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Abstract

The objective of this study to investigate the long and short-term relationship between *economic growth, human capital, and agriculture sector in Indonesia. In addition, to analyze the interrelationship between economic growth and agriculture added value. The data used is time series data in the period 1985-2017 obtained world development indicators from the World Bank database. The analytical approach used is of causality with the vector error correction model* **(***VECM) and simultaneous equations model with two-stage least square (2SLS). The finding of this study, first, in agricultural added value equation indicates the validity of the long and short-term equilibrium relationship between variables, there is long and short-term causality in the direction of economic growth, human capital for agriculture added value; second, the finding in the economic growth model indicates that human capital, agriculture added value, population, government expenditure, foreign direct investment, non-agricultural added value, and technology has positive sign and significant effect on the economic growth; third, the finding in the agriculture added value model indicates that human capital, economic growth, government expenditure, rural population, and technology has positive and significant effect on agricultural added value. Meanwhile, non-agricultural added value has a negative sign and significant effect on agriculture added value.*

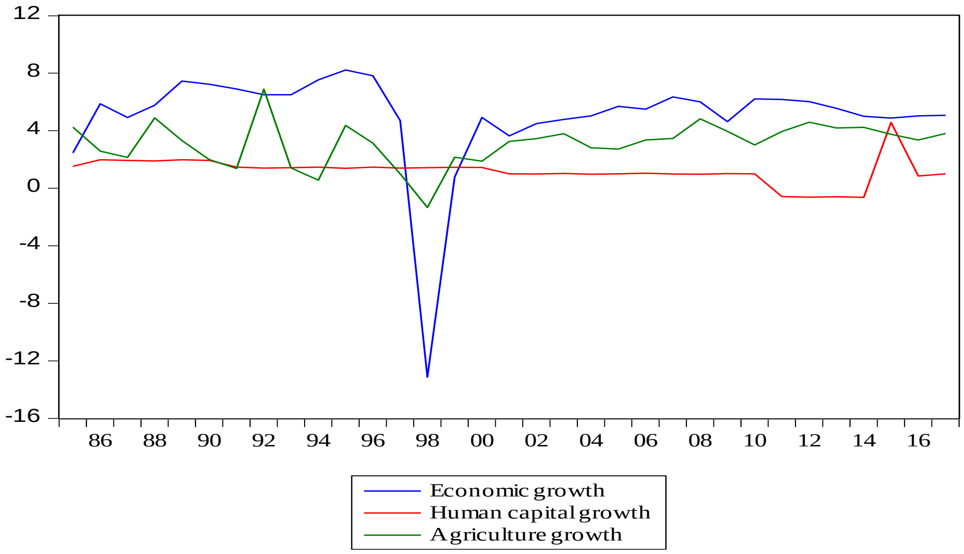
Keywords: e*conomic growth, human capital, agriculture sector, non-agriculture sector, VECM, 2SLS.*
JEL Classification: *C30; E24; O40; Q10*

1. Introduction

Economic development in Indonesia cannot be separated from the role of the agricultural sector. As an agricultural country, approximately 40% of Indonesia's population depend on agriculture. The agricultural sector has the role with regard to employment, food providers, and contributors of foreign exchange through exports, etcetera. Several studies have been conducted found that the agricultural sector is the engine of development (the engine of growth) both in terms of provision of raw materials and ingredients for food, as well as an input for products produced by other sectors (Apostolidou et al., 2014; Tiffin & Irz, 2006; Valdes, 1991). Naturally, the economic growth should be supported by the development of a strong agricultural sector both in terms of supply and demand side.

The government role in the agriculture sector is important with the aims order to avoid crises in the agricultural sector, therefore the government must intervene in the agricultural policy. The government role is also required to break the chains of the poverty cycle, it is a general overview of the interrelationships of some characteristics of developing countries, such as available natural resources has not been managed optimally. Indonesia populations livelihoods are mostly farmers, while current farmers conditions that are less productive because of economic dualism existence such as the modern sector in the system market economy and the traditional sector which follow the subsistence economy. In addition, the other problem is the high population growth rate to the quality of human resources is still relatively low.

Government policies relating to the domestic production of a commodity which includes price and trafficking policy input and output are in principle intended to strengthen or improve the competitiveness of the commodity in question in the domestic market (Azwardi et al., 2016). This should be undertaken so that domestic producers are encouraged to utilize domestic resources intensively, so expect the producers concerned can operate with a higher added value than ever before.



Source: World Bank, World Development Indicators, 2018 (processed)

Figure 1. Trend of Economic Growth, Human Capital & Agriculture in Indonesia (%), 1985-2017

The role of the agricultural sector in Indonesia is reflected in the added value contribution to the gross domestic product (GDP) with an average of 16.39% in the period 1985-2017. The contribution of the agricultural sector in Indonesia is still relatively higher than in other sectors, in Figure 1 shows the trend of economic growth and agricultural added value. The average economic growth during 1985-2017 at 4.99%, and the average growth of human capital index at 1.20%, while the average growth of agricultural added value at 3.13%. Nevertheless, their growth is still positive. This indicates that the growth of the human capital and agriculture added value grow slower than economic growth.

