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IS THERE A CAUSALITY RELATIONSHIP BETWEEN LAW ENFORCEMENT, CRIME RATES, AND ECONOMIC GROWTH? AN EMPIRICAL EVIDENCE FROM WESTERN INDONESIA

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Abstract

The economic impact of law enforcement and crime rates empirically has not been widely revealed by researchers. In fact, in general, economic activities can be related to security factors. This study analyzes the influence of law enforcement and crime on economic growth. Using a panel data set of 8 provinces from western Indonesia during the period 2006-2017, the study found that there were no long-run relationships between the three variables. In the short-run, law enforcement and crime rates have a positive and significant effect on economic growth. Law enforcement has a significant and negative effect on crime rates, and vice versa crime rates have a positive and significant effect on law enforcement. The results of the Granger causality test indicate the existence of bidirectional causality between crime rates and law enforcement and between law enforcement and economic growth. Furthermore, unidirectional causality exists running from crime to economic growth.

Keywords: Economic Growth, Law Enforcement, Crime Rates, Panel Vector Autoregressive, and Granger Causality Test.

JEL classification: K14, K42, O47

1. Introduction

Law enforcement is one of the determinants of the success of economic activities. Even it has been essential in assuring long-term economic development (Chen, 1999; Allen et al., 2005). When law enforcement decreases, the condition has an adverse impact on economic activity. In the regions suffering from higher criminal rate, economic actors require the certainty of ownership and business security in order that their asset is secure from criminal acts such as robbery, fraud, and so on. The existence of law enforcement in supporting economic activities as stated by Porath (2006) that the legal aspects of economic activity are an important thing to ensure the activities will be going on night and day properly. Conversely, when law enforcement is low and the criminal level is high, these conditions have a negative impact on economic activity and in turn, can reduce economic growth. A number of research studies have found that the higher law-enforced regions, on average, have higher per capita income than lower law-enforced regions (Buonanno, 2013).

In the context of the regional economy in Indonesia, a study of the relationship between law enforcement, crime rates, and economic growth is interesting to analyze. Based on the report of the Indonesian Central Bureau of Statistics in 2012-2016, a number of regions in Indonesia are suffering from high crime rates, especially in western Indonesia. The law enforcement in the area is also relatively different between one province and another. In this study, law enforcement is proxied from the level of the settlement of criminal cases (crime clearance), namely the ratio of criminal cases resolved by the court in a certain period of time

with a total of criminal cases that occurred in the area at the same time. Furthermore, the level of economic growth in each province in western Indonesia is also relatively different from one and another (Amri, 2018). This is indicated by the annual per capita income of the respective province. In 2006, the highest per capita income province is Sumatera Utara of IDR7,427.09 million per year, then followed by Riau province in the second with per capita income of IDR7,512.51 thousand per year. Conversely, the lowest per capita income province is Bengkulu of Rp.4,496.06 thousand. Until 2015 both Sumatera Utara and Riau provinces are still be first and second highest per capita income province in western Indonesia, respectively. If the economic growth of the region can be associated with non-economic aspects such as crime and law enforcement, it is important to analyze the causal relationship between the three variable.

The study on the relationship between law enforcement, crime, and economic growth has been carried out by many economic researchers. However, the empirical evidence they found is still a contradiction between one study and another. Empirical evidence regarding the relationship between crime and economic growth, for example, the results of research by Goulas & Zervoyianni (2013) concludes that crime has an ambiguous effect on economic growth. In term of the macroeconomic uncertainty, the findings of their study point out that the high crime rates can reduce annual output growth by between 0.49% and 0.62%. Unlike Goulas & Zervoyianni, empirical research conducted by Kizilgol & Selim (2017) concluded that economic growth has a positive effect on crime. Previously, the study of Mulok et al. (2016) also found an indication that the two variables were correlated with one another. The argument rationalizing the nature of the relations is that good economy tends to generate more crime, and the opposite occurring bad economies.

Several research studies on the relationship between law enforcement and economic growth have not yet provided fix conclusions. For example, research findings of Pere (2015) for the case of the Western Balkan countries found a positive relationship between law enforcement and economic growth. The finding is in line with the results of the study of Lorenzani et al. (2014) which concluded that law enforcement is able to improve business security in the community and in turn lead to output growth. However, in contrast to the two researchers, the results of the study of Ozpolat et al. (2016) for the case of three countries groups (high income, middle income and low-income countries) present inconclusive conclusions. Their findings inform that the relationship between law enforcement and economic growth is not relevant to explain the level of economic development of the middle income and low-income countries.

In contrast to previous research, our study reexamined the causal relationship between economic growth, law enforcement, and crime in the context of Indonesia. Especially so far, the study of the interrelationships between the three variables is still very little highlighted by economic researchers, especially for the western region of Indonesia. Whereas, predicting economic growth by using legal variables as predictor variables is very useful for policymakers in strengthening law enforcement to ensure business security for economic actors. In order to detail the analysis of the relationship between these variables, we employed the Panel-Vector Autoregressive (PVAR) as means of data analysis. The analysis accompanied by an analysis of impulse response function, variance decomposition, and Granger causality test. So that the results of the study not only detect the direction and significance of the relationship between variables but also reveal which of the one variable causing changes in the other two variables

Systematically, this paper arranged in five parts. The first part is an introduction highlighting a number of issues and the scientific arguments of the importance of the study. The second section contains a literature review complemented by a number of empirical findings regarding the relationship between variables. The third part is a research method that describes the source and measurements of the data as well as the econometric model used to analyze the relationships between variables. Then the fourth part is the result of research and discussion, and the last part is conclusions and suggestions..

