Analysis of Palm Oil Production, Export, and Government Consumption to Gross Domestic Product of Five Districts in West Kalimantan by Panel Regression

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Abstract. Gross Domestic Product (GDP) is an indicator of economic growth in a region. GDP is a panel data, which consists of cross-section and time series data. Meanwhile, panel regression is a tool which can be utilised to analyse panel data. There are three models in panel regression, namely Common Effect Model (CEM), Fixed Effect Model (FEM) and Random Effect Model (REM). The models will be chosen based on results of Chow Test, Hausman Test and Lagrange Multiplier Test. This research analyses palm oil about production, export, and government consumption to five district GDP are in West Kalimantan, namely Sanggau, Sintang, Sambas, Ketapang and Bengkayang by panel regression. Based on the results of analyses, it concluded that REM, which adjusted-determination-coefficient is 0,823, is the best model in this case. Also, according to the result, only Export and Government Consumption that influence GDP of the districts.

1. Introduction

Gross domestic product (GDP) considered as a measure of economic growth in a region. So that GDP has a prominent influence to Gross National Product of a country. Central Bureau of Statistics Republic of Indonesia (BPS) argued that West Kalimantan is on the 22 place out of 33 provinces in Indonesia. Meanwhile, West Kalimantan is the second biggest region in Indonesia that has been enriched by large natural resources as well as other areas in Indonesia.

Some researchers conducted several types of research that evaluated some aspects that can contribute to GDP. The first character, palm oil plantation, was done by [1] and [2]. [1] analysed effects of palm-oil- farm development to economic growth, regarding poverty alleviation of five districts, in Riau Province as a part of central of palm oil plantation development. According to this research, it concluded that palm oil plantation in the five districts produces both positive multiplier effect score and farm welfare index.

[2] evaluated impacts of palm oil plantation which was organised by Sarawak and Land Consolidation and Development Authority (SALCRA) to the prosperity of land owner community around SALCRA, namely Iban and Bidayuh community. They summed up that the palm oil plantation contributed to the increase of community income, infrastructure improvement such as roads, clean water providing, electricity and health services that improve the live quality of the community. In another research, there is analyse expansion policy of palm oil plantation in Sambas district due to community well-being from 2006 until 2011. Based on the recent studies, it deduced that there was an increase of 3.43% in Sambas's GDP each year.

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The second aspect, which has been evaluated giving influence to GDP by some researchers, is export. [3] analysed influence between infestation, labour force and export to GDP of Buleleng, a district in Bali Province by path analysis. The result of the research argued that those aspects, in this case, is export, was significantly influence Buleleng GDP.

The third issue that was considered to evaluate in this research is government consumption. The impact of government consumption to GDP has been examined by [4]. This study used panel regression and deduced that government use was significantly giving a positive contribution to district's GDP in Central Java Province.

Furthermore, panel regression has been used prominently to evaluate many cases in numerous journals such as [5], [6], [4], [7], [8], [9], [10], and [11]. Those journals will be utilised to study the methodology in analysis panel data.

In a nutshell, there is some evidence that palm oil plantation (in this case is palm oil production), export, and government consumption fosters GDP in other districts in Indonesia. Therefore, this paper aims to analyse the relationship between those factors and five-district GDP in West Kalimantan, namely Sanggau, Sintang, Sambas, Ketapang and Bengkayang by panel regression. This research attempted to analyse district-level data of those factors from 2007 to 2013 [12].

2. Panel Regression

A longitudinal or panel data set is a combination of cross section and time series data. Panel data provides multiple observations on each in the sample over time. Meanwhile, a regression model utilised to analyse panel data is called by panel regression model [13]. Besides, a panel regression model offers advantages over conventional cross section or time series data set. Some benefits of a panel regression model are [14].

1. It could be more accurate to estimate parameters of a model. It is caused by a large number of data points and increases the degrees of freedom on it. Besides, data panel also can decrease the collinearity among independent variables.
2. It can simplify computation and statistical inference. In normal condition, calculation of panel regression estimator or inference could be more complicated rather than estimator based on either cross-sectional or time series data. However, in the case of nonstationary time series analysis which the large sample approximation of the distributions of least square or maximum likelihood estimators is not longer normally distributed. Nevertheless, using panel data, researchers can invoke central limit theorem across cross section units to denote that limiting distributions of various estimators remain asymptotically normal.

[15] stated that a panel regression model (PRM) is different from both regular time series and cross section regression model.

A PRM

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

Where y_{it} is the dependent variable, x_{it} is the independent variable, and ε_{it} is the error term, uncorrelated with x_{it}, with mean zero and constant variance σ_ε^2. Besides, 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.