Several previous studies state that between agriculture and economic growth has the relationship, meanwhile, there is also the opinion that the agricultural sector does not seem to be a major force in influencing the economic growth (Gardner, 2005). However, the World Development Report by the World Bank (2007) shows that the country economy based on the agriculture sector could be a major engine of growth, whereas, in developed countries is already doing the agriculture transformation, this sector has been considered less important in driving economic activity, but still the main instrument for reducing poverty in rural areas.

The empirical approach to evaluate the impact of agriculture on economic growth beneficial to developing endogenous growth theory by incorporating the potential contribution of agriculture (Barro & Sala-i-Martin, 2004; Botrić, 2013). This approach was tested empirically by Hwa (1988) results prove that the agricultural sector is beneficial only for non-agricultural growth because most of the agricultural sector development depends on providing modern input and technology of the industrial sector.

Many empirical studies establish a correlation between the agricultural sector and economic growth, and the results are by no means have a two-way causality. But when both sectors have grown independently or as a result of the growth of other sectors that are public, then the observed correlation may not be beneficial. For this reason, some researchers believe that there is a correlation effect of the agricultural sector to economic growth, and ultimately endogenity problem in empirical study can be completed. The effects of agricultural growth on economic growth proves that in developing countries increase of agricultural GDP causes of non-agricultural GDP growth, but there is not related to the case in developed countries (Bravo-ortega & Lederman, 2005). On the other hand, the relationship between the agricultural value added per worker and GDP per capita to provide proof that the added value of agricultural GDP to be the cause of economic growth in developing countries (Tiffin & Irz, 2006). While developed countries do not have a clear relationship, except countries that have a competitive advantage in the agricultural sector.

Similarly, the linkages between the agricultural sector to the economic growth has the impact on the expansion of manufacturing output and can lead to negative agricultural growth in the short term, because there is competition between sectors for resources (Gemmell, Lloyd, & Mathew, 2000). Meanwhile, the agricultural growth that is positive in the long term due to the growth in the manufacturing sector also has an impact on the agricultural sector (Shifa, 2015). By contrast, growth in the agricultural sector does not affect other economic sectors. This resulted in the growth of the manufacturing sector will stimulate demand for agricultural commodities and new technology will provide input to the agriculture sector (Cervantes-godoy & Dewbre, 2010). Furthermore, several studies that determine the relationship between agriculture and economic growth in proving that there is a relationship in the short term and long term of the added value of agriculture to real GDP per capita (Samimi & Khyareh, 2012). Other results show that GDP per capita also lead to increased agricultural added value in the short term (McArthur & McCord, 2017).

On the other side, the increase of economic growth and agriculture sector in Indonesia cannot be separated from the role of human capital. In this case, the government has an important role in providing education and information services to farmers in the use of new technology and innovation to improve production. Likewise, the welfare of farmers and the agricultural sector added value will increase. Meanwhile, several studies also have to investigate the relationship between human capital and economic growth, because human capital also recognized as the principal indicators of economic development. The impact of human capital on the economic growth gained prominence in the literature. It is becoming increasingly important to investigate about the effect of the good public health system and education on the economic growth of countries around the globe (Alataş & Çakir, 2016; and Imran et al., 2012).

The main objective of this study was to identify the relationship between economic growth, human capital and agriculture added value in Indonesia. In this context, the study also examines interrelationship the agriculture added value and economic growth in Indonesia, it is expected to describe more about the importance of agriculture added value and economic growth in Indonesia. This study is expected to contribute, first, expected to provide an empirical analysis of the relationship between economic growth, human capital, and agriculture added value in Indonesia; second, for the improvement of government policy implications for the agricultural sector and economic growth; and third, to the knowledge and development of endogenous growth theories and economic development in Indonesia.

2. Literature Review

The main objective of this study was to the relationship between economic growth, human capital, and agriculture added value and investigated the determinant of economic growth and agriculture added value in Indonesia. Currently the agricultural sector and export of primary commodities have become the main driver for economic growth in Indonesia. On the other hand, GDP per capita in Indonesia increased significantly, but the country is still classified as low-income countries in the world (World Bank, 2016). Several studies, using analysis of cross-country effects of agriculture and non-agriculture, support the argument that enhancement the agricultural sector will boost economic growth and human development, thus reducing poverty (Christiaensen, Demery, & Kuhl, 2011; Diao, Hazell, Resnick, & Thurlow, 2007).

As well as study conducted by Garner (2006), which explores the growing trend of African countries, the observations show that Africa has a poor economic performance as a result of economic policy and other factors such as low investment levels. Fabrizio & Valdés (2006) suggest three policies to boost agricultural productivity and reduce poverty by the labor market policy, the farmer's income, and food price.

Some debate the experts stated that poverty reduction is not effective if it only depends on the growth of the sector, but should be encouraged also economic performance in other sectors. On the other hand, the growth of the agricultural sector is more dominant for poverty reduction than growth in other sectors (Christiaensen et al., 2011). Similarly, a study conducted by Irz et al., (2001) used cross-country estimation models to investigate the impact of agricultural growth on poverty eradication. The researchers looked at the relationship value-added agriculture to economic growth and poverty reduction. The results of large studies conducted by experts showed a strong relationship between increasing agricultural productivity to poverty reduction.

