the importance of examining the degree of income polarization in reducing regional property crime. Policymakers should consider monitoring the degree of income polarization when designing policies that can prevent and reduce property crime at the provincial level. As discussed earlier, highly polarized regions lead to heightened social tension, which increases the likelihood of those segregated in a society conducting criminal activities. In addition, higher income polarization in a region hinders upward income

mobility for low-income groups, creating frustration and making those at the bottom of the income bracket commit property crimes. Furthermore, when policymakers plan to design policies that can lower income polarization, they should consider a combination of socioeconomic policies that can boost economic growth, the level of educational attainment of household heads, and higher employment rates in manufacturing (Gochoco-Bautista et al., 2013). Official income polarization indices in Indonesia at the national and regional levels are currently unavailable. Statistics Indonesia should consider estimating and publishing the income polarization index regularly so policymakers can use it to design socioeconomic policies to lower crime.

As shown earlier, the link between income polarization and crime is complex. More studies are needed to understand this relationship better. These studies may consider using various income polarization measures to test the relationship. Further studies need to examine the relationship in specific regions and at lower levels of administrative regions, e.g., city/district. For Indonesia, further analysis is needed to see the link between urban and rural areas and eastern and western Indonesia. Moreover, further studies may consider using alternative crime data, such as a victimization survey in which a sample of individuals is questioned whether they have been victims of a crime and in what circumstances (Bourguignon, 2000). In addition, other types of crime could be researched that are not included in this article. Further research into the factors influencing income polarization will help us understand why income polarization varies across regions. This knowledge can help explain the rise in crimes associated with increased income polarization.

References

Anderson, D. A. (2012). The cost of crime. *Foundations and Trends® in Microeconomics*, *7*(3), 209–265. https://doi.org/10.1561/0700000047

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. https://doi.org/10.1016/0304-4076(94)01642-D

Baharom, A. H., & Habibullah, M. S. (2009). Crime and income inequality: The case of Malaysia. *Journal of Politics & Law*, *2*(1), 55.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, *76*(2), 169–217. https://doi.org/10.1086/259394

Blau, J. R., & Blau, P. M. (1982). The cost of inequality: Metropolitan structure and violent crime. *American Sociological Review*, *47*(1), 114. https://doi.org/10.2307/2095046

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. https://doi.org/10.2307/2095046

Bourguignon, F. (2000). Crime, violence, and inequitable development. In B. Pleskovic & J. Stiglitz (Eds.), *Annual World Bank Conference on Development Economics* (pp. 199–220). The World Bank.

Brennan-Galvin, E. (2002). Crime and violence in an urbanizing world. *Journal of International Affairs*, *56*(1), 123–145. http://www.jstor.org/stable/24357886

Brush, J. (2007). Does income inequality lead to more crime? A comparison of cross-sectional and time-series analyses of United States counties. *Economics Letters*, *96*(2), 264–268. https://doi.org/10.1016/j.econlet.2007.01.012

Bursik, R. J. (1984). Urban dynamics and ecological studies of delinquency. *Social Forces*, *63*(2), 393–413. https://doi.org/10.1093/sf/63.2.393

Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using stata (Vol. 2)*. College Station, TX: Stata Press.

Chintrakarn, P., & Herzer, D. (2012). More inequality, more crime? A panel cointegration analysis for the United States. *Economics Letters*, *116*(3), 389–391. https://doi.org/10.1016/j.econlet.2012.04.014

Chiu, W. H., & Madden, P. (1998). Burglary and income inequality. *Journal of Public Economics*, *69*(1), 123–141. https://doi.org/10.1016/S0047-2727(97)00096-0

Choe, J. (2008). Income inequality and crime in the United States. *Economics Letters*, *101*(1), 31–33. https://doi.org/10.1016/j.econlet.2008.03.025

Dahlberg, M., & Gustavsson, M. (2008). Inequality and crime: separating the effects of permanent and transitory income*. *Oxford Bulletin of Economics and Statistics*, *70*(2), 129–153. https://doi.org/10.1111/j.1468-0084.2007.00492.x

Daly, M., & Wilson, M. (1997). Crime and conflict: Homicide in evolutionary psychological perspective. *Crime and Justice*, *22*, 51–100. https://doi.org/10.1086/449260

Doyle, J. M., Ahmed, E., & Horn, R. N. (1999). The effects of labor markets and income inequality on crime: Evidence from panel data. *Southern Economic Journal*, *65*(4), 717–738.