Moreover, [15] asserted that panel regression model focus on how controlling the impact of unobserved heterogeneity for getting valid inference on β_{it}. For example, in a linear regression model, suppose unobserved heterogeneity is individual specific and time invariant. So that, the individual specific effect on y_{it} could either be invariant with the x_{it} or interact with x_{it}. In this case, (1) can be written as

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

The parameters α_i^* and β_i can be different from the various cross-sectional units, even though both of them 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 utilised to estimate (3) as follows [14]

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

Three models can be chosen to obtain estimators in panel regression, namely Common Effect Model, Fixed Effect Model, and Random Effect Model. Those types explained as follows:

1. Common Effect Model (CEM)
   CEM was written as (3) where the regression parameters estimated by Least Square. Cross section data and time series in CEM data are united and considered as one whole observation.
2. Fixed Effect Model (FEM)
   [14] stated that FEM written as
   $$y_{it} = \alpha_i^* + \boldsymbol{\beta} x_{it}' + \varepsilon_{it}, \qquad i = 1,2,\dots,N; \ t = 1,2,\dots,T \tag{4}$$
   In FEM, α_i^* vary over individuals. In this research, FEM assumes that there are no time-specific effects.
3. Random Effect Model (REM)
   REM wrote as (1), but α_{it} is considered as a random variable with the expectation α_0 so that $\alpha_i^* = \alpha_0 + \varepsilon_i$. Consequently, REM expressed as
   $$y_{it} = \alpha_0 + \beta_{it}x_{it} + w_{it} \tag{5}$$
   where $w_{it} = \varepsilon_i + \varepsilon_{it}$.

Usage panel regression to analyse independent variables and dependent variables involve some statistical tests. Those are Chow Test, Hausman Test and also Lagrange Multiplier Test. Chow test is a test that utilised to select, which one is better between CEM and FEM. Meanwhile, Hausman Test is carried out to analyse whether or not the existence of random effect in the model. On the other hand, Lagrange Multiplier Test will be conducted to choose between CEM and REM that is better to use in analyse panel regression. Those tests can be studied extensively from [9], [15], [14] and [13].

3. Analysis And Result

In this section, panel regression will be applied to analyse palm oil production, export, and government consumption, that are considered giving an influence to GDP of the five districts in West Kalimantan. For simplification reason, the variables in this research namely export, government consumption, and palm oil production successively are symbolised by x_1, x_2, and x_3.

Firstly, Chow Test was done to evaluate which one is better between CEM and FEM to use in modelling panel data. Chow Test showed that F-calculated is 181.43, which is more than F-table with $\alpha = 5\%$, 2,82. So that, it can be concluded that FEM is a better model to use rather than CEM.

After Chow Test, Hausman Test is conducted to examine whether there is a random effect or not in the model. According to Hausman Test's result, REM is a better model than FEM. It is shown by chi-square statistics at 6.065 which is bigger than chi-square table, with degrees of freedom 3 and $\alpha = 5\%$, at 7.814.

Next, at the third step, to make sure the results of the first and the second phase, Lagrange Multiplier Test was executed. Lagrange Multiplier Test deduced that REM is the best model to analyse the panel data due to LM-calculated, 59.94493, that is bigger than a value of chi-square table with degrees of freedom 3 and $\alpha = 5\%$, 7.814.

According to the three test results, it concluded that REM is the best model rather than CEM and FEM. The result shows that palm oil production does not significantly influence the five district's GDP so that by backwards elimination, palm oil production variable x_3 eliminated. Moreover, the evidence for the best REM can be seen in Table 1 as follows.

Table 1. REM after Backwards Elimination

Variable	Coefficient	t-Statistic	Prob
C	574.0381	2.193829	0.0370
X1	0.849075	2.702087	0.0118
X2	6.175591	7.810495	0.0000

Random Effects (Cross)	
Sanggau-C	107.5346
Sintang-C	25.06422
C-C	770.7759
Sambas-C	-228.9822
Bengkayang-C	-674.3925
Weighted Statistics	
R-squared	0.836099
Adjusted R-Squared	0.823958

According to Table 1, REM for this case with Adjusted R-squared 0.824 written as follows

$$\hat{y}_{it} = 574.0381 + 0.8490x_1 + 6.1756x_2 \qquad (6)$$

Parameter estimation using REM utilise Generalised Least Square (GLS). Consequently, the estimators are robust from heteroscedasticity and autocorrelation problems. Moreover, based on Table 1, it can be deduced that every rise of export as one billion rupiahs will increase the GDP about 849 million rupiahs. Furthermore, each increase of government consumption as one billion rupiahs, it can contribute rising of the GDP approximately 6.175 million rupiahs.

REM can distinguish effect of every district by error component, so estimation of GDP for five areas in West Kalimantan written as follows at Table 2

Table 2. REM for Five Districts in West Kalimantan

District	Estimation of GDP
Sanggau	$681,572 + 0.849075x_1 + 6.175591x_2$
Sintang	$25,064 + 0.849075x_1 + 6.175591x_2$
Sambas	$770,775 + 0.849075x_1 + 6.175591x_2$
Ketapang	$345,055 + 0.849075x_1 + 6.175591x_2$
Bengkayang	$-674,393 + 0.849075x_1 + 6.175591x_2$

The interpretation of Table 2 is analogue with the analysis in the previous table.
According to the results, palm oil production of the five districts in West Kalimantan cannot give a contribution to the GDP. Similarly, it concluded that palm oil plantation, in this case, cannot be considered as a tool to increase the community's prosperity. Some researchers reported that palm oil plantation donates adverse effects for both the environment and also the community nearby the farm areas. The negative effects of palm oil plantation were reported by [16] and [17].

4. Conclusion
According to the results, it summarised that export and government consumption indicate the positive contribution to GDP of Sanggau, Sintang, Sambas, Ketapang and Bengkayang. Meanwhile, palm oil production is not significantly giving impact to the GDP.

Acknowledgments

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