Some empirical approach to test the argument that the change in agricultural growth not only affect the economic sectors of agriculture but also affects the rural and national economy. Thirtle, Lin, & Piesse (2003) used the same model and show that R&D investments in agricultural can lead to value-added agriculture is big enough to give effect to the price which is quite satisfactory in the agricultural sector, and an increase in agricultural productivity has profound effects on poverty reduction. Therefore, in this study, trying to evaluate the effects of agricultural productivity is the value-added agriculture, together with market linkages in other sectors to economic growth and human development.

Several previous studies investigating the fundamental factors affecting economic growth and human development using the development of the Solow growth model among other studies conducted by Ding & Knight (2009); Hoeffler (2002); Ndambiri et al. (2012); Nkurunziza & Bates (2003); and Ramsey (2005). Regarding the debate about whether the development of the Solow growth model can affect the growth of specific regions, more specifically to the case of Africa, according to study results by Hoeffler (2002) found that the performance of poor countries in Africa can be fully accounted for by using Solow growth model development. Indeed, the effect, particularly against the state, cannot be observed, but the development of the Solow Growth Model can explain economic growth in African countries. Correspondingly, Ding & Knight (2009) stated that the increase in economic growth in China in line with the Solow Growth Model. Although the review of the literature still generally sees the impact of economic growth on poverty reduction.

The concept of Human capital has the role in economic growth and development because human beings occupy the production center, distribution, and consumption chain (Penda, 2012; Šlaus & Jacobs, 2011; Son, 2010). The macroeconomic perspective, the accumulation of human capital productivity, technological innovations, increases returns to capital and makes growth in agriculture more sustainable (Penda, 2012; Son, 2010). The productive workforce in Indonesia agriculture needs to be replaced by young educated farmers that will introduce innovation and modernity in agricultural practices. Education is essential as the supplier of trained manpower and a prerequisite to accomplishing entrepreneurial goals (Kayode, Kajang, & Anyio, 2013; Penda, 2012). Agricultural ventures must be attractive, profitable and sustainable to induce economic growth (Penda, 2012). These major attributes can be achieved through scientific study to develop quality inputs, improve agronomic practices and develop good management skills (Fan et al., 2012; Penda, 2012). Likewise, agricultural information services should be upgraded to provide the education needed to modernize production practices and perception of agriculture as a provider of home food to be a feasible business opportunity (Chapman & Tripp, 2003; Penda, 2012).

Inabilities to increasing added value in the agricultural sector due to most of the population in low-income countries cannot be generated sufficient revenues regularly (Economic Report on Africa, 2013). Moreover, without a solid foundation to enhance the productive activities that lead to the opportunity to earn a decent wage, efforts for poverty alleviation, human capital development, it will remain useless. However, several studies have more analyze the role of agricultural added value to economic growth in high and medium income countries. The focus of study in the future will come is the ASEAN countries such as Indonesia, it is important because Indonesia still has limited technological resources, agriculture is still traditional, and the other side of the output of these farmers is one of foreign exchange earnings for the country. Therefore, the objective of this study to investigate the role of agriculture added value to economic growth.

3. Research Method

The scope of this study used variable economic growth, agriculture added value, human capital index, foreign direct investment, gross capital formation, agriculture labor, population, government spending, value-added in other sectors such as industry and services, rural population, technology. As for the data description used in the study as follows:

Table 1. Data and Source

Description	Unit	Source
GDP per capita (y)	(US$, constant 2010)	WDI, 2018
Agriculture added value (vag)	(US$, constant 2010)	WDI, 2018
Human capital (hc) (Barro & Lee, 2013)	index	FRED, 2018
Gross Capital Stock (k)	(US$, constant 2010)	WDI, 2018
Population (pop)	person	WDI, 2018
Labor of agriculture (l)	person	WDI, 2018
Labor force (labor)	person	WDI, 2018
Government spending (goe)	(US$, constant 2010)	WDI, 2018
Foreign direct investment (fdi)	(BoP, US$, current 2010)	WDI, 2018
Non-agriculture added value (nonag)	(US$, constant 2010)	WDI, 2018
Rural population (rurpop)	person	WDI, 2018
Technology (tech)	proxy with time trend (year)	-

Source: World Bank (2018), (FRED, 2018)

The scope of this study in Indonesia and subject of this study is economic growth, human capital, and agriculture added value. The data used in this study is time series data, the observation period 1985-2017. Sources of data obtained from the database World Bank (2018) using data world development indicators (WDI).

3.1. Unit Root Test

Stages in testing the relationship between agriculture, human capital, and economic growth. we study the stationary properties of time series, in testing this stationary has many criteria, one of the most popularized is the Augmented Dickey-Fuller test, this testing was popularized by Dickey & Fuller (1979) and this article also using this test. The general equation is presented as follow:

$$\Delta X_t = \alpha + \rho t + \beta X_{t-1} + \sum_{i=1}^{k-1} \gamma_i \Delta X_{t-1} + \varepsilon_t \quad (1)$$

Where: X_t is the vector of the main endogenous variables in the study of agriculture added value, human capital and economic growth.

