Article

The Nexus between Crime Rates, Poverty, and Income Inequality: A Case Study of Indonesia

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Abstract: This study examines whether income inequality and poverty are determinants of crime rates across 34 provinces in Indonesia. Three indicators of income inequality and four poverty measures are tested to examine whether the dimension and degree of unequal welfare distribution are linked to crime occurrences. We use panel data from 2010 to 2019 with the Generalized Method of Moments (GMM) approach. The findings indicate that higher income levels and wider income inequality are associated with higher crime rates. Our first indicator of income inequality, non-food expenditure, has a larger impact on crime rates than our second and third indicators, i.e., the gap in food expenditure and the Gini ratio. Poverty is also positively associated with crime. The wider the poverty gap (a measure of poverty) and the severity index, the higher the deprivation levels among the poor, which lead to more crime. The significant and positive effect of poverty on crime rates, and the positive nexus between crime, income, and inequality suggest that Indonesia will face a higher crime risk as the country becomes increasingly more affluent. In such a scenario, policymakers can leverage education and investment (domestic and foreign) to minimize the crime rate. The government could also strengthen crime prevention programs, crime settlement systems, and policing in Indonesia, and raise the budget for social assistance.

Keywords: crime rates; income inequality; population density; poverty; well-being; quality of education

1. Introduction

Crime remains a common problem that causes various economic, social, and political impacts in societies worldwide (Ivaschenko et al. 2012). Aside from giving rise to uncertainty, crime also makes economic activities inefficient as resources need to be reallocated from productive activities to crime reduction and prevention (Ahmad et al. 2014; Detotto and Otranto 2010). In developing countries, crime occurrences that are not properly handled can slow down the process of becoming a sovereign, developed, equitable, and prosperous country. Societies facing increasing crime rates require preventive and reactive measures, which often need more than the government's capacity.

Studies have shown, both theoretically and empirically, the relationship between inequality and crime, which then generate rational models of criminal behavior (Becker 1968). In the economic theory of crime postulated by Becker, crime is influenced by different incentives, pressures, and deterrent mechanisms that individuals face across environments. The rational model of criminal behavior argues that individuals commit crimes when the margin between criminal benefits and a criminal penalty is greater than benefits from legitimate employment. In other words, crime risk is higher when the inequality gap is wider (Kang 2016). Income gaps often result in an environment where low-income (often poor) people tend to gain more returns from illegal activities than legal ones. According to the strain theory postulated by Merton (1949), individuals who perceive themselves as less successful than their peers may experience frustration. Wider income inequality exerts higher pressure on these individuals, which also translates into a greater incentive to commit crimes. In the social disorganization theory, Shaw and McKay (1942) point

out that when regulations in the community weaken, social controls dwindle, and crime rises. In this situation, individuals disadvantaged by income inequality often face choices between staying in the legal domain or venturing into the illegal one (Chiu and Madden 1998) because it offers higher economic benefits (Mauladi et al. 2022).

Past empirical studies have proven that inequality is a contributing factor to crime in many countries, including Russia (Hauner et al. 2012), the United States (Brush 2007), China (Cheong and Wu 2015), and Indonesia (Sugiharti et al. 2022a; Widyastaman and Hartono 2022). In Europe, eastern and northern regions showed how inequality resulted in higher crime rates. In contrast, western and southern Europe showed that inequality had no significant effect on crime rates (Kim et al. 2020). In China, Song et al. (2020) showed that consumption inequality is a major driver of crimes.

In Indonesia, inequality is prevalent, and characteristics across provinces and islands can be vastly different. In several provinces in Sumatra, Sulawesi, and Maluku-Papua, the Gini ratio is above 0.40, with a crime rate of over 200 cases per 100,000 population, higher than in other regions (Figure 1). A recent study in Indonesia has shown that income inequality, as proxied by the Gini ratio, contributes to increased occurrences of robbery and fraud (Sugiharti et al. 2022a). Using a Theil index, Widyastaman and Hartono (2022) found that within regions and across regions in Indonesia, individual income inequality significantly impacts crime victimization. Likewise, using a multi-regression approach, Armin (2020) found a significant nexus between income inequality, proxied by the Gini ratio, and crime in Indonesia. Using a spatial autocorrelation model, Dian Trisnawati and Ismail (2019) also found that broader income inequality proxied by the Gini index correlates with a higher crime rate in Indonesia. However, it remains unknown whether specific types of inequality, such as gaps in food and non-food expenditures, have led to higher crime rates. Most studies in Indonesia use the Gini index or Theil approach to measure income inequality, but little is known about other measurements to examine the link between income inequality and crime rates. This research aims to answer this question and offers novelty in this area. We included three indicators of income inequality: the Gini index, the gap in food expenditure, and the gap in non-food expenditure. The gap in food expenditure is measured by the percentage of consumer spending on food in urban areas compared to rural areas. Likewise, non-food expenditure is measured by comparing rural and urban spending on non-food consumption. Using these three indicators of unequal welfare distribution can avoid overgeneralizations caused by the Gini ratio and see whether specific gaps impact crime rates in Indonesia differently. Earlier studies (i.e., Smeeding et al. 1988) suggest that different income inequality and poverty measures need to be considered in policy-making, as absolute and relative indicators have different sensitivities.
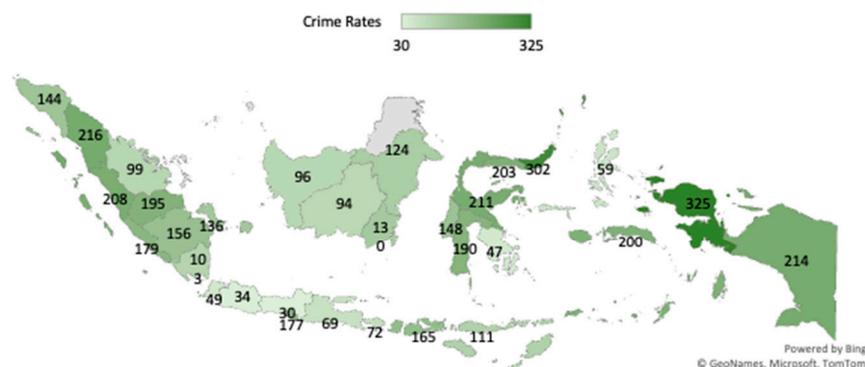
Figure 1. Crime Rates 2019—Indonesia. Source: Statistics Indonesia (BPS) 2019 (processed).