2. LITERATURE REVIEW

2.1. The link between law enforcement and economic growth

A number of theories and empirical studies have explained the relationship between law enforcement and the economy. Law enforcement is an important requirement to ensure the certainty of economic activities in the community (Xu, 2011). The existence of legal certainty is essential for economic growth (Haggard & Tiede, 2011). The economic activities require legal certainty, especially regarding equality of rights for communities in carrying out economic activities (Lisitsyn-Svetlanov et al., 2018). When an area is categorized as an insecure area and has no legal certainty, the condition has an adverse impact on economic activity which in turn reducing output growth. Therefore, the relationship between economic activity and law enforcement is very close. For example, the empirical research conducted by Pere (2015) for the case of the Western Balkan countries has identified a close relationship between law enforcement practices and economic growth.

Empirical studies by a number of researchers regarding the relationship between law enforcement and economic growth provide unclear conclusions. The results of the research by Ozpolat et al. (2016) for the case of three countries groups (high income, middle income, and low-income countries) present inconclusive conclusions. Their findings inform that the relationship between law enforcement and economic growth is not relevant to explain the level of economic development of the middle income and low-income countries. While the results of the study by Adekoya & Raza (2016) in Nigeria discover that law enforcement reflected through punishment for criminals enable increase economic growth in the short run. Also, the crime dependence on punishment shows a negative value of 0.582 on economic growth. But the negativity of crime dependency on punishment shows that punishment is not efficient in promoting economic growth.

Unlike the results of the empirical research of the two researchers, the research study of by Lorenzani et al. (2014) regarding the relationship between the civil justice system and economic growth found that law enforcement increases entrepreneurial activity so that it affects investment and employment and in turn improve economic growth. The better law enforcement and better business security encourage productive economic activities.

2.2. The link between crime rates and economic growth

The study on the relations between crime and the economy has become the focus of interesting studies by a number of economic researchers. However, the empirical findings they found have not provided the same conclusion. The existence of a causal relationship between the two variables due to crime affecting production activities. The empirical study conducted by BenYishay & Pearlman (2014) for the case of Mexico has found out that higher rates of crime are associated with a significantly lower probability of enterprise plans to improve income growth. This thing explicitly indicates that criminal activities have a negative impact on economic growth. Unlike the findings of BenYishay & Pearlman, previously, Hemley & McPheters (1975) found that at the lower levels of income and production, crime tended to decreases. But when the economy increased, crime tends to increase. In other word, there is an inverse relationship between the two variables.

Sharma et al. (2011) in their research in India verified the existence of a negative relationship between crime and economic growth. Criminal activities in certain areas not only disrupt the comfort of people's lives but also adversely affect the investment climate and production activities (Adekoya & Raza, 2016). An empirical study of Islam (2014) for the case of 27 developing countries found out a negative relationship between economic growth and crime. Similar to Islam's findings, the research study conducted by Havi (2014) in Ghana also discover that the correlation coefficient between economic performance and the crime rate is negative and significant. The existence of a negative relationship between crime and economic growth caused by crime adversely affects production activities and output growth in the economy (Neanidis & Papadopoulou, 2013; Motta, 2016).

Research conducted by Goulas & Zervoyianni (2015) using a panel of data sets of 26 countries found that crime has an asymmetric effect on economic growth depending on the level of macroeconomic certainty. Crime is not a barrier to growth when economic conditions

allow investment gro[illegible]. Conversely, when economic conditions vis-to-vis uncertainty conditions, the crime has a negative impact on economic growth. In the macroeconomic uncertainty, their findings prove that every 10% increase in crime caused per capita income to fall by betwe[illegible]0.49% and 0.62%. The research findings of Ahmad et al. (2014) in Pakistan also revealed that crime rates has a negative and significant impact on economic growth in the long run, but, in short-run, the effect of crime rates on economic growth is negative but insignificant.

In contrast to the findings above, the results o[illegible]he Kizilgol & Selim (2017) study for the case of the Turkish economy found a positive relationship between economic growth and criminal activity. [illegible]iously, Mulok et al. (2016) also found that the impact of economi[illegible] growth on crime is found to be positive and statistically significant. The existence of a positive relationship between crime and economic growth is explained by Nayebyazdi (2017) using the Kuzne[illegible] curve that increasing economic growth can increase income inequality. Due to the fact that in the early stages of economic growth, there[illegible]more income inequality and income inequality leads to crime occurrence. The inc[illegible]se in income inequality as a result of economic growth as described in the Kurztnet curve has a strong and robust effect regarding crime rates rising (Lobont et al., 2017).

2.3. The link between law enforcement and crime rates

Several empirical studies regarding the relationship between law enforcement and crime that have been carried out by previous researchers also have not provided the same conclusions. Research conducted by Cnok (1979) found that law enforcement can have an impact on the tendency of criminal behavior in the community. Previously, the research findings of Antunes & Hunt (1973) presented empirical evidence that law enforcement allows reducing crime rates. Increasing law enforcement in a region is usually supported by legal instruments such as the police, for example, in handling criminal cases to get to court. Increasing police efforts will lead to increased clearance rates and in turn, reducing the level of cri[illegible]ates (Cloninger & Satorius, 1979; Alves et al., 2013). Ross & Walker (2016) in their study on the causality relationship between law enforcement and crime rates for the case of California found that lower law enforcement increases crime rates directly.

In contrast to the conclusions of a number of researchers above, the results of the Sh[illegible]d and Blackley (2007) study found that law enforcement was positively associated with crime rates. The increase in law enforcement is parallel with the increase in crime rates due to the tendency of criminals to carry out their actions caused by various factors such as economic, social, and so on. Therefore, even though law enforcement is increasing, but in poor economic conditions, the crime rates will not decrease.