The unit root test of assumes that the accuracy of α parameter is identical across the passage (i.e. $\alpha = \beta$ for all i), whereas the order of lag α can freely vary. This procedure tests the null hypothesis α=0 for all i against the alternative hypothesis α<0 for all i. The rejection of the null hypothesis shows the possibility of continuing the process of integration of time series data and vice versa. Acceptance of alternative hypotheses enables individual series to be integrated. The unit root test can be estimated on the data of level and for the first difference in the form of natural logarithms.

3.2. Johansen Co-Integration Test

Empirically, this study focus on the causal impact of agriculture added value, the human capital on economic growth in Indonesia, the present paper attempts to use the Johansen maximum likelihood co-integration test (Johansen, 1988) to determine long-run relationships among the variables being investigated. In examining causality, the Granger causality analysis is also performed. In order to obtain good results from the test, selecting the optimal lag length is so important. The Johansen co-integration framework takes its starting point in the vector error correction model (VECM), as for the equation can be presented as follow:

$$x_t = A_1 x_{t-p} + \ldots + A_p x_{t-p} + By_t + \varepsilon\_t, \quad (2)$$

Where: x_t is a vector of endogenous variables and A represents the autoregressive matrices. y_t is the deterministic vector and B represents the parameter matrices. ε_t is a vector of innovations and p is the lag length.

3.3. Granger Causality Using the Vector Error Correction Model

The VEC model expected can identify the long-run relationship among the series under study, the Johansen co-integration test must be done. However, the test does not indicate anything about the direction of causality among the variables in the system; therefore, the Granger causality analysis must be done. If the series are co-integrated, the VECM-based Granger causality analysis is an appropriate technique used to determine the long-run and the short-run relationships (Engle & Granger, 1987) as presented as follows:

$$\Delta\ln\ (y)_t = \beta_{1,t} + \sum_{i=1}^{n-1} \beta_{11,j}\, \Delta\ln(y)_{t-i} + \sum_{i=1}^{n-1} \beta_{12,j}\, \Delta\ln(hc)_{t-i} + \sum_{i=1}^{n-1} \beta_{13,j}\, \Delta\ln(vag)_{t-i} + \delta_1 EC_{t-1} + \mu_{1t} \quad (3)$$

$$\Delta\ln(hc)_t = \beta_{2,t} + \sum_{i=1}^{n-1} \beta_{21,j}\, \Delta\ln(y)_{t-i} + \sum_{i=1}^{n-1} \beta_{22,j}\, \Delta\ln(hc)_{t-i} + \sum_{i=1}^{n-1} \beta_{23,j}\, \Delta\ln(vag)_{t-i} + \delta_2 EC_{t-1} + \mu_{2t} \quad (4)$$

$$\Delta\ln(vag)_t = \beta_{3,t} + \sum_{i=1}^{n-1} \beta_{31,j}\, \Delta\ln(y)_{t-i} + \sum_{i=1}^{n-1} \beta_{32,j}\, \Delta\ln(vag)_{t-i} + \sum_{i=1}^{n-1} \beta_{33,j}\, \Delta\ln(hc)_{t-i} + \delta_3 EC_{t-1} + \mu_{3t} \quad (5)$$

where: the notation of ln(vag), ln(hc), and ln(y) denote the natural logarithms of agriculture added value, human capital index, and real GDP per capita, respectively. Our main focus is on the first model. The coefficients of the EC_{t-1} term indicate causality in the long run and the joint F-test of the coefficients of the first-differenced independent variables confirms short-run causality. The symbol Δ denotes the first-difference operator. μ_{1t}, $\mu_{2t,}$ and μ_{3t} are the stationary disturbance terms for Equations (4) and (5), respectively. n is the order of the VAR, which is translated into a lag of n-1 in the error correction mechanism. In this study, the short-run causality is determined through the Wald test of the joint significance of lags of the independent variables, which is known as Granger causality test based on vector error correction model.

3.4. Simultaneous Equations Model

The analytical method used the quantitative approach with an econometric model that was developed from the economic growth model Solow (1956) with estimation methods the two-stage least square (2SLS). As for model used in this study to refers of study has conducted by Bloom, Canning, & Sevilla (2004); Hourizene & Wilson (2017); Mangeloja (1994); and Thirtle et al. (2003). The models in this study were initially based on the Solow growth model (Solow, 1956), which is in accordance with the formulation of study in the sense that there is an effect of agricultural inputs to economic growth. The basic model starts from the neoclassical growth model as follows:

$$Y_{(t)} = F\ (K_{(t)}, L_{(t)}, A_{(t)}) \tag{6}$$

Based on the interest in this study, Y is the gross domestic product (GDP); A is the level of technology, which is shown by the trend of the time (Solow, 1957); K is capital or shares, and L is the amount of labor. According to the Solow growth model, it is more appropriately used for output per worker instead of output per capita because not everyone in the country to contribute to output growth (Solow, 1956). Therefore, to get all the variables in the model expressed in terms of each worker, by dividing each side of the previous equation for labor (L). Thus, equation (7) obtained are as follows:

$$\frac{Y}{L} = f\left(\frac{A}{L}, \frac{K}{L}, \frac{L}{L}\right) \tag{7}$$

Furthermore, the model in equation (8) becomes:

$$y = a\ k^{\alpha}\ h^{\beta}(vag)^{(1-\alpha-\beta)} \tag{8}$$

The agriculture added value per worker (vag) incorporated in the model based on the assumption that these variables contribute to growth. In this version of the Solow model development, investment in human capital (hc) is an important explanatory variable in the model of growth. However, investment in human capital is not a proxy of the total school population but uses an index developed by Barro & Lee (2013), using an index of human capital per person. This index is calculated based on the school year and return to education (Psacharopoulos, 1994). The producer is assumed to be able to absorb new technologies and methods or to use it in the production process in order to increase agricultural growth and overall.