Past studies have looked at how poverty impacts crime rates—the higher the poverty, the higher the crime rates (Ali and Peek 2009; Imran et al. 2018; Wrigley-Asante et al. 2016). However, poverty in developed countries is different from that in developing countries. In developed countries, poor people have limited budgets, but they have access to or

assistance for food, shelter, medical care, and clean water. This is not the case in developing countries, so poor people tend to live in extreme poverty. This condition often compels them to commit property crimes to survive (Pare and Felson 2014). A study in India has shown how poverty has become a major cause of the increasing crime rate (Bharadwaj 2014). In China, poverty is called the mother of crime as it is responsible for the increasing number of homicide cases (Dong et al. 2020).

Poverty remains a prevalent problem in Indonesia, so government policies and strategies have always prioritized its alleviation (Muryani and Esquivias 2021; Sugiharti et al. 2022b). Figure 2 shows that provinces with a high percentage of poverty also display high crime rates. Nguyen (2019) has empirically proven that extreme poverty weakens the impact of education on crime rates. However, earlier studies in Indonesia have not tested whether the nexus between poverty and crime applies to the main poverty indicators. We aim to fill this gap by examining four indicators of poverty in Indonesia, namely (1) the number of poor people, (2) the average headcount index, (3) the average poverty gap index, and (4) the average poverty severity index. With these indicators, we can extend the literature on the nexus between poverty and crime in Indonesia.
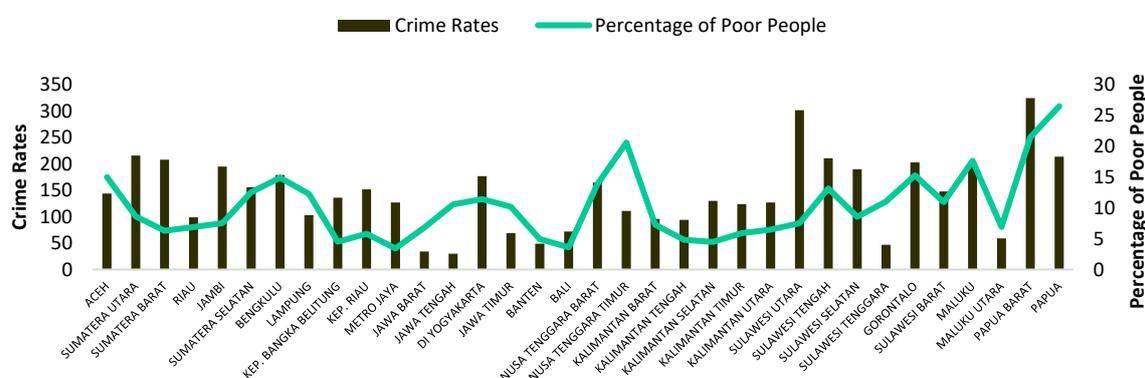
Figure 2. Crime Rates and Poverty Rates, 2019. Source: Statistics Indonesia (BPS), 2019 (processed).

The number of poor people or the absolute number of individuals living below the poverty line (the income threshold according to provincial estimates) provides an approximation of the connection between poverty and crime. By 2019, nearly 25 million Indonesians were considered poor according to national standards. Likewise, the average headcount index provides a relative measure of poverty or the percentage of people living below the poverty line. Meanwhile, the average poverty gap index considers how far poor individuals are from the poverty line (depth of poverty). The index overcomes the general assumption that all poor people are equally poor and helps visualize how many resources are needed to equalize income among individuals—the higher the poverty gap index, the more severe the poverty is. Lastly, the average poverty severity index squares the average poverty gap to obtain a more proportionate measurement of the poverty severity. The poverty severity index indicates how far a poor individual's income is below the poverty line. The further down the income from the poverty line, the more severe the poverty is.

Employing four measures of poverty instead of only the number or the percentage of poor individuals helps assess whether poverty is linked to crime rates and whether poverty severity can intensify the relationship between poverty and crime. Distinguishing the types of poverty has important implications. First, poverty can be transitory or chronic, with the latter imposing greater structural challenges to escape due to the long periods of destitution. Second, the high number of people living under the poverty line can lead to social problems and hinder government efforts to provide assistance to lift them out of poverty (Sugiharti et al. 2022b). Third, poverty severity is not captured in headcount ratios or the total number of poor individuals as they do not account for the level of deprivation (Mai and Mahadevan 2016). Fourth, the impact of poverty on crime may be different if the deprivation is related to food or non-food. Furthermore, identifying whether the deprivation is related to food or

non-food can help the government design more targeted efforts to assist the poor. Fifth, poverty is not homogenous and has different challenges across regions, suggesting the need for more disaggregated poverty measures to address the problems.