Duclos, J.-Y., Esteban, J., & Ray, D. (2004a). Polarization: Concepts, measurement, estimation. *Econometrica*, *72*(6), 1737–1772.

Duclos, J.-Y., Esteban, J., & Ray, D. (2004b). Polarization: Concepts, measurement, estimation. *Econometrica*, *72*(6), 1737–1772. http://www.jstor.org/stable/ 3598766

Ehrlich, I. (1973). Participation in illegitimate activities: A theoretical and empirical investigation. *Journal of Political Economy*, *81*(3), 521–565. https://doi.org/10.1086/260058

Entorf, H., & Spengler, H. (2000). Socioeconomic and demographic factors of crime in Germany: Evidence from panel data of the German states. *International Review of Law and Economics*, *20*(1), 75–106.

Esteban, J.-M., & Ray, D. (1994). On the measurement of polarization. *Econometrica*, *62*(4), 819. https://doi.org/10.2307/2951734

Fajnzylber, P., Lederman, D., & Loayza, N. (1998). *Determinants of crime rates in Latin America and the world*. World Bank Group.

Fajnzylber, P., Lederman, D., & Loayza, N. (2002a). Inequality and violent crime. *Journal of Law and Economics*, *45*(1 I), 1–40. https://doi.org/10.1086/338347

Fajnzylber, P., Lederman, D., & Loayza, N. (2002b). What causes violent crime? *European Economic Review*, *46*(7), 1323–1357. https://doi.org/10.1016/S0014-2921(01)00096-4

Fajnzylber, P., Lederman, & D., Loayza, N. (2000). Crime and victimization: An economic perspective, *Economía*, *1*(1), 219–302.

Foster, J. E., & Wolfson, M. C. (2014). Erratum to: Polarization and the decline of the middle class: Canada and the U.S. *The Journal of Economic Inequality*, *12*(3), 435–437. https://doi.org/10.1007/s10888-011-9180-5

Fukase, E. (2010). Revisiting linkages between ppenness, education and economic growth: System GMM approach. *Journal of Economic Integration*, *25*(1), 193–222. http://www.jstor.org/stable/23000971

Gaviria, A., & Pagés, C. (2002). Patterns of crime victimization in Latin American cities. *Journal of Development Economics*, *67*(1), 181–203. https://doi.org/10.1016/ S0304-3878(01)00183-3

Glaeser, E., Resseger, M., & Tobio, K. (2008). *Urban inequality* (NBER Working Paper No. 14419). National Bureau of Economic Research, Inc.

Gochoco-Bautista, M. S., Bautista, C. C., Maligalig, D. S., & Sotocinal, N. R. (2013). Income polarization in Asia. *Asian Economic Papers*, *12*(2), 101–136. https://doi.org/10.1162/ASEP_a_00214

Hardiawan, D., Yusuf, A. A., & Muljarijadi, B. (2019). The impact of expenditure inequality and socioeconomic on crime rates in Indonesia: Cross-sectional study using spatial econometrics and geographically weighted regression. *Proceedings of the Achieving and Sustaining SDGs 2018 Conference: Harnessing the Power of Frontier Technology to Achieve the Sustainable Development Goals (ASSDG 2018)*. https://doi.org/10.2991/assdg-18.2019.14

Hsieh, C. C., & Pugh, M. D. (1993). Poverty, income inequality, and violent crime: A meta-analysis of recent aggregate data studies. *Criminal Justice Review*, *18*(2), 182–202. https://doi.org/10.1177/073401689301800203

Kelly, M. (2000). Inequality and crime. *Review of Economics and Statistics*, *82*(4), 530–539. https://doi.org/https://doi.org/10.1023/A:1021169610837

Kornhauser, R. (1978). *Social sources of delinquency: An appraisal of analytic models*. University of Chicago Press Chicago.

Li, J., Wan, G., Wang, C., & Zhang, X. (2019). Which indicator of income distribution explains crime better? Evidence from China. *China Economic Review*, *54*, 51–72. https://doi.org/10.1016/j.chieco.2018.10.008

Messner, S. F., Raffalovich, L. E., & Shrock, P. (2002a). Reassessing the cross-national relationship between income inequality and homicide rates: Implications of data quality control in the measurement of income distribution. *Journal of Quantitative Criminology*, *18*(4), 377–395. https://doi.org/https://doi.org/10.1023/A:1021169610837

Mincer, J. (1991). *Education and unemployment*. (NBER Working Paper No. w3838). Columbia University. https://doi.org/10.3386/w3838

Palokoto, T., Purwanti, Y., & Mudakir, Y. B. (2020). Analisis konsekuensi ekonomi akibat kejahatan di Indonesia. *Jurnal Ekonomi Dan Pembangunan Indonesia*, *20*(2), 146–159.

Portnov, B. A., & Rattner, A. (2003). Spatial patterns of crime in Israel: Investigating the effects of inter-urban inequality and proximity. *43rd Congress of European Regional Science Association.*

Pratt, T. C., & Godsey, T. W. (2003). Social support, inequality, and homicide: A cross-national test of an integrated theoretical model. *Criminology*, *41*(3), 611–644. https://doi.org/10.1111/j.1745-9125.2003.tb00999.x

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86–136.

Rufrancos, H., & Power, M. (2013). Income inequality and crime: A review and explanation of the time? Series evidence. *Sociology and Criminology-Open Access*, *01*(01). https://doi.org/10.4172/2375-4435.1000103

Saridakis, G. (2004). Violent crime in the United States of America: A time-series analysis between 1960–2000. European Journal of Law and Economics, *18*, 203–221.

Shaw, R., & McKay, H. (1942). *Juvenile delinquency and urban areas*. University of Chicago Press.

Trisnawati, D., Ismail, D. S., & others. (2019). Inter-provincial spatial linkages of crime pattern in Indonesia: Looking at education and economic inequality effects on crime. *The Indonesian Journal of Geography*, *51*(2), 1–8.

Zhang, Y., Liu, S., & Liu, L. (2011). Can we attribute increasing criminal rate to enlarging urban-rural inequality in China. *Economic Research Journal*, *2*, 59–72.

Appendix 1

Variable Description and Data Source

No.	Variables	Description	Source
1	Homicide	Number of homicide cases in a province	Crime Statistics, Statistics Indonesia
2	Property crime	Number of total property crimes, including burglary, theft, property damage	
3	DER Polarization index	Duclos, Esteban, Ray income polarization index with values between 0 and 100, higher index, higher polarization	Author's calculation from SUSENAS, Statistics Indonesia
4	Gini index	Gini index as a proxy of income inequality with values between 0 and 100, higher value, higher inequality	Statistics Indonesia
5	Per capita GRDP	Regional GDP per number of total citizens living within a province in Rupiah	Statistics Indonesia
6	Population density	Number of people per square kilometer	Statistics Indonesia
7	Unemployment	Open unemployment (Percentage)	Statistics Indonesia
8	Urbanization	Percentage of population living in cities	Statistics Indonesia

Appendix 2

	Property Crime	Homicide	Polarization	Inequality	GRDP	Population Density	Unemployment	Urbanization
Property Crime	1							
Homicide	0.6251* 0.0000	1						
Polarization	0.2416* 0	0.1617* 0.0052	1					
Inequality	0.1754* 0.0024	0.0868 0.1357	0.8860* 0.0000	1				
GRDP	0.2768* 0	0.0982 0.0913	-0.078 0.1798	0.0624 0.2835	1			
Population Density	0.4444* 0	0.1494* 0.0099	0.3165* 0	0.2932* 0.0000	0,095 0.1023	1		
Unemployment	0.2902* 0	0.1344* 0.0205	-0,0631 0.2786	0.0108 0.8532	0.2857* 0	0.1951* 0.0007	1	
Urbanization	0.3718* 0	-0.0137 0.8145	0.0984 0.0905	0.1907* 0.0010	0.5384* 0	0.6619* 0	0.3920* 0	1