The empirical growth model, coupled with the human capital index and the contribution of value-added agriculture, in the form of other equations are as follows:

$$\mathrm{y_t} = \alpha_0 + \alpha_1 \mathrm{h_t} + \alpha_2 \mathrm{vag_t} + \mathrm{e_r} \tag{9}$$

with: $\gamma = 1 - \alpha - \beta$,

Where: the symbol (hc) is human capital index; and the symbol (vag) is the contribution of agriculture value-added per worker. Another potential variable is an important factor for economic growth as in the study conducted by Bloom et al. (2004); Christiaensen & Demery (2007); Fan, Hazell, & Thorat (2000); Thirtle et al. (2003); Soebyakto & Bashir (2017) include the population growth rate (pop), government spending (goe), trade openness (open), foreign direct investment (fdi), and non-agricultural sector added value (nonag).

The method of estimation 2SLS allows avoiding the problems of violations of the assumptions that occur if there is a correlation between the error terms and the independent variable, and other assumptions such as multicollinearity, heteroscedasticity, and autocorrelation. Several previous studies using 2SLS estimation techniques, among others; Anderson & Bruckner (2012) that estimate the empirical growth model. Bahmani-Oskooee & Niroomand (1999); Fakhr (2008) using the same estimation techniques to test the model of growth and social development. This study uses a model of simultaneous equations, as for the economic growth model and agriculture added value is presented as follows:

$$\text{lny} = f(\text{lnhc}, \text{lnvag}, \text{lnk}, \text{lnl}, \text{lntech}, \text{lnpop}, \text{lngoe}, \text{lnfdi}, \text{lnnonag}, \text{lny}_{t-1}) \quad (10)$$

All variables are likely to be transformed into a logarithm is as follows:

$$\ln y_t = \alpha_0 + \alpha_1 \text{lnhc}_t + \alpha_2 \text{lnvag}_t + \alpha_3 \text{lnk}_t + \alpha_4 \text{lnl}_t + \alpha_5 \text{lnpop}_t + \alpha_6 \text{lngoe}_t + \alpha_7 \text{lnfdi}_t + \alpha_8 \text{lnnonag}_t + \alpha_9 \text{lntech}_t + \alpha_{10} \text{lny}_{t-1} + \mu_{1t} \quad (11)$$

As the description mentioned in the introduction, the final dimension of this study is expected to assess the effect of human capital to agriculture added value. Generally, the model estimation is done using two-stage least square (2SLS) to determinants of agriculture added value. Human capital index (hc) measured by the approach using by Barro & Lee (2013) and became a dependent variable in the econometric model. Furthermore, the agriculture added value models can that is presented as follows:

$$\text{lnvag} = f(\text{lnhc}, \text{lny}, \text{lnk}, \text{lnl}, \text{lntech}, \text{lnrurpop}, \text{lngoe}, \text{lnopen}, \text{lnnonag}, \text{lnvag}_{t-1}) \quad (12)$$

All variables are likely to be transformed into a logarithm is as follows:

$$\text{lnvag}_t = \gamma_0 + \gamma_1 \text{lnhc}_t + \gamma_2 \text{lny}_t + \gamma_3 \text{lnk}_t + \gamma_4 \text{lnl}_t + \gamma_5 \text{lntech}_t + \gamma_6 \text{lnrurpop}_t + \gamma_7 \text{lngoe}_t + \gamma_8 \text{lnopen}_t + \gamma_9 \text{lnnonag}_t + \gamma_{10} \text{lnvag}_{t-1} + \mu_{2t} \quad (13)$$

The general procedure to be followed in determining the identification from any structure equation and the result from that identification shows that the two of structural model are over-identified equation so that it can proceed with the estimate using simultaneous equations system with estimation of two-stage least square (Gujarati, 2004).

4. Result and discussion

In this section, explaining some of the test results that have been done among other the empirical findings for the stationary test based on Augmented Dickey-Fuller test, the Johansen co-integration test, the Granger causality test based on the vector error correction model estimation, and the result of simultaneous equation model estimation using two-stage least square (2SLS).

Table 2. The Result of Unit Root Test: At First Differences

Variable	t-statistics ADF	ADF McKinnon Critical Value	Unit Root Test
Δ(lny)	-4.065769	-3.661661 -2.960411 -2.619160	*stationary
Δ(lnvag)	-4.585416	-3.661661 -2.960411 -2.619160	*stationary
Δ(lnhc)	-9.794175	-3.699871 -2.976263 -2.627420	**stationary

Note: stationary at sign: *first differences: Max-lag =8, **2nd differences: Max-lag = 8, Test critical values at 1% level

Table 2 shows the unit root test results using the ADF test at level shows that data is not stationary, meanwhile, after made adjustments with the first-order differentiation process shows that data stationary. The results are proved by compared with the critical value of McKinnon. If the ADF t-statistic value is less than the critical value of McKinnon, then the data is not stationary, and vice versa if the ADF t-statistic value is greater than the critical value of McKinnon, then the data is stationary. Unit root test at first difference result indicated that all variables which will be estimated in this study were stationary at 1% significance level (Table 2). This means that all variables in this study can be used for time series analysis and predefined VEC model equations.