In addition to the two explanatory variables highlighted (poverty and inequality), this study also identifies the impact of Gross Domestic Regional Product (GDRP), population density, education attainment, domestic and foreign investment, and government spending on infrastructure (Montolio 2018) on crime rates in Indonesia. Socioeconomic variables can also underlie criminal actions worldwide (Sugiharti et al. 2022a). Wide income gaps and poverty lead to lower economic growth and fewer employment opportunities, which could trigger criminal actions (Anser et al. 2020). Other factors that exacerbate the conditions are low levels of education, lack of investment, and inadequate infrastructure. As a result, poor individuals may lack economic opportunities, which widens the gaps in resource distribution and lowers the returns from legally permitted lines of work (Muryani et al. 2021). With poor economic opportunities and 'attractive' incentives from work that involve law-breaking, crime rates will rise, especially when the state fails to maintain social order.

We collected socioeconomic data at the province level to create panel data from 34 provinces from 2010 to 2019. As socioeconomic activities and crime rates differ substantially across the country, aggregation of data at the national level can result in over-generalizations, so it needs to be avoided. Therefore, we used the Generalized Method of Moments (GMM) to estimate the connections between socioeconomic variables and crime rates. We employed three indicators of income inequality and four poverty indicators to be tested in the model. The results of this study can generate policy recommendations for the Indonesian government to combat crimes and support Indonesia's 2045 Vision. It should be noted that data on specific types of crime are not available at the provincial level, rendering it impossible to estimate the poverty–inequality–crime nexus at the provincial level.

The remainder of this paper is organized as follows. Section 2 presents previous studies in the inequality–poverty–crime literature. Section 3 presents the data and methodology. Section 4 outlines the results and the policy implications. Section 5 concludes the study.

2. Previous Studies

The relationship between inequality and crime rates has attracted much attention from criminologists, economists, sociologists, and policymakers (Chintrakarn and Herzer 2012). Studies have identified the determinants of crime rates from a socioeconomic perspective (Bothos and Thomopoulos 2016; Chalfin 2014; Green 2016; Khan et al. 2015; Lobonţ et al. 2017). The scopes of the studies include factors that determine crime rates at the national level in a country (Halicioglu et al. 2012; Hazra 2020; Messner et al. 2013) and across countries (Ayang et al. 2022; Gull et al. 2021; Torrente et al. 2017), as well as comparing the factors in developed and developing countries (Pare and Felson 2014). Other studies also compare different types of crime (Badiora et al. 2017; Bunei et al. 2014; Rosenfeld and Fornango 2008; Sugiharti et al. 2022a).

The literature on the link between income inequality, poverty, and crime rates has not been conclusive. According to economic theory, inequality's effect on crime is ambiguous because it may be positively related to how citizens are protected against crime (Chintrakarn and Herzer 2012). Nonetheless, many studies have shown that increasing inequality can worsen crime (Cheong and Wu 2015; Costantini et al. 2018; Rufrancos et al. 2013). For example, Wu and Wu and Wu (2012) show empirical evidence of how inequality positively impacts economic-motivated crime and negatively impacts non-economic-motivated crime. Using a GMM approach for 16 economies, Anser et al. (2020) found a positive relationship between income inequality (Gini index), unemployment, and crime rates, arguing that these two socioeconomic factors are the major determinants of increasing crime rates. Similarly, Hazra (2020) applied cross-sectional dependence to study the nexus between inequality and crime in India and found that inequality, poverty, and education strongly correlate with crime rates.

Income inequality may trigger crimes because there are more upper-income level individuals who can become targets (Costantini et al. 2018). Others argue that the lack of social integration and limited economic opportunities for less fortunate individuals lead to more crimes in unequal societies such as China (Cheong and Wu 2015). An unequal distribution of wealth deprives certain individuals, such as those with lower levels of education or in rural areas, of fair access to employment, education opportunities, services, and other prospects. Still, other scholars argue that inequality has little or no effect on crime. For example, using the variance decomposition approach, Atems (2020) proves that inequality has little attribution to crime rates. Moreover, Nagasubramaniyan and Joseph (2022) found a negative linkage between the Gini ratio and violent crime rates in India using GMM and other data panel techniques. Some studies have yet to prove how income inequality affects violent crime rates, arguing that violent crime is more often attributed to psychological, medical, and social conditions rather than socioeconomic factors.

In the Indonesian context, several studies suggest a positive link between income inequality and crime. Sugiharti et al. (2022a) found a significant impact of unequal income distribution on crime using a GMM approach across provinces in Indonesia, arguing that wider gaps in wealth distribution gave rise to criminal actions. However, Sugiharti et al. (2022a) did not examine the possible link between other inequality indicators, poverty, and crime rates in more detail. Widyastaman and Hartono (2022) found a positive linkage, arguing that intra- and extra-regional income inequality has resulted in increasing criminal actions in Indonesia. Likewise, other studies using panel data suggest that unequal income distribution has triggered criminal actions (Nguyen 2019; Dian Trisnawati and Ismail 2019; Armin 2020). However, studies focusing on the links between crime, inequality, and poverty are limited. In the existing studies, the results remain inconclusive, especially regarding the appropriate indicators to measure income inequality. Whitworth (2013) argues that local and spatial inequalities matter in this context.

Some studies have also observed the nexus between income inequality and crime in other regions. In the United Kingdom, Whitworth (2013) found that the Gini ratio is connected to the occurrences of burglary, robbery, and motor vehicle theft. However, the Gini index alone cannot be the sole indicator of the increasing crime rates. Other factors such as unemployment and demographic variables also contribute to crime risks. For example, Nagasubramaniyan and Joseph (2022) did not find a significant impact of the Gini index on violent crime but found that social variables, such as education, employment, and population, deter violent crime. In Italy, Distefano et al. (2019) found that, in high-income areas, widening income gaps give rise to crime because individuals with low incomes try to keep up with the wealthy—the wider the gap, the higher the crime rates. Using cluster analysis, Lombardo (2016) concluded that criminal actions in Italy occur in three clusters: in affluent areas, in areas with an intense vicious circle of criminality, and in areas of low economic performance. Lombardo (2016) also found that socioeconomic variables such as employment, investment, and education could deter crime.