3. Data and research methods

Dataset used to the study is taken from the annual report of the Indonesian Statistics of [illegible]reau. The data form of the panel data set of 8 provinces from western Indonesia pertaining Aceh, Sumatera Utara, Sumatera Barat, Riau, Jambi, Sumatera Selatan, Bengkulu and Lampung Province with annual data over 2006 to 2007. The economic growth is proxied by regional per capita income (RPI) at a constant price of 2000. The use of regional per capita income in measuring the economic growth of the respective provinces refer to a number of the previous research study (Amri and Nazamuddin, 2018; Amri, 2018; Amri et al., 2019). Law enforcement is measured by the number of criminal cases brought to criminal justice. In other words, the variable is clearance rates to total crime ratio. Further, the measurement of crime rates proxied with the probability of citizens being exposed to criminal acts per 100,000 inhabitants.

The first stage in data analysis is started by analyzing stationarity. We used the Levine–Lin–Chu (LLC) method (Levine, Lin, & Chu, 2002) and the Pm[illegible]esaran–Shin (IPS) method (Im, Pesaran, & Shin, 2003) to check the order of integration to see w[illegible]en the time series variable attains stationary. The basic principle of the two methods is the Augmented Dickey-Fuller (ADF) test. The LLC method inquires the heterogeneity of intercepts across mem[illegible]rs of the panel, while the IPS method reviews the heterogeneity in the intercepts and the slope

coefficients. Both tests were applied by averaging individual ADF t-statistics across cross-section units.

The second stage in the method of the analysis is co-integration test. The concept of co-integration, introduced by Granger (1969), is relevant to the problem of determining long-run relationship between the variables. The basic idea that underpins co-integration is simple. If the difference between two non-stationary series is itself stationary, then the two series are co-integrated. If two or more series co-integrated, it is possible to interpret the variables in these series as being in a long-run equilibrium relationship (Engle & Granger, 1987). By contrast, a lack of co-integration suggests that the variables have no long-run relationship-thus, in principle, the postulated variables can arbitrarily move far away from each other.

$$\Delta LRPI_{it} = \alpha_0 + \sum_{j=1}^{n} \beta_{1j}\Delta LRPI_{it-j} + \sum_{j=1}^{n} \beta_{2j}\Delta LCrime_{it-j} + \sum_{j=1}^{n} \beta_{3j}\Delta LLE_{it-j} + \mu_{it} \quad (1)$$

$$\Delta LCrime_{it} = \alpha_0 + \sum_{j=1}^{n} \beta_{1j}\Delta LRPI_{it-j} + \sum_{j=1}^{n} \beta_{2j}\Delta LCrime_{it-j} + \sum_{j=1}^{n} \beta_{3j}\Delta LLE_{it-j} + \varepsilon_{it} \quad (2)$$

$$\Delta LLE_{it} = \alpha_0 + \sum_{j=1}^{n} \beta_{1j}\Delta LRPI_{it-j} + \sum_{j=1}^{n} \beta_{2j}\Delta LCrime_{it-j} + \sum_{j=1}^{n} \beta_{3j}\Delta LLE_{it-j} + \nu_{it} \quad (3)$$

where $\Delta LRPI$ denotes the first difference of the natural logarithm of regional per capita income as proxies of economic growth, $\Delta LCrime$ denotes the first difference of the natural logarithm of crime rate, and ΔLLE denotes the first difference of the natural logarithm of law enforcement. i denotes the province of i, and t denotes the period of t. Furthermore, α and are constants to be estimated, as well as μ, ε and ν denotes a stochastic error term of the PVAR equation, respectively.

In the next stage, we test the causality relationship between the three variables using Granger Causality VAR methods, so that we can clearly know whether economic growth (RPI) has an impact on crime rate and law enforcement or vice versa the two variables cause economic growth. For each of the two questions, a Chi-square (Wald) test is utilized to test the significance of the effect of the respective exogenous variable statistically. Moreover, the VAR methodology allows us to analysis the impulse response that detects the manner in which each endogenous variable responds to the shocks of the exogenous variable evaluated through the residual variables. Thus, shock spread from one of certain variables to the other within the dynamic structure of the VAR model.

4. THE RESULT AND DISCUSSION

4.1. The descriptive statistics of the variables

The regional economic growth rate in the western region of Indonesia is relatively different between one region and another. This difference indicated by the difference in per capita income of each province. The results of the descriptive statistics show that the highest annual per capita income is IDR12,755.99 thousand. The opposite of IDR4,096.06 thousand with an average of IDR7,326.64 thousand.

Furthermore, the results of the descriptive statistics of crime rates showed that the highest number of 317. This informs that the probability of the community to do criminal acts per 100,000 inhabitants are 317 peoples. On the contrary, the lowest number is 22 peoples. In term of law enforcement, the variable is proxied by the ratio of the resolved cases to total crime cases that show the highest ratio of 79.93 percent point. This thing indicates that the number of criminal cases that successfully prosecuted to criminal system justice was 79.93 percent of the total cases. While the lowest ratio is 11.72 percent point.

The results of the normality test of each of these variables using Jarque-Berra test showed that the p-value of economic growth was 0.096 (> .05), which means that per capita income as a proxy for economic growth normally distributed. Furthermore, the p-value of crime rates and law enforcement respectively amounted to 0.107 and 0.124, which means the two

variables were also normally distributed. The descriptive statistics, the normality test and correlation matrix of the three variables as summarized in Table 1.