Table 3 summarizes the results of co-integration analysis using Johansen's maximum likelihood approach using maximum eigenvalue and trace statistics. VAR = 1 is used in the Johansen estimation procedure. The estimation procedure assumes that there is no deterministic trend in the variable of agriculture added value (vag), human capital (hc), and economic growth (y), and also explains that the data generation process does not contain the term trend. Then a constant term is included in the estimate. Both produce evidence to reject the null hypothesis that the vectors co-integration to a zero degree for vector co-integration at a significance level of 5%.

Table 3. The **Result of Johansen Co-Integration Test**

Variable-variable: lny, lnhc, lnvag, VAR=1				
Trace test				
Null Hypothesized (H_0)	**Eigenvalue**	**Trace Stat**	**Critical Value 95%**	**Prob.****
r = 0	0.743285	56.66134	29.79707	0.0000
r < 1	0.487990	19.94701	15.49471	0.0100
Maximum Eigenvalue test				
Null Hypothesized (H_0)	**Eigenvalue**	**Max-Eigen Stat**	**Critical Value 95%**	**Prob.****
r = 0	0.743285	36.71433	21.13162	0.0002
r < 1	0.487990	18.07410	14.26460	0.0119

Source: Authors calculation
Notes: Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

On the basis of these results, the long-term relationship between agriculture added value, human capital and economic growth received statistical support in the case of Indonesia in the period 1985-2017. After testing that the variables are co-integration, the vector error correction model (VECM) can be applied. Residual lags of co-integrated regressions with appropriate amounts of lag are included in the Granger causality test structure. The lag length of the structure depends on the irreversible error correction model. Corrected error correction models pass through a series of diagnostic tests include serial correlation with the basis of inspection of the autocorrelation functions of residuals as well as the reported Lagrange multipliers.

Table 4, shows the VECM is sensitive to the selection of optimal lag length. Thus, the necessary lag length of agriculture added value (vag), human capital (hc) and economic growth (y) series is determined by Schwarz Information Criteria (SC) and it reveals the optimal lag length of five for the third model. Besides, the VECM result shows that the error correction term, ECT_{t-1} (0.31) in the third model (i.e. *VAG* equation) is positive and statistically significant at 1% level. This suggests the validity of long-run equilibrium relationship between the variables. It also implies that 31% of disequilibrium from the previous period's shock converges back to the long run equilibrium in the current period. In other words, there exists unidirectional long-run causality running from economic growth, human capital to agriculture added value.

Table 4. The result of vector error correction model to long-run causality

EC:	C	$\Delta(lny_{t-1})$	$\Delta(lnhc_{t-1})$	$\Delta(lnvag_{t-1})$	ECT_{t-1}	Summary
$\Delta(lny)$	-0.23	0.25	3.74	-1.15	-0.32	R^2: 0.73 Adj. R^2: 0.29 F-stat: 1.65 Akaike AIC: -3.68 Schwarz SC: -2.87
	-0.07	-0.46	-2.24	-1.50	-0.28	
	[-3.17]***	[0.54]	[1.67]*	[-0.77]	[-1.13]	
$\Delta(lnhc)$	0.01	-0.08	-0.01	0.32	0.05	R^2: 0.88 Adj. R^2: 0.69 F-stat: 4.55 Akaike AIC: -7.33 Schwarz SC: -6.52
	-0.01	-0.07	-0.36	-0.24	-0.05	
	[1.15]	[-1.09]	[-0.03]	[1.33]	[1.06]	
$\Delta(lnvag)$	0.01	0.48	2.01	-1.83	0.31	R^2 : 0.88 Adj. R^2: 0.69 F-stat: 4.60 Akaike AIC: -6.40 Schwarz SC: -5.58
	-0.02	-0.12	-0.58	-0.39	0.07	
	[0.35]	[4.07]***	[3.47]***	[-4.72]***	[4.30]***	

Source: Authors calculation
Note: Significant level at ***1%, **5%, and *10%

Meanwhile, the VECM results for first model (i.e. *Y* equation) showed the not presence of long-run equilibrium relationship between human capital, agriculture added value to economic growth. Similarly for the second model (i.e. *HC* equation) showed the not presence of long-run equilibrium relationship between agriculture added value, economic growth to human capital. This is evidenced from the value of ECT_{t-1} insignificant in the model. Once the long-run causality test between agriculture added value, human capital, and economic growth, we can also test whether the various lags of the independent variable can jointly influence the dependent variable or not. In other words, the short-run causal relation can also be tested among the dependent and past values of the independent variable jointly. It can be tested with the help of the Wald statistics test as presented in Table 5.