In past research, crime measurements as dependent variables vary. Coccia (2017) uses intentional homicide (per 100,000 people) as a parameter, Ozden et al. (2018) use crime occurrences, and Akpom and Doss (2018) use violent crime (murder, robbery, assault, and rape) and property crime (motor vehicle crime, burglary, and larceny). However, most studies use crime occurrences per 100,000 population as a more proportionate and comparable measure of criminality (Leiva et al. 2020; Masterson and Yasenov 2021; Mulamba 2021; Piza and Chillar 2021; Rosenfeld and Fornango 2008).

Similarly, the independent variables to determine the factors influencing crime rate vary greatly, from social to economic variables. For example, Ivaschenko et al. (2012) use unemployment, education, wage levels, poverty, economic activity, and income inequality as variables, as well as the government's spending on law enforcement. Rakshit and Neog (2020) use poverty, enrollment rate, education expenditure, policing efficiency, employment, teacher-to-student ratio, male-to-population ratio, age composition, and urbanization as explanatory variables. Meanwhile, Brosnan (2018) uses crime rate, the ability of the

police to solve crimes, income, relative income, unemployment rate, and men aged 15–24 years as independent variables. Anser et al. (2020) use GDP per capita, the Gini index, educational expenditure, unemployment, trade openness, and poverty headcount ratio. Likewise, Nagasubramaniyan and Joseph (2022) explored the linkage between violent crime in India and socioeconomic variables such as the Gini index, population, unemployment, and education.

The impact of GDP as an income variable on crime varies widely. Levitt (2002) proves a strong positive impact of income on crime rates. Lin (2007) shows that the impact of GDP is different for each type of crime, where murder and victimization show a negative impact, and robbery and theft show a positive impact. This is because the latter type of crime suggests that they occur in higher-income environments where victims are likely to report to the police. Khan et al. (2015) show that higher income leads to higher crime rates in the long term but lower ones in the short term. Over time, people with criminal intentions may become more familiar with the situations in a higher-income environment. When the opportunity presents itself, they could be tempted to commit a crime, which may gradually escalate in the long run.

Other studies have looked at the impact of population density on crime rates (Akçomak and ter Weel 2012; Andresen 2011; Atems 2020). Andresen (2011) argues that a highly dense and diverse population breeds more crimes. The impact of population density on crime rates is significantly positive, meaning densely populated areas face more crime than rural areas (Akçomak and ter Weel 2012). A study by Atems (2020) also shows a strong significant positive impact of population density on crime.

Meanwhile, Buonanno and Leonida (2006) investigated the impact of education on crime. Using the population's average years of schooling, the results showed that education significantly negatively impacts crime of all types. In other words, investing in education can save the social costs of crime. Educated society shows lower crime occurrences such as theft, vandalism, threats, and assault (Groot and van den Brink 2010).

Other studies have also considered the role of investment, infrastructure, and poverty in affecting crime rates (Dong et al. 2020; Imran et al. 2018; Montolio 2018). Khan et al. (2015) prove that the impact of poverty on crime rates is positive in the long term but negative in the short term. This is because poverty results in more stress and mental illness over time, which may trigger individuals to commit a crime.

3. Methodology

This study uses panel data from 34 provinces in Indonesia between 2011 and 2019. Some provinces do not have data from the 2011–2019 period, namely Bengkulu (2012–2019), North Kalimantan (2018–2019), West Sulawesi (2017–2019), Maluku (2016–2019), and Papua (2017–2019). In total, there are 281 observations. All data were obtained from Statistics Indonesia (BPS). Table 1 shows a description of the variables used in this research.

Table 1. Description of The Variables.

Variables		Description
CRIME_RATE	Crime Rate	Crime rate per 100,000 population
Gap_1	Gini Ratio	Gini ratio values range between 0 (zero) and 1 (one). A value closer to 1 indicates a wider income inequality.
Gap_2	Gap in Non-Food Expenditure	A gap in the percentage of non-food consumption expenditures between urban and rural areas, ranging from 0 to 100. The closer to 100, the wider the gap in non-food consumption expenditures between urban and rural areas.
Gap_3	Gap in Food Expenditure	A gap in the food consumption expenditure ratio between urban and rural areas, ranging from 0 to 1. The closer to 1, the wider the gap in food consumption expenditure between urban and rural areas.
GRDP [1]	Gross Regional Domestic Product	Gross Regional Domestic Product in each province.
POP_DENSITY	Population Density	The level of population density in each province.
ALS	Average Length of Schooling	The average length of schooling in each province.
DI	Domestic Investment	Total domestic investment in each province.
FDI	Foreign Direct Investment	Total Foreign Direct Investment in each province.
INFSP	Infrastructure Spending	Local government spending on infrastructure.
POOR	Number of Poor People	The total number of poor people in each province.
AHCI	Average of Head Count Index	The average percentage of the population below the poverty line between urban and rural areas.
APGI	Average of Poverty Gap Index	The average expenditure gap of each poor against the poverty line between urban and rural areas.
APSI	Average of Poverty Severity Index	Average distribution of spending among the poor in urban and rural areas

[1] A weakness in the use of regional data (i.e., GRDP, infrastructure expenditure, etc.) is that certain concepts are often under-represented or are not properly captured in regional data. As an example, the regional GRDP is less reliable than a national GDP as regional GRDP often misses to account for inter-regional and international trade.