Table 1. Descriptive Statistics, Test of Normality and Correlation Matrix

	Percapita Income (IDR1000)	Crime Rates (perpetrators of criminal acts per 100,000 inhibitans)	Law Enforcement (ratio of the resolved cases to total crime cases) (%)
Descriptive Statistics			
Mean	7,326.64	189	48.65
Median	7,032.37	199	45.59
Maximum	12,755.99	317	79.93
Minimum	4,096.06	22	11.72
Test of Normality			
Jarque-Bera	4.668	4.469	4.265
Probability	0.097	0.107	0.124
Correlation Matrix			
Per capita Income	1		
Crime Rates	0.553	1	
Law Enforcement	0.053	0.022	1

Source: Author's Computation using E-views 9.0.

Table 1 above represents the long-run correlation between the three variables. The nature of relations between per capita income and crime rates is strongly positive which is shown by a correlation coefficient of 0.553. Furthermore, the correlation coefficient between income and law enforcement and between per capita income and crime rates of 0.053 and 0.022, respectively. The coefficients are close to zero, which means the relationship is very weak.

4.2. The result of unit root test

Prior to conducting any econometric analysis, it is important to examine whether the panel data are stationary (or unit root). As explained earlier, the unit root test in this study using six methods. The tests are namely Levin, Lin & Chu (LLC), Im, Pesaran & Shin (IPS), ADF - Fisher X2, ADF - Choi Z-stat, PP – Fisher dan PP – Choi test. The result of the test as summarized in table 2.

Table 2. The Result of Panel Unit Root Test

No	Variable	Methods	Individual Intercept				Intercept & Trend			
			Level		First Difference		Level		First Difference	
			T-stat	P-value	T-stat	P-value	T-stat	P-value	T-stat	P-value
1	Law Enforcement (LLE)	Levin, Lin & Chu	-3.657	0.000	-12.752	0.000	-13.663	0.000	-12.038	0.000
		Im, Pesaran & Shin	-2.299	0.011	-6.118	0.000	-4.416	0.000	-3.105	0.001
		ADF - Fisher X^2	29.506	0.021	66.175	0.000	43.602	0.000	52.542	0.000
		ADF - Choi Z-stat	-2.6115	0.005	-5.553	0.000	-2.688	0.004	-4.4116	0.000
		PP - Fisher	29.280	0.022	72.713	0.000	33.086	0.007	53.236	0.000
		PP – Choi	-2.667	0.004	-6.347	0.000	-2.174	0.015	-4.839	0.000
2	Crime (LCrime)	Levin, Lin & Chu	-0.957	0.169	-0.507	0.306	1.728	0.958	-4.302	0.000
		Im, Pesaran & Shin	0.784	0.784	-1.010	0.156	2.628	0.995	-0.654	0.256
		ADF - Fisher X^2	8.961	0.915	23.563	0.099	4.698	0.997	21.503	0.160
		ADF - Choi Z-stat	0.961	0.832	-1.366	0.086	3.111	0.999	-1.727	0.042
		PP - Fisher	24.472	0.079	65.722	0.000	12.418	0.715	70.615	0.000
		PP – Choi	-1.521	0.064	-4.831	0.000	3.347	0.999	-5.887	0.000
3	Economic Growth (LRPI)	Levin, Lin & Chu	4.591	1.000	-4.379	0.000	-6.492	0.000	-6.524	0.000
		Im, Pesaran & Shin	6.172	1.000	-2.059	0.019	-1.433	0.076	-1.736	0.041
		ADF - Fisher X^2	1.355	1.000	30.572	0.015	26.990	0.042	36.195	0.003
		ADF - Choi Z-stat	6.304	1.000	-2.135	0.016	-1.033	0.151	-2.579	0.005
		PP - Fisher	3.403	0.999	35.766	0.003	7.591	0.960	53.255	0.000
		PP – Choi	6.133	1.000	-2.811	0.003	2.419	0.992	-3.820	0.000

Source: Author's Computation using E-views 9.0

As shown in table 2 above at the level, the majority of the respective p-value for all methods of panel unit root test is greater than 0.05. This indicates that the variables are non-stationer in level. However, the p-value is less than .05 at the first difference neither for Individual Intercept or Intercept & Trend. Thus, the variables achieved stationary at the first difference.

4.3. The result of co-integtation test

The co-integration tests aim to determine whether the variables studied toward long-run equilibrium one another. In this respect, we utilized Pedroni's (1999) co-integration test which suggests there are seven statistical methods to detect the presence of cointegration phenomena in the panel data set. The methods divided into two groups. The first group is namely cointegration in the within-dimension (panel test) namely the v-statistical panel, rho-statistical panel, PP-statistical, and ADF-statistics panel. The second group is the co-integration test of between dimension (group test) including Group rho-Statistics, Group PP-Statistics, and Group ADF-Statistics. The tests propose two hypotheses consisting of a null hypothesis proposing the existence of co-integration between the law enforcement, crime rates, and economic growth, and the alternative hypothesis suggesting the variables are co-inegrated. The rejection of one of the hypotheses was based on the p-value generated by the output E-views with the criterion that the alternative hypothesis is accepted and vice-versa the null hypothesis is rejected if p-value < .05. On the contrary, the alternative hypothesis is rejected, and the null hypothesis is accepted if p-value> .05. The result Pedroni's cointegration test as shown in Table 3.