The next is the hypothesis-null test at the short run causality is that the past lags of the independent variable, i.e. agriculture added value, and human capital cannot jointly influence the value of the dependent variable, i.e. economic growth. If the probability value of Chi-square in the Wald Statistics is less than 0.05, the Null Hypothesis is rejected or vice versa. The same process is repeated for testing the short run causality between past lags of the independent variable, i.e. economic growth, agriculture added value and the dependent variable, i.e. human capital. Similarly, for testing the short run causality between past lags of the independent variable, i.e. economic growth, human capital and the dependent variable, i.e. agriculture added value. The results of the short-run causality as presented in Table 5 as follow:

Table 5. The Result of Wald Tests to Short-run Causality

Dependent variable	Chi-sq & Prob.			Inference (short-run causality)
	Δ(lny$_{t-1}$)	**Δ(lnhc$_{t-1}$)**	**Δ(lnvag$_{t-1}$)**	
Δ(lny)	- -	4.478 0.483	15.710*** 0.008	Δ(lnhc) on Δ(lny): no short-run causality Δ(lnvag) on Δ(lny): short-run causality
Δ(lnhc)	5.930 0.313	- -	8.289 0.1410	Δ(lny) on Δ(lnhc): no short-run causality Δ(lnvag) on Δ(lnhc): no short-run causality
Δ(lnvag)	41.524*** 0.000	22.771*** 0.000	- -	Δ(lny) on Δ(lnvag): short-run causality Δ(lnhc) on Δ(lnvag): short-run causality

Note: Significant level at ***1%, **5%, and *10%
Source: Authors calculation

After testing the Wald statistics as shown in Table 5, it is confirmed that there is no short-run causality between economic growth and agriculture added value toward human capital. However, when the Wald statistics are tested shows that between economic growth and human capital to agriculture added value, it is confirmed that there exists short-run causality. The past lags of economic growth and human capital jointly impact the value-added of agriculture in the short run. Similarly, Wald statistics test between value-added of agriculture to economic growth. The past lags of agriculture added value impact the economic growth in the short run.

Table 6. The result of Granger Causality Tests

Null Hypothesis:	**Lag**	**F-Statistic**	**Prob.**
lnhc does not Granger Cause **lny** **lny** does not Granger Cause **lnhc**	5	0.37841 2.53904	0.8566 0.0684*
lnvag does not Granger Cause **lny** **lny** does not Granger Cause **lnvag**	5	2.97873 4.87159	0.0413** 0.0060***
lnvag does not Granger Cause **lnhc** **lnhc** does not Granger Cause **lnvag**	5	4.33218 0.24172	0.0100** 0.9383

Note: Significant level at ***1%, **5%, and *10%
Source: Authors calculation

To ensure there is any the causality between economic growth, human capital, and agriculture added value, we can use another alternative approach that is Granger causality test. The estimation results reject the hypothesis of causality relationship between these variables (Table 6). Empirically, the estimation result explains that the unidirectional relationship between human capital toward economic growth at significant level 10%. It means an increase in the human capital leads to economic growth increases. These results are well supported by the previous studies conducted by Ali, Egbetokun, & Memon (2018); and Sulaiman et al., (2015). Similarly, the relationship between human capital and agriculture added value has relation unidirectional, where human capital increase will be pushed agriculture added value increase at significant level 5%. These findings also in line with the result of the study by Bleakley (2013); and Djomo & Sikod (2012).

Meanwhile, for the relationship between agriculture added value and economic has a bidirectional relationship at significant level 1% and 5%, which indicates that both have the causal relationship, which means agriculture added value has the dominant role in push economic growth. Similarly, economic growth will agriculture added value increase. These findings confirm the results of study conducted by Anderson & Bruckner (2012); Apostolidou et al. (2014); Odetola & Etumnu (2013); and Tiffin & Irz (2006).

After detecting the relationship between economic growth, human capital, and agriculture added value, we then tried to analyze the factors affecting economic growth and agricultural value added using a simultaneous equation system approach. In Table 7, we can see the estimation result using two-stage least square (2SLS), the result of the economic growth model shows that human capital and the agriculture added value showed a positive sign and significantly influenced the economic growth at significant level 5%, this was in line with the estimation result Granger with VECM which has been tested before this proof clearly confirms the results of previous study, that human capital and agriculture added value are the engine of growth of the economy (Alataş & Çakir, 2016; Djomo & Sikod, 2012). The findings are in line with the results of the study that has been done by Alataş & Çakir (2016); Djomo & Sikod (2012); Apostolidou et al. (2014); and Tiffin & Irz (2006).

Table 7. The Result of Model Estimation

Variable	Descriptions	Model lny	Model lnvag
c	constant	25.82274*** (5.432690)	7.054155 (8.487900)
lnhc	Human capital	0.119536** (0.053710)	0.452967** (0.193637)
lnvag	Agriculture added value	0.266882*** (0.042571)	-
lnl	Labor total	0.039368 (0.023519)	-
lnpop	Population	2.427534*** (0.313340)	-
lny(-1)	Lag economic growth	0.064065*** (0.018905)	-
lnk	Gross capital formation	0.001098 (0.016245)	0.032292 (0.062212)
lngoe	Government spending	0.055598*** (0.011781)	0.130588*** (0.070155)
lnfdi	Foreign direct investment	0.001538** (0.000686)	0.029027 (0.026928)
lnnonag	Non agriculture added value	0.749526*** (0.040517)	-1.001006*** (0.234759)
lntech	Technology	0.015229*** (0.003678)	0.046917*** (0.011196)
lny	Economic growth	-	1.563648*** (0.320393)
lnlabor	Labor of agriculture	-	0.032292 (0.062212)
lnrurpop	Rural population	-	1.892256** (0.711558)
Lnvag(-1)	Lag agriculture added value	-	0.023032 (0.161475)
R-squared		0.999947	0.999427
Adjusted R-squared		0.999922	0.999155
F-statistic		39976.88	3665.226
Prob.(F-statistic)		0.000000	0.000000
J-statistic		0.000000	7.65E-23
Durbin-Watson stat		1.986063	2.292864

Source: Authors calculation
Note: Significant level at ***1%, and **5%

Meanwhile, other variables such as population, government expenditure, foreign direct investment, non-agricultural sector, and technology has positive sign and significant effect on economic growth. As the findings reveal that the population is one factor that plays an important role in economic growth this confirms the results of study that has been done by Easterlin (1967); Headey & Hoge (2009); and Peterson (2017). The findings indicate that the population is a dynamic balance factor, in which the population has two roles, the population is the subject and the object of development when population growth can be controlled, then the growth can be a driver of economic growth. However, when the amount is not controlled it will be a burden of development.

The next of government expenditure variables play an important role in economic growth, these findings are also in line with the results of study conducted by Wu, Tang, & Lin, (2010) and Chandio, Jiang, Rehman, Jingdong, & Dean (2016). Line with the study has been done by Pegkas (2015) this study also concluding that foreign direct investment positively contributes to economic growth, these findings could serve as the basis that the increase of FDI has significant effect on the increase of economic growth.

Similarly, the non-agricultural added value that has a positive and significant impact on economic growth, these findings also confirm the results of study that has been done by Hourizene & Wilson (2017) which if non-agricultural added value increases, it will drive an increase in economic growth. In the Solow growth model, asserting that technology has a positive role to increase the rate of economic growth, on the basis of these findings also proves that the use of technology will both promote economic growth in Indonesia, this finding is also in line with the results of study that has been done by Hourizene & Wilson (2017). While the economic growth lag variable used gives an answer that the variable is autoregressive, there is a time role of the variable. The previous economic growth became the basis for the perfecting of economic growth in the future.

Likewise, on the other hand, the agricultural value-added model shows that human capital and economic growth have a positive and significant effect on agricultural added value at significant level 5%. This finding also confirms the results of Granger's earlier estimates, which indicate that there is a one-way relationship between human capital to agricultural value added, while economic growth has a two-way relationship to agricultural value added, the findings also confirm the results of study that has been done by Alataş & Çakir (2016); Djomo & Sikod (2012); and Hourizene & Wilson (2017). The same findings also on government spending and technology that have a positive sign and significant effect on agricultural added value. These findings confirm the results of study that has been done by Hourizene & Wilson (2017) in the case of Sub-Saharan Africa.

While non-agricultural value added has a negative sign and a significant influence on agricultural added value, it indicates that there is a market linkage between agricultural added value and non-agricultural added value, these findings indicate that increasing non-agricultural added value will lead to a decrease in agricultural value added. This finding is in line with the results of study conducted by Hourizene & Wilson (2017). The next rural populations has positive sign and a significant influence on agricultural added value at significant level 5%, it indicating that increasing rural populations will encourage increased agricultural added value. This finding is in line with the results of study conducted by Cowan (2002) in the case of United States.

5. Conclusions

The conclusions in our study indicate that there is an error correction term (ECT_{t-1}) shown with a coefficient value of -0.31 in the third model (agricultural added value equation) is positive and statistically significant at 1% level. This indicates the validity of the long-term equilibrium relationship between variables. It also implies that 31% of the imbalance of the previous period shocks reunited into long-run equilibrium in the current period. In other words, there is long-term causality in the direction of economic growth, human capital for agriculture added value. Meanwhile, VECM results for the first model (economic growth equation) show no long-run equilibrium relationship between human capital, agricultural added value to economic growth. Similarly for the second model (human capital equation) shows no long-run equilibrium relationship between agricultural value added, economic growth on human capital. This is evidenced from the insignificant value of ECT_{t-1} in the model.

In addition, another finding of this study is short-term causality between past lags from independent variables, i.e. agricultural added value and human capital cannot jointly effect on economic growth, in other words only agricultural value-added has a short-term relationship on economic growth. Meanwhile, for short-term causality between past lags from independent variables, i.e. economic growth and agricultural added value not affect the dependent variable, i.e. human capital, in other words, it has no short-term relationship. In another side, for short-term causality between past lags from independent variables, i.e. economic growth and human capital to the dependent variable, i.e. agricultural added value jointly has an effect on agricultural added value, in other words between variables have a short-term relationship. Furthermore, the findings of this study indicate that the unidirectional causality of human capital towards economic growth and agricultural added value provides support for hypotheses that indicate that human capital development is at the high level in Indonesia over a period of time, has an impact on economic growth and agricultural added value which is increasing. Meanwhile, the relationship between economic growth and agricultural added value indicated bidirectional causality.

Other findings, in simultaneous equation models of economic growth, indicate that human capital variables, agricultural added value, population, lag of economic growth, government expenditure, foreign direct investment, non-agricultