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Analysis of Palm Oil, Rubber and Orange Production to Gross Domestic Product of Six Districts in West Kalimantan by Panel Regression

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Abstract. West Kalimantan is one of the provinces in Indonesia that has an important role to produce palm oil, rubber and also orange. This research attempted to evaluate the relationship between the three crucial commodities and the prosperity of inhabitants at six districts in the province namely Bengkayang, Ketapang, Landak, Sambas, Sintang, and Sanggau. For this case, the prosperity of the community at the six districts is measured by gross regional domestic product at 2010 constant market prices (GDP). This research was conducted by panel regression that chooses the best model among common effect model, fixed effect model, and random effect model based on the results of Chow Test, Hausman Test, and Lagrange Multiplier Test. According to the result of analysis, it can be concluded that fixed effect model with adjusted determination-coefficient 0.96 is the best model to evaluate this case. Moreover, the model also deduced that only palm oil production that give contribution to GDP of the six districts.

1. Introduction

Gross Domestic Product (GDP), an indicator utilised to see the strength of a country's local economy, is an important factor to determine Gross National Product (GNP). According to [1], West Kalimantan is ranked 22nd out of 33 provinces in Indonesia in 2014 due to the number of GDP. Then, among other five-provinces GDP in Kalimantan, West Kalimantan is the worst one. Meanwhile, West Kalimantan is the second biggest region in Indonesia that has been enriched by huge natural resources as well as other regions in Indonesia. Both evidences show that there is an unbalanced situation between GDP and wide area of the province.

Some researchers have evaluated some aspects that can give a contribution to GDP. Those aspects are production of palm oil, rubber and orange plantation. The first aspect, palm oil plantation, have been investigated by [2] and [3]. [2] conducted an analysis of some effects of palm-oil-plantation development to economic growth concerning poverty alleviation of five districts in Riau Province. According to this research, it can be summarized that palm oil plantation at the five districts donates positive multiplier effect score and farm welfare index. In other research, [3] also evaluated the influence of palm oil plantation managed by Sarawak and Land Consolidation and Development Authority (SALCRA) to prosperity of land owner community nearly SALCRA, namely Iban and Bidayuh community. Based on the research, it can be concluded that the palm oil plantation can increase the community income and improve the infrastructure.

The other aspects considered to give an influence to GDP is rubber and orange production. [4] has completed a research that analysed rubber commodity as a subsector plantation toward growth of agriculture sector in West Sumatera. The research claimed that rubber commodity significantly gave a positive impact to the economic of West Sumatera Province. Then, another aspect utilized in this research is orange production. There are some researchers such as [5], [6], and also [7] who reported that there were a relationship between orange production and GDP.

Evaluation of the three aspects and GDP will be executed by panel regression because there are a mixture of cross section and times series data in the data. Panel regression itself has been utilised prominently to evaluate some cases in numerous articles such as [8], [9], [10], [11], [12], [13], [14], [15], and [16]. Those journals will be utilised to study the methodology in analysis of panel data.

According to the previous researches, there were some evidence that palm oil plantation (in this case is palm oil production), rubber and orange production fostered GDP in other districts in Indonesia. Therefore, this paper intends to analyse relationship between some factors and six-district's GDP in West Kalimantan, namely Bengkayang, Ketapang, Landak, Sambas, Sintang, and Sanggau by panel regression. This research would attempted to analyse district-level data of those factors from 2010 to 2015 derived from [1].

2. Panel Regression

A combination of time series and cross section data is called by panel data. Panel data consists of multiple observations on each individual in the sample over time. Meanwhile, panel regression model is a regression model used to analyse panel data [17]. Panel regression model gives more advantages than classic regression. According to [18], the model could be more accurate to estimate parameters of a model. The better accuracy is caused by there is a large number of data points and there is an increase of degrees of freedom. In addition, the model also can minimize the collinearity among independent variables.

A panel regression model (PRM) can be expressed as

$$y_{it} = \alpha_{it} + \beta_{it} x_{it} + \varepsilon_{it}\,, \qquad i = 1,2,\dots,N\,;\; t = 1,2,\dots,T \tag{1}$$

where y_{it} is dependent variable, x_{it} is independent variable, and ε_{it} is the error term, uncorrelated with x_{it}, with mean zero and constant variance σ_{ε}^2. In addition, α_{it} is a scalar and β_{it} is regression coefficient, *slope*. The subscript i denotes the cross section dimension while t symbolises the time series dimension [19].

Moreover, [19] stated that individual specific effect on y_{it} could be either invariant with the x_{it} or interactive with x_{it}. So that, (1) can be written as

$$y_{it} = \alpha_i^* + \beta_i x_{it} + \varepsilon_{it}\,, \qquad i = 1,2,\dots,N\,;\; t = 1,2,\dots,T \tag{2}$$

The parameters α_i^* and β_i can be different for each cross sectional units, eventhough the parameters stay constant over time. Following this assumption, a variety of sampling distribution can occur. For example, sampling distribution can seriously mislead the least square regression of y_{it} on x_{it} when all of NT observations are used to estimate (3) as follows [18]

$$y_{it} = \alpha^* + \beta\ x_{it} + \varepsilon_{it}\,, \qquad i = 1,2,\dots,N\,;\; t = 1,2,\dots,T \tag{3}$$

Generally, there are three panel models that can be chosen to analyse relationship among variables after passing some statistical tests. The models are Common Effect Model, Fixed Effect Model, and Random Effect Model. Common Effect Model (CEM) regards cross section and time series data as a one whole observation. CEM can be written as (3) and the regression parameters can be estimated by Least Square. Meanwhile, [14] stated that FEM can be written as

$$y_{it} = \alpha_i^* + \beta x_{it}^{'} + \varepsilon_{it}\,, \qquad i = 1,2,\dots,N\,;\; t = 1,2,\dots,T \tag{4}$$

where there are different α_i^* cover individuals. In this research, there will be an assumption that there is no time specific effects.

Besides CEM and FEM, Random Effect Model (REM) can be choosen as the best model to analyse the data. REM can be written as (1) but α_{it} is assumed as a random variable with the expectation α_0, so that $\alpha_i^* = \alpha_0 + \varepsilon_i$. Consequently, REM can be expressed as

$$y_{it} = \alpha_0 + \beta_{it} x_{it} + w_{it} \tag{5}$$

where $w_{it} = \varepsilon_i + \varepsilon_{it}$.

The three models which were mentioned previously have to be choosen by some statistical tests namely Chow Test, Hausman Test and Lagrange Multiplier Test. Chow test is a test used to select CEM or FEM that is better to analyse panel data. Meanwhile, Hausman Test is conducted to check whether or not the existence of random effect in the model. On the other hand, Lagrange Multiplier Test will be executed to choose between CEM and REM that is better to explain panel data. Those tests can be studied extensively from [13], [19], [18] and [17].

3. Analysis And Result

In this section, panel regression will be applied to analyse palm oil production, rubber production and orange production that are considered giving an influence to GDP of the six districts in West Kalimantan. In Indonesia, palm oil and also rubber production is separated become two types namely large estates and smallholders estates. Only palm oil and rubber production which is produced by smallholder estates will be analysed in this research. Meanwhile for GDP, this research will utilise Agricultural-Forestry-Fishery Gross Regional Domestic Product at Constant-Market-2010 Prices by Regency/City from 2010 until 2015. The data utilized at this study are accessed from [1]. Then, for simplification reason, the variables in this research namely GDP, palm oil production, rubber production, and orange production successively are symbolized by $y, x_1, x_2,$ and x_3.

Firstly, multicollinearity test was conducted to check the existence of multicollinearity among the independent variables. According to the VIF value in Table 1, it can be shown that multicollinearity is not exist at this case.

Secondly, Chow Test was executed to evaluate which one is better between CEM and FEM to use in modelling panel data. Chow Test showed that F-calculated is 8300, which is more than F-table with $\alpha = 5\%$, 3.35. So that, it can be concluded that FEM is a better model to use rather than CEM.

After Chow Test, Hausman Test was done to examine whether there is a random effect or not in the model. Based on Hausman Test's result, FEM is better model than REM. It was shown by chi-square-statistics at 20.848 which is bigger than chi-square table, with degrees of freedom 3 and $\alpha = 5\%$, at 7.814.

Next, at the third step, Lagrange Multiplier Test was conducted to check the existence of heteroscedasticity in FEM. At this step, it can be shown that LM-calculated is 3.749, that is smaller than value of chi square table with degrees of freedom 3 and $\alpha = 5\%$, 5.99. So that, it can be deduced that there is no heteroscedasticity in FEM.

According to the results of the tests, it can be concluded that FEM is the best model to analyse the relationship among GDP, palm oil production, rubber production, and orange production. The FEM after backward elimination can be seen in the Table 2.

Table 1. Multicollinierity Test

Independent Variables	VIF
x_1	1,302
x_2	1,396
x_3	1,341

Table 2 FEM after Backward Elimination

Variable	Coefficient	t-Statistic	Prob
C	2315365	21.28027	0.0000
X1	5.861956	3.823540	0.0006
Fixed Effects (Cross)			
Sanggau-C	107.5346		
Sintang-C	25.06422		
C-C	770.7759		
Sambas-C	-228.9822		
Bengkayang-C	-674.3925		
R-squared	0.969172		
Adjusted R-Squared	0.962793		

Table 3. FEM for Five Districts in West Kalimantan

District	Estimation of GDP
Sanggau	$2604935{,}7 + 5{,}861956x_1$
Sintang	$1643582{,}1 + 5{,}861956x_1$
Sambas	$3362448 + 5{,}861956x_1$
Ketapang	$3148601{,}1 + 5{,}861956x_1$
Bengkayang	$1381593{,}6 + 5{,}861956x_1$
Landak	$1751029{,}6 + 5{,}861956x_1$

According to Table 2, FEM for this case with Adjusted R-squared 0.96 is written as follows

$$\hat{y}_{it} = 2315365 + 5{,}861956x_1 \quad (6)$$

Based on Table 2, palm oil production is the only one factor giving significant influence to the six district's GDP. Moreover, based on Table 2, it can be deduced that every rise of palm oil production as one ton will increase the GDP about 5,86196 million rupiahs. Furthermore, FEM can distinguish effect of every district, so estimation of GDP for six districts in West Kalimantan can be written as follows at Table 3.

According to the results, palm oil production of the six districts in West Kalimantan can give contribution to the GDP. Similarly, it can be concluded that palm oil plantation, in this case, can be considered as a tool to increase the community's prosperity.

4. Conclusion

According to the results, it can be deduced that only palm oil gives the positive contribution to GDP of Sanggau, Sintang, Sambas, Ketapang, Bengkayang, and Landak.

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