This study uses the following model:

$$LNCRIME\_RATE_{it} = \beta_0 + \beta_1 CRIME\_RATE_{i,t-1} + \beta_2 GAP_{jit} + \beta_3 LNGRDP_{it} + \beta_4 LNPOP\_DENSITY_{it} + \beta_5 LNALS_{it} + \beta_6 LNDI_{it} + \beta_7 LNFDI_{it} + \beta_8 LNINFSP_{it} + \beta_9 LNPOOR_{it} + \varepsilon_{it} \tag{1}$$

$$LNCRIME\_RATE_{it} = \beta_0 + \beta_1 CRIME\_RATE_{i,t-1} + \beta_2 GAP_{jit} + \beta_3 LNGRDP_{it} + \beta_4 LNPOP\_DENSITY_{it} + \beta_5 LNALS_{it} + \beta_6 LNDI_{it} + \beta_7 LNFDI_{it} + \beta_8 LNINFSP_{it} + \beta_9 LNPOOR_{it} + \beta_{10} AHCI_{it} + \varepsilon_{it} \tag{2}$$

$$LNCRIME\_RATE_{it} = \beta_0 + \beta_1 CRIME\_RATE_{i,t-1} + \beta_2 GAP_{jit} + \beta_3 LNGRDP_{it} + \beta_4 LNPOP\_DENSITY_{it} + \beta_5 LNALS_{it} + \beta_6 LNDI_{it} + \beta_7 LNFDI_{it} + \beta_8 LNINFSP_{it} + \beta_9 LNPOOR_{it} + \beta_{10} APDI_{it} + \varepsilon_{it} \tag{3}$$

$$LNCRIME\_RATE_{it} = \beta_0 + \beta_1 CRIME\_RATE_{i,t-1} + \beta_2 GAP_{jit} + \beta_3 LNGRDP_{it} + \beta_4 LNPOP\_DENSITY_{it} + \beta_5 LNALS_{it} + \beta_6 LNDI_{it} + \beta_7 LNFDI_{it} + \beta_8 LNINFSP_{it} + \beta_9 LNPOOR_{it} + \beta_{10} APSI_{it} + \varepsilon_{it} \tag{4}$$

where *i* indicates the province in Indonesia (34 in total), *t* indicates the time, and *j* indicates the indicator employed as GAP (Gini Ratio, Gap of Non-Food Expenditure, and Gap of Food Expenditure). In Equation (1), we estimate a model using the number of poor people with no other poverty index. In Equation (2), we test the Average Head Count Index (AHCI). In Equation (3), we include the Average Poverty Gap Index (APDI). In Equation (4), we use the Average Poverty Severity Index (APSI).

This study uses the Generalized Method of Moments (GMM-DIFF) estimation technique because it is suitable for small samples (Arellano and Bond 1991; Nguyen 2019). Our sample fulfills the GMM requirement, where the number of cross-sections (N = 34) is greater than the number of time series (T = 9) (Tchamyou 2020). We apply the GMM as it has superior performance over other estimation techniques and can handle endogeneity bias. For example, Ordinary Least Squares (OLS) regression often generates biased and inconsistent estimations as a result of uncontrolled endogeneity (Ullah et al. 2018). Meanwhile, static panel regression, for example, the fixed effect, does not allow using the lagged value of the independent variable, leading to a loss of valuable information. Static panel estimation may create problems such as heteroscedasticity and autocorrelation. On the other hand, GMM has better properties to control for endogeneity bias, such as unobserved heterogeneity and simultaneity, most particularly dynamic endogeneity (Ullah et al. 2018).

The dynamic panel estimation GMM further expands the fixed effect model by including an internal transformation process and the lagged value of the dependent variable as an instrument to control dynamic endogeneity (Ullah et al. 2018). A dynamic panel estimation offers several advantages (Perera and Lee 2013): (1) it allows the exploitation of time series and cross-sectional properties of dynamic relationships between dependent with independent variables, (2) produces an unbiased estimation coefficient, and (3) helps control the possible endogeneity of all independent variables so that the GMM produces efficient, effective, stable, and consistent estimates (Nguyen 2019; Perera and Lee 2013). Therefore, the GMM estimator can provide more reliable conclusions (Anser et al. 2020). We follow the two-step GMM model as it offers more efficient and consistent estimates (Arellano and Bond 1991).

4. Results

The average crime rate in Indonesia in 2019 was 166, which means that for every 100,000 people in Indonesia, 166 people are at risk of committing a crime (Table 2). If grouped by region, Sulawesi has the highest average crime rate of 249.6, followed by Sumatra, with an average crime rate of 204.9. Since a crime rate gap between islands exists, gaps may also exist at the provincial level.

Table 2. Descriptive Statistics.

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
CRIME_RATE	177.843	166.000	496.000	14.000	86.591	0.418	2.862	8.422 **
GAP_1	0.375	0.378	0.475	0.272	0.042	−0.197	2.511	4.612 *
GAP_2	12.191	10.861	66.240	2.060	9.664	4.425	23.498	5836.725 ***
GAP_3	0.142	0.116	0.279	0.000	0.164	4.590	24.351	6324.026 ***
GRDP	38,134.920	28,575.950	174,136.600	9675.890	29,973.940	2.479	8.868	690.938 ***
POP_DENSITY	772.592	102.000	15,900.000	8.500	2683.533	5.147	28.110	8622.667 ***
ALS	8.109	8.040	11.060	6.070	0.951	0.548	3.304	15.151 ***
DI	6456.440	2876.500	62,094.800	1.000	10,106.060	2.799	11.420	1196.932 ***
FDI	856.464	390.900	7124.900	2.400	1271.393	2.484	9.350	760.925 ***
INFSP	1428.139	833.600	29,036.300	138.300	2600.061	6.727	58.935	38,751.890 ***
POOR	852.418	380.110	5356.210	48.610	1221.128	2.437	7.7386	540.967 ***
AHCI	11.133	9.565	31.920	3.445	5.672	0.923	3.515	42.967 ***
APGI	1.953	1.615	8.780	0.395	1.399	1.926	7.608	422.304 ***
APSI	0.525	0.400	3.430	0.000	0.493	2.805	12.624	1452.981 ***

Note: *, **, *** indicate significant figures at the 10%, 5%, and 1% levels.

One of the factors affecting the crime rate in Indonesia is inequality. The data show that Indonesia's average Gini ratio (GAP_1) is 0.375. Sulawesi has the highest average Gini ratio of 0.399, followed by Java (0.384) and Sumatra (0.377). Inequality in this study is also measured using the percentage of non-food consumption expenditure between urban and rural areas (GAP_2), which has an average of 12,191. In contrast to the Gini ratio, Java has the highest GAP_2 average of 12.658, followed by Maluku, Papua (10,702), and Kalimantan

(10,674). In addition to GAP_2, this study also measures inequality using the gap of food consumption expenditure ratio between urban and rural areas (GAP_3) with an average of 0.142. The data show Maluku has the highest average GAP_3 of 0.154, followed by Papua (0.154), Sulawesi (0.134), and Bali (0.133).

In Table 3 we report the results for three indicators of inequality employed in this study: GAP_1 (Gini Ratio), GAP_2 (Gap of Non-Food Expenditure), and GAP_3 (Gap of Food Expenditure). We provide four sub-models (columns) for each GAP model, where independent variables are added progressively. The sub-models employ different indicators of poverty: Number of Poor People (POOR), Average Head Count Index (AHCI), Average Poverty Gap Index (APGI), and Average Poverty Severity Index (APSI). We validate the results using the Sargan test of endogeneity. Results are available upon request.

Table 3. Result using the three indicators on income inequality gap.

	GAP_1				GAP_2				GAP_3			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CRIME_RATE(−1)	0.177 ***	0.167 ***	−0.100	0.095	0.181 ***	0.118 **	0.019	0.155 **	0.144***	0.135 ***	0.045	0.151 ***
	(0.040)	(0.036)	(0.116)	(0.071)	(0.037)	(0.046)	(0.044)	(0.080)	(0.053)	(0.046)	(0.053)	(0.036)
GAP	−0.060	0.343	2.925 **	0.168	0.010 ***	0.014 ***	0.036 ***	−0.001	0.017	0.358 *	0.344	0.301
	(0.250)	(0.251)	(1.144)	(0.285)	(0.003)	(0.005)	(0.009)	(0.010)	(0.290)	(0.183)	(0.256)	(0.379)
LNGRDP	0.582 **	0.432	0.718	0.377	0.392 **	0.027	0.692 **	0.407	0.777 ***	0.736 *	0.736 **	0.636
	(0.295)	(0.267)	(0.755)	(0.262)	(0.182)	(0.254)	(0.310)	(0.389)	(0.196)	(0.425)	(0.362)	(0.518)
LNPOP_DENSITY	−0.706	−0.065	−0.899	0.163	−0.628	−1.200	−0.139	−2.470	−0.115	−1.351	−0.095	−1.366
	(1.056)	(0.777)	(2.674)	(2.004)	(0.726)	(1.050)	(0.989)	(1.998)	(0.287)	(0.962)	(0.856)	(1.210)
LNALS	−2.215	−2.167	−1.148	−3.639 *	−2.598 **	1.354	−3.581 **	−1.667	−4.064 ***	−0.557	−3.798 **	−3.485 ***
	(1.682)	(1.631)	(2.694)	(1.948)	(1.072)	(1.580)	(1.487)	(1.808)	(0.797)	(1.845)	(1.626)	(0.845)
LNDI	−0.048 ***	−0.045 ***	−0.099 ***	−0.052 ***	−0.014 ***	−0.013 ***	0.003	−0.052 ***	−0.058 ***	−0.015 **	−0.067 ***	−0.013 *
	(0.005)	(0.006)	(0.022)	(0.007)	(0.005)	(0.005)	(0.008)	(0.013)	(0.008)	(0.007)	(0.007)	(0.007)
LNFDI	−0.034 *	−0.039 **	−0.112 **	−0.042	−0.042 **	−0.042	−0.089 ***	0.004	−0.032 *	−0.010	−0.031	−0.015
	(0.018)	(0.017)	(0.050)	(0.032)	(0.017)	(0.026)	(0.030)	(0.036)	(0.017)	(0.021)	(0.020)	(0.020)
LNINFSP	0.055 **	0.075 ***	0.250 ***	0.166 **	0.071 ***	0.081 ***	0.064 ***	0.268 ***	0.067	0.087 ***	0.110 ***	0.104 ***
	(0.026)	(0.017)	(0.084)	(0.067)	(0.026)	(0.026)	(0.018)	(0.081)	(0.049)	(0.025)	(0.025)	(0.022)
LNPOOR	1.066 ***				0.898 ***				0.694 *			
	(0.244)				(0.245)				(0.361)			
AHCI		0.073 *				0.187 ***				0.184 ***		
		(0.041)				0.037				(0.040)		
APGI			0.568 ***				0.353 ***				0.242 ***	
			(0.107)				(0.066)				(0.029)	
APSI				0.886 ***				0.993 ***				0.710 ***
				(0.094)				(0.151)				(0.131)
AR(1)	0.7390	0.0601	0.1034	0.0812	0.0571	0.9867	0.1450	0.0523	0.9802	0.1307	0.2732	0.0841
AR(2)	0.2018	0.0967	0.5025	0.6117	0.1926	0.9693	0.2716	0.5852	0.9846	0.1053	0.6130	0.1646
J-Statistic	0.3238	0.2684	0.3923	0.4691	0.2035	0.3231	0.3504	0.3851	0.2848	0.2682	0.4368	0.3522

Note. Gap 1, Gini Ratio; Gap 2, Gap of Non-Food Expenditure; and Gap 3, Food Expenditure. *, **, *** indicate significant values at the 10%, 5%, and 1% levels. The value in brackets "()" indicates the standard error.

The results consistently show that an increase in crime rates in the previous year (CRIME_RATE$_{-1}$) tends to increase crime rates in the current year (See Table 3). This finding is similar to what Ajide (2021) found in Nigeria. Therefore, the resolution of criminal cases must be improved to deter criminals and reduce crime rates. GAP_1, GAP_2, and GAP_3 have a significant positive effect on crime rates, meaning that the higher the Gini ratio, the gaps in food and non-food expenditures, the higher the crime rates. However, out of the three gaps, the increase in the non-food expenditure gap (GAP_2 or columns 5 to 8) has the largest coefficient indicating the highest impact on crime rates. Non-food expenditures are typically used to buy goods above basic needs so that they can trigger jealousy among people, hence criminal actions (Harris and Vermaak 2015).

In several studies, the impacts of GRDP on crime rates vary widely. Some studies find no significant evidence of the link between GRDP and crime (Ajide 2021), others indicate a positive impact (Gull et al. 2021), and some find a negative effect (Chen and Zhong 2021; Sandner and Wassmann 2018). In our results, the increase in GRDP positively impacts crime rates, which means that an increase in GRDP can intensify crime rates. These results align with a previous study (Hazra 2020), where rich countries with high GDPs see more criminal actions than poor countries with low GDPs. Frequent criminal actions in affluent areas could be associated with income gaps. In other words, the increasing GRDP at the regional level may not necessarily decrease inequality in communities and regions. This

result suggests that a high GRDP must truly reflect the income per capita of the community to lower crime.

Earlier studies have indicated that crime rates often increase with population density (POP_DENSITY) (Song et al. 2020). Crime can be understood as a conflict between people, so the greater the population density, the greater the conflict potential and the higher the crime risk (Song et al. 2020). In our results, population density shows a negative impact on crime, although not significant.

Meanwhile, education (Average Length of Schooling, ALS) has a negative impact on crime, so improving public education is likely to reduce crime rates. The coefficient is larger than other indicators, suggesting its central role in minimizing criminal actions. Education is an important investment in the welfare and security of the state and society. It is essential for crime prevention and to equip people with the necessary competence to secure a job (Gull et al. 2021).

Investments, both domestic and foreign, have a negative effect on crime rates. More domestic and foreign investment often translates into more job opportunities and increases the knowledge and skills of workers, which means they become more productive (Sabir et al. 2019). High productivity can lead to a reduction in the crime rate. Promoting investment across the country can positively impact income growth and decrease crime rates, in line with a previous study in Indonesia by Muryani et al. (2021).

Government spending on infrastructure differs between regions, causing differences in the quality and quantity of infrastructure (Muryani et al. 2021), which lead to more criminal actions (Perkins et al. 2022). For example, the construction of more infrastructure in the area has led to an increase in crime. In East Java, the construction of vital infrastructures, such as ports and toll roads, has encouraged urbanization. Urban areas become increasingly denser, and more urban problems emerge. In 2018, crime rates in some regencies in East Java increased by 13% after infrastructure development, with cases including theft, murder, drug abuse, rape, and alcohol. This result is contrary to a study in Spain (Montolio 2018), where infrastructure expenditure led to lower crime rates as the development was accompanied by job creation.

This study uses four indicators to measure the impact of poverty on crime rates. All poverty indicators show a positive impact of poverty on crime rates. The increase in poverty significantly increases crime rates, in line with earlier studies (Adekoya and Razak 2020). The poverty indicator accounting for the number of poor people (POOR) and the Average Poverty Severity Index (APSI) have a high coefficient compared to other poverty indicators (AHCI and APGI). Still, increasing crime levels are partly explained by high levels of poverty in Indonesia (POOR, AHCI, APGI, and APSI).

Finally, we conducted two diagnostic tests. The first is the Arellano and Bound (AR) tests for both the first and second orders. This test examines whether the estimation results have autocorrelation problems (Hall and Howell-Moroney 2012; Huay and Bani 2018; Nguyen 2021). The null hypothesis is that there is no autocorrelation. The results show that the probability values of AR(1) and AR(2) are greater than 5%, so it could be concluded that all models we use have no autocorrelation in either the first order or the second order. The second is the Hansen J-Statistic test to see the validity of the instrument used (Anser et al. 2020). This test examines over-identifying restrictions. The null hypothesis is that the chosen instruments are valid (Oseni 2016; Younsi et al. 2019). Our results show that the Hansen J-Statistic probability value is more than 5%, so it could be concluded that the instruments used in the model are valid. In other words, there are no model specification problems.

5. Discussion

Similar to earlier studies, e.g., by Anser et al. (2020), Costantini et al. (2018), Hazra (2020), and Cheong and Wu (2015), our findings show a positive and significant relationship between income inequality (Gini index) and crime. However, it should be noted that previ-

ous studies, such as by Hazra (2020), used income inequality and poverty as determinant factors but did not examine other inequality and poverty indicators.

Meanwhile, Cheong and Wu (2015) found that income gaps across regions trigger more criminal actions but did not explore the impact of the gaps among individuals (i.e., food and non-food expenditures) within a region as a potential cause of crime. Our results are in line with Widyastaman and Hartono (2022), stating that intra- and inter-regional crime in Indonesia is caused by income inequality. We contribute by including new indicators of income inequality not examined in earlier studies.

In line with earlier studies, our results support the idea that socioeconomic factors motivate criminal actions (Anser et al. 2020; Hazra 2020; Widyastaman and Hartono 2022). Education can deter potential criminals and lower crime (Anser et al. 2020; Hazra 2020; Nagasubramaniyan and Joseph 2022). Another way to minimize criminal actions is by creating more economic opportunities through employment, domestic investment, and FDI. Moreover, we find that the gaps between individuals (overall income and food and non-food expenditures) can trigger more criminal actions. This finding is in line with Distefano et al. (2019). Areas with higher income and gaps may see more criminal actions as individuals try to catch up with high-income earners.

Future studies should incorporate different types of crime to avoid oversimplification, as not all criminal actions are related to socioeconomic factors. Inequality and poverty may drive people to commit certain crimes and not others. However, exploration of the nexus between inequality and specific criminal actions is not possible due to data unavailability in Indonesia. A previous study by Kelly (2000) found that socioeconomic factors, such as poverty, motivate habitational crime but not violent crime. Another direction for future studies is to include the government's legal and judicial actions, as the literature has shown evidence of their role in preventing crimes (Hazra 2020; Sugiharti et al. 2022a).

It should also be noted that our study does not take into account inequality spillover effects. Future studies should explore the within- and across-region economic inequalities as both are likely to have impacts on crime rates. For example, a high prevalence of crime in a certain region may spillover into the neighboring regions. Future studies could assess the spatial effect of crime rates that may exist within and between regions.

Despite the similarity with earlier studies, our results contribute to the literature in the following ways. First, we provide new evidence on the attribution of income inequality to crime rates in Indonesia. Second, we argue that wider gaps in food expenditure among individuals (basic needs) have a stronger impact on crime rates than gaps in non-food expenditure (secondary and tertiary needs). This suggests the importance of identifying gaps in income or expenditure and revisiting the expenditure concept. Gaps in the ability to fulfill essential needs trigger more crime than gaps in non-essential needs. The economic theory of crime by Becker (1968) is more relevant in assessing the nexus between inequality and crime compared to the strain theory by Merton (1949). Third, we argue that poverty rates are a major driver of crime, but it should be noted that the impact of poverty gaps (depth of poverty) and the severity of poverty on crime rates is more significant than the conventional headcount ratio. Fourth, we found that higher income and a history of criminal actions in a developing country such as Indonesia lead to more criminal actions. This indicates the need to establish more stringent legal and judicial systems, as well as better preventive and policing efforts.

6. Conclusions

This study examines the determinants of crime activity across 34 provinces in Indonesia from 2011 to 2019. We test whether the unequal distribution of income, poverty, education, investment, and infrastructure are linked to crime rates in Indonesia. Income inequality is captured in three variables: the Gini ratio, the gaps in food expenditure between urban and rural areas, and the gap in non-food expenditure. Earlier studies have focused on the Gini ratio as an indicator of inequality, overlooking the differences in expenditures on basic needs and other baskets of goods. The finding suggests that all indicators of income

inequality are associated with higher crime rates in Indonesia, suggesting that unequal distribution of wealth motivates criminal actions. An important point to note is that as the gap in non-food expenditure increases, criminal actions rise more substantially than when the gaps in other inequality indicators increase. This may suggest that deprivation of non-basic needs can trigger feelings that could motivate criminal actions, such as jealousy and envy. Meanwhile, the positive effect of GRDP on crime rates suggests that crime rates increase along with income levels. Incomes in Indonesia are growing more rapidly among higher-income individuals than those in the lower strata (Sugiharti et al. 2022b), suggesting the need for more effective policies to reduce the gaps.

Moreover, the study tests whether poverty is associated with crime rates, revealing that extreme poverty is positively related to crime. Two out of the four indicators of poverty have a higher impact on crime rates: the average poverty gap and poverty severity index. Such findings suggest that deeper poverty levels trigger more criminal actions. Therefore, policymakers need to look at the severity and intensity of poverty in society to formulate more targeted policies. Severity and poverty gaps are more related to chronic poverty, where deeper structural reforms are needed to lift individuals from long-term destitution.

The results also indicate that policymakers must improve education and increase investment to combat crime. A longer length of schooling and higher investment flows (domestic and foreign) are associated with lower criminal activities. In addition, expenditure on infrastructure needs to be prioritized as it can be associated with lower crime rates. The government should assess whether infrastructure projects help lower income gaps and increase the incomes of those living under the poverty line.

Policy interventions should focus on the following aspects. The first is improving the economic climate through the generation of more employment opportunities and a better investment climate to reduce criminal actions. The second is building human capital through education to deter crime, as it can provide better economic opportunities to individuals. Other provisions of public services that support human capital building can also be explored (e.g., childcare services, health facilities, community development centers, treatment centers, social security nets). Third, it is critical to reallocate infrastructure expenditure to areas that improve income distribution and lower poverty. Considerable growth in infrastructure expenditure seems to widen income gaps, leading to more criminal actions. Fourth, community programs to improve economic welfare and human capital among less fortunate people are needed to prevent survival-motivated criminal actions. Fifth, policing and judicial systems need to be improved to deter criminal actions. Sixth, policymakers need to reallocate government funds to assist people living in poverty and those on lower income levels to reduce the income gap in society. Seventh, it is necessary to accompany rapid economic growth with income distribution to increase equity and decrease poverty and crime rates.

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