Table 3. The Result of Pedroni's residual-based cointegration test

Panel Cointegration Statistics (Within-Dimension)		
Test Statistics	Statistical Values	
	Individual Intercept	Individual Intercept and Trend
Panel v-Statistic	1.105 (0.866)	125.311 (0.000)**
Panel rho-Statistic	1.331 (0.909)	2.308 (0.989)
Panel PP-Statistic	0.776 (0.781)	0.296 (0.617)
Panel ADF-Statistic	2.695 (0.997)	-0.569 (0.285)
Group Mean Panel Cointegration Statistics (Between-Dimension)		
Test Statistics	Statistical Values	
	Individual Intercept	Individua Intercept and Trend
Group rho-Statistic	2.235 (0.987)	3.417 (0.999)
Group PP-Statistic	0.817 (0.793)	0.551 (0.709)
Group ADF-Statistic	2.581 (0.995)	-1.463 (0.072)*

Source: Author's Computation using E-views 9.0

Note: The values in parentheses are probabilities values. Ho: no cointegration; * and ** indicate the rejection of null hypothesis at 90% and 95% significant level, respectively.

Based on table 3 above, it is known that only some criteria can be fulfilled. The statistical tests show that either one of Panel v-Statistic, rho-Statistic Panel and rho-Statistic Panel are significant for both individual intercept methods and individual intercept and trend method. That things indicated by the p-value of the respective statistic method is lower than 0.05. Furthermore, the statistical test of the ADF-Statistic Panel shows the p-value of 0.0337 (< 0.05) for the individual intercept method and 0.5284 (> 0.05) for the individual intercept and trend. Co-integration test in term between dimension (group test) consists of Group rho-

Statistic, Group PP-Statistic, and Group ADF-Statistic. Either one of the three statistic methods provides the p-value < 0.05. Referring to the results of Pedroni's (1999) panel cointegration tests as described in table 3 above can be interpreted the absence of co-integrative relations between the three variables. In other word, this thing informs that there is no long-run relationship between them.

Furthermore, acceptance or rejection of the hypothesis with Kao's residual panel cointegration test also based on the p-value. The provision of the test is if the p-value < 0.05 indicate that there is cointegration among the three variables. Otherwise, the p-value > 0.05 means the variables have no cointegrated. The result of Kao's residual panel cointegration test in Table 4.

Table 4. The Result of Kao's Residual Panel Cointegration Test

Null Hypothesis	ll-Statistic	P-value
No cointegration	0.499	0.309
Residual Variance	0.002	
HAC variance	0.005	

Source: Authors' Computation using E-views 9.0

Table 4 evinces the results of Kao's (1999) panel cointegration test. The statistical result of the test shows that the p-value of 0.309 (>0.05). Hence, the null hypothesis is accepted and that thing indicates that there is no long-run relationship between law enforcement, crime rates, and economic growth. In other words, there is no evidence pointing out the three variables are co-integrated in the long-run.

4.4. 4.4 The result of the lag length criteria

The tests were determined based on informational criteria - the Akaike information criterion (AIC), Hannan-Quinn (HQ), and Schwarz information criterion (SC), taking into consideration that if the number of lags is too small then the model does not capture all the information while if there are too many lags then the degree of freedom is wasted. Different information criteria suggest different optimal lag lengths for the VAR model, as shown in Table 5. The standard information criteria of sequential modified LR test statistic and Final prediction error show an optimal lag length of 6. Information criteria of Akaike information criterion also show an optimal lag length of 5.

Table 5. Result of VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	118.1680	NA	6.34e-07	-5.7584	-5.6517	-5.7126
1	139.1155	37.7056	3.49e-07	-6.3558	-5.8491*	-6.1726
2	145.4206	10.4033	4.03e-07	-6.2210	-5.3344	-5.9004
3	155.1603	14.6096	3.97e-07	-6.2580	-4.9914	-5.8000
4	179.0565	32.2599	1.96e-07	-7.0028	-5.3562	-6.4074
5	199.1526	24.1153*	1.21e-07	-7.5576	-5.5309	-6.8249
6	213.6666	15.2397	1.02e-07*	-7.8333*	-5.4267	-6.9632*

Source: Author's Computation using E-views 9.0

Note: * indicates lag order selected by the criterion; LR stands for sequential modified LR test statistic (each test at 5% level); FPE is standing for Final prediction error; AIC stands for Akaike information criterion; SC stands for Schwarz information criterion, and HQ stands for Hannan-Quinn information criterion.

Since the variables achieved stationarity after first differencing and Akaike information criterion shows an optimal lag length of 6, we use the lag length of 6 for the econometric model of panel vector autoregressive.

4.5. The result of panel vector autoregressive

The economic growth in a certain period is positively and significantly influenced by itself at one and five periods earlier. It shows that economic activity produces output (goods and services) in a period capable of increasing production capacity for the next period. The effect

of crime on economic growth shows ambiguous results. In the first period, the variable has a positive and insignificant effect, but in the second period, it has a positive and significant effect on economic growth. This indicates that criminal activities are not an obstacle to economic growth. Even the existence of a positive relationship between the two variables after two periods explicitly informs that the dynamics of the two variables move in the same direction. Furthermore, for the 3-5 period horizon, the effect of crime on economic growth is negative and insignificant. An increase in criminal activities in a certain period has an opposite impact on economic growth in the 3-5 periods later, but not significant.

In terms of the effect of law enforcement, this study found that for one-five period horizons, law enforcement has no significant effect on economic growth. The significant and positive effect of the variable on economic growth exists after the sixth period. This indicates that law enforcement in a certain period has a positive impact on economic growth in the next periods. This finding is consistent with the results of the Morganti & Garofalo study (2019) using a panel of data sets of 62 countries which discovered that law enforcement has a positive and significant effect on economic growth. The complete information of the econometric model analysis which discovers the direction of causality relationship between the variables generated through PVAR as summarized in Table 6.

Tabel 6. The Summary of Panel Vector Autoregressive

Endogenous Variable	Exogenous Variable					
	ΔLRPI		ΔLCRIME		ΔLLE	
	Coefficient	t-statistics	Coefficient	t-statistics	Coefficient	t-statistics
ΔLRPI (-1)	0.5529	3.0034	-1.4108	-0.4249	-11.1917	-3.0625
ΔLRPI(-2)	0.3305	1.6183	3.5625	0.9675	5.0525	1.2465
ΔLRPI(-3)	-0.8239	-2.8750	0.8079	0.1564	-1.8186	-0.3197
ΔLRPI(-4)	0.4307	1.3773	-6.3323	-1.1231	-0.8527	-0.1374
ΔLRPI(-5)	0.8969	3.1942	1.5014	0.2973	17.9517	3.2288
ΔLRPI(-6)	-0.3461	-1.3342	0.1331	0.0284	-1.0964	-0.2129
ΔLCRIME (-1)	0.0041	0.3622	-0.2308	-1.1280	-0.0914	-0.4056
ΔLCRIME (-2)	0.0239	2.2207	0.0983	0.5049	-0.3681	-1.7170
ΔLCRIME (-3)	-0.0085	-0.9789	0.3394	2.1744	0.4733	2.7542
ΔLCRIME (-4)	-0.0011	-0.1640	-0.2144	-1.8523	-0.0633	-0.4963
ΔLCRIME (-5)	-0.0066	-0.9586	-0.1899	-1.5329	-0.0309	-0.2264
ΔLCRIME (-6)	0.0109	1.5171	-0.0434	-0.3323	0.1814	1.2617
ΔLLE (-1)	-0.0071	-0.7469	-0.0959	-0.5565	-0.6547	-3.4506
ΔLLE (-2)	0.0066	0.6825	-0.3324	-1.9093	-0.2592	-1.3526
ΔLLE (-3)	0.0067	1.0512	-0.2759	-2.3866	-0.4789	-3.7631
ΔLLE (-4)	-0.0015	-0.2136	-0.1319	-1.0587	-0.8881	-6.4743
ΔLLE (-5)	0.0031	0.3095	-0.2489	-1.3669	-0.5143	-2.5661
ΔLLE (-6)	0.0205	2.8755	-0.1470	-1.1453	-0.0847	-0.5991
C	-0.0016	-0.2048	0.0813	0.5777	-0.3900	-2.5183
R-squared	0.7099		0.1790		0.7640	
Adj R-squared	0.0014		0.4563		0.5529	
S.E. equation	0.0082		0.1474		0.1623	
F-statistic	6.3016		1.4724		8.0149	
Akaike AIC	-6.4698		-0.6856		-0.4934	
Schwarz SC	-5.6676		0.1166		0.3088	
Mean dependent	0.0434		-0.0039		0.0304	
S.D. dependent	0.0152		0.1627		0.3340	

Source: Author's Computation using E-views 9.0

Note: t statistics > 2.00 indicate a significant effect; and t statistics < 2.00 indicate an insignificant effect.

As shown in Table 6 above, at the 2-period horizon, the influence of crime on economic growth is positive and significant. Conversely, at the 3-5 period horizon is negatively insignificant. The existence of same direction relations between the two variables is in line

with the results of the study of Kizilgol & Selim (2017) in the case of the Turkish economy finding a positive relationship between economic growth and the number of criminal actors. Conversely, this finding is a contrast to the empirical findings of Kathena & Sheefeni (2017) for the case of the Namibian economy, which concluded that the increase in crime rates lead to economic growth decrease. The research study of Blackburn et al. (2017) also points out that crime has a negative effect on growth. Similar to the findings, Diaw et al. (2014) also proved a number of contradictive results regarding the nature of the causal relationship between crime and economic growth.

The negative effects of crime rates on economic growth are due to criminal activities having a destructive impact on the economic activities of the community. The activities besides being able to cause on social insecurity in the community, but also impact on the uncertainty of business prospects which is, in turn, reducing economic performance (Estrada & Ndoma, 2014). These findings confirm the empirical research conducted by Motta (2016) in Latin America, which has revealed that there is a negative relationship between criminal activity and economic performance.

Economic growth has no significant effect on crime rates. This indicates that the tendency of criminals to engage in criminal activities not be influenced by the intensity of the economic activities of the communities. Output growth in the economy does not impact on the behavioral intentions of criminal actors in realizing their evil deeds. This finding is contrary to the findings of Mulok et al. (2016) in Malaysia concluded that the impact of economic growth on crime rates is statistically significant.

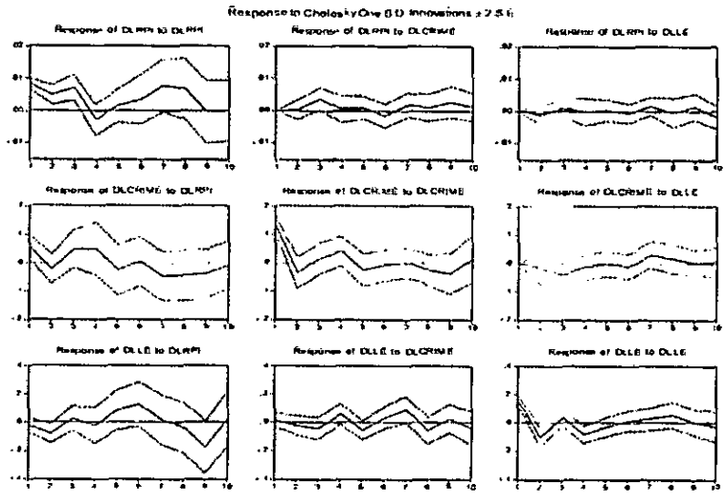
Crime rates for a certain period were positively and significantly affected by the crime rates of the previous 3-period. In other word, the increase in crime at the period of t, prompt an increase in crime at the following 3-period (t+3). The perceived benefits which are obtained by the perpetrators of certain criminal activities encourage them to repeat the evil actions in the future. This is what causes crime to have a positive effect on its own self.

Law enforcement has a negative and significant effect on crime rates in the 3rd-period. The increase in law enforcement for a certain period has a negative effect on the crime rates of the three periods later. The ability and success of law enforcement officials get perpetrators up to court be able to reduce the desire of them to repeat the criminal activities. Accordingly, there is an adverse relationship between the two variables. Furthermore, economic growth and crime rates had a positive and significant effect on law enforcement at the 5th and 3rd period, respectively. The higher the intensity of economic activity, the higher the crime rates, and the more the number of criminal cases resolved to the criminal system justice. The existence of a positive and significant effect of crime rates on law enforcement is consistent with the results of Shepard and Blackley's (2007) study concluding that the arrest of criminal offenders by law enforcement officials are positively related to the higher levels of crime rates.

4.6. The result of impulse response function

The impulse response function is used to detect the behavior of a variable in responding to the shock of its own self and other variables in a dynamic model. In this respect, the IRF analysis aims to investigate the response of law enforcement, crime rates, and economic growth when the shock that occurred in its own self individually or other variable changes.

Figure 1. Result of Impulse Response Function



The economic growth positively responds to the shock of its own self within the 1-3 period horizon. Hereinafter, the response was negative in the 4th period and then positive in the 5-9 period. In the 10th period, the response towards the long-run equilibrium. The response of economic growth to the shock of crime rates is relatively small but tends to be positive during the analysis period. Further, the response of economic growth to the shock of law enforcement is also relatively small and is around the long-run equilibrium line.

The response of crime to the shock of law enforcement is negative during the 1-7 period horizon, then positive in the 8th period. Hereafter, in the 9-10 period horizon, the response was relatively small and towards the equilibrium point. The response of law enforcement to economic growth is negative until the third period. Then, the response is positive during the fourth to seventh period. Further, law enforcement responds negatively to economic growth from the eighth period and then toward the balance point in the tenth period. The response of law enforcement to shock in crime rates positive in the first period, then negative in the second and third periods. The response fluctuates until the tenth period approaches the equilibrium point.

4.7. The result of variance decomposition analysis

One way to determine how important the different exogenous shocks are in explaining the dependent variables is to calculate the fractions of the forecast error variance of these variables attributable to the respective orthogonal shocks. The analysis would reveal the contribution of the variable in explaining the forecast error variance of either itself or others. The variance decomposition analysis is utilized to assess the dynamic interactions between the variables in panel VAR model.

The results of the variance decomposition are shown in Table 7. In general, the results further substantiate the earlier findings which base on the impulse response function. Variations in regional economic growth (RIPI) variable explain around 89 percent of its forecast error variance at the 5-years horizon, indicating that decreasing in economic growth is one of the most important variables in explaining the dynamic of its own variance. The VDA result also shows that crime rates and law enforcement contribute up to 8.78 percent and 1.57 percent of the forecast error-variance of economic growth at the 5-years horizon, respectively. This indicates the two variables are not one of the important factors in explaining the evolution of regional economic growth in western Indonesia.

Table 7. Variance Decomposition of Variables

Period	Variance Decomposition of ΔLRPI:			Variance Decomposition of ΔLCRIME:			Variance Decomposition of ΔLLE:		
	ΔLRPI	ΔLCRIME	ΔLLE	ΔLRPI	ΔLCRIME	ΔLLE	ΔLRPI	ΔLCRIME	ΔLLE
1	100.0000	0.0000	0.0000	14.0069	85.9930	0.0000	2.2803	1.0231	96.6966
2	98.3844	0.2137	1.4019	14.9694	84.0357	0.9949	15.9937	1.8281	82.1782
3	89.7375	8.6609	1.6016	21.2791	72.6789	6.0419	16.1307	5.1998	78.6695
4	90.0712	8.3876	1.5412	26.2193	68.1651	5.6156	13.9844	10.5393	75.4763
5	89.6552	8.7786	1.5663	27.2433	67.3494	5.4073	21.9237	13.3004	64.7759
6	88.8460	9.4663	1.6876	27.1818	67.1559	5.6623	35.7025	11.7611	52.5364
7	89.4144	8.3766	2.2091	30.7525	61.3926	7.8549	32.3866	19.4841	48.1293
8	90.6482	7.4027	1.9490	33.4058	58.5293	8.0649	31.3311	21.2336	47.4354
9	87.8368	9.6009	2.5624	34.4939	57.9441	7.5621	46.7679	16.8455	36.3866
10	86.3631	9.9965	3.6404	34.3373	58.0193	7.6434	46.1834	17.6135	36.2031
	Cholesky Ordering: ΔLRPI ΔLCRIME ΔLLE								

Source: Author's Computation using E-views 9.0

4.8. The result of PVAR Granger causality test

In order to determine the direction of causality relationship among the variables, we employee Granger causality/block exogeneity wald tests. The result of the test shows that bidirectional causality exists between crime rates and law enforcement and between economic growth and law enforcement. There is unidirectional causality running from crime to economic growth. Table 8 describes the direction of the causality relationship between the variables.

Tabel 8. The Result of VAR Granger Causality/Block Exogeneity Wald Tests

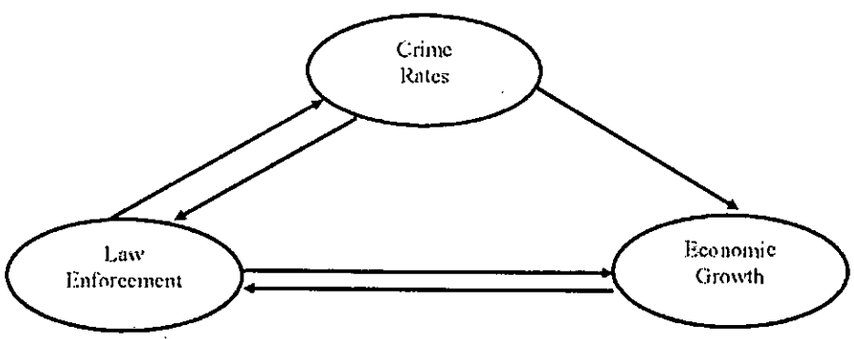
Dependent Variable	*Independent Variable*		
	ΔLRPI	ΔLCRIME	ΔLLE
ΔLRPI	-	(16.809) [0.021]**	(12.313) [0.067]*
ΔLCRIME	(4.026) [0.673]	-	(16.991) [0.009]***
ΔLLE	(32.107) [0.000]***	(28.613) [0.000]***	-

Note: Number in ( ) is chi-square, Number in [ ] is p-value, * significant at 90% level, ** significant at 95% level and *** significant at 99% level.

Source: Author's calculation with Eviews 9.0

Refer to Table 8 above, the direction of causality relationship among the variables as shown in Figure 2.

Figure 2. The direction of causality relationship among the three variables



The existence of bidirectional causality between law enforcement and crime explicitly informs that law enforcement can encourage a decrease in criminal acts in the community. As the PVAR results explained earlier, law enforcement has a negative effect on crime at the 1-5 period horizon. Thus, the decrease in criminal activities is a response to an attempt by security forces to prosecute criminal actors to court. In other words, the decrease of the crime rates caused by the increase of clearance rates as proxies of law enforcement.

This finding supports the research findings of Cloninger & Satorius (1979) confirming that an increase in police efforts will cause an increase in crime clearance rates and in turn to reduce the crime rates. Furthermore, the intensity of crime can also affect law enforcement. Increased criminal activities in the community encourage security forces, especially the police, to increase the intensity of law enforcement. Accordingly, crime clearance rates are also positively and significantly related to the intensity of criminal acts in the community. These results in line with the research findings Shepard and Blackley (2007) which found out that the arrest of crime actors positively related to high crime rates. [18]

Bidirectional causality also exists between law enforcement and economic growth. The running of causality from law enforcement to economic growth indicates that the sustainability of economic activities is a response to law enforcement. The economic activities require the support of conducive social conditions with low crime rates. When law enforcement increases, security is more assurance and in turn, accelerates economic activity in the community. This finding confirms the results of Pere (2015) research for the case of Western Balkan countries which concludes that there is a close relationship between law enforcement practices and economic growth. Previously, empirical studies conducted by Lorenzani et al. (2014) in a number of European countries also proven that law enforcement increases entrepreneurial activity so that it impacts on domestic and foreign investment and in turn, an improves to economic growth.

Further, economic growth can also influence law enforcement. Increased economic growth reflect the increases in economic activity. Economic growth as an indication of an increase in people's income stimulates the interest of criminals to take actions such as robbery, fraud and so on in order to obtain a certain amount of income. Having a response to the conditions, the security officer of the local government tried to encourage law enforcement by taking legal act against the perpetrators of crime.

Unidirectional causality exists running from crime rates to economic growth. This indicates that the production of goods and services in the community response to criminal acts. The interpretation is then in line with the results of the PVAR previously explained that crime rates have a negative effect on economic growth due to its impact on the development of the business activity. The crime rates are associated with the lower probability of enterprise to expanse business activities (Ben Yishay & Pearlman, 2014).

However, this finding in contrast to the results of a study in Namibia by Kathena & Sheefeni (2017) showed that there is bidirectional causality running from crime rates to economic growth. On the contrary, criminal activities do not respond to economic growth. This finding is also different from the results of research by Kathena & Sheefeni (2017) for the case of Namibian economy which presents empirical evidence of the existence of a two-way causality relationship between the two variables.

5. Conclusions and Suggestion

This study was intended to investigate the functional relations among law enforcement, crime rates, and economic growth, and detect whether there was causality between these variables. Using the panel data set of 8 provinces from western Indonesia for the period of 2006-2017, the econometric models that were applied to discover these relations were panel cointegration tests, panel vector autoregressive, and Granger causality tests. This study has concluded two important points. Firstly, there is no long-run equilibrium relationship among three variables. Both crime rates and law enforcement positively affect economic growth. Law enforcement has a negative and significant effect on crime rates, and vice versa crime rates have a positive and significant effect on law enforcement.

Secondly, there was bidirectional causality between crime rates and law enforcement, and between law enforcement and economic growth. Higher law enforcement was a response to

the higher crime rates, and vice versa, the decrease in crime rates was a response to an increase in law enforcement. The increased productive activities in the economy are the economic impact of law enforcement. In the same time, when the intensity of economic activity increased, the local government in western Indonesia effort to improve law enforcement in assuring the economic activity. In addition, there is a unidirectional causality running from crime rates to economic growth. Economic growth has a response to criminal activities. Even though the crime rates did not significantly cause a decrease in the intensity of economic activity, however, the occurrence of the criminal acts such as theft, robbery, and fraud, for example, it still has a destructive impact on the development of the productive economic activities.

Referring to the conclusions above the strategic policy of the local government, particularly for the provinces in western Indonesia should enhance law enforcement to reduce crime rates. Increase the number of police officers, especially regional police, including investigators for criminal acts. So that more criminals who received punishment for their criminal acts. In relation to economic development policies, the government should effort to increase employment creation for the working age population. Thus, they will get a job to avoid criminal acts such as theft, fraud, robbery, and so on.

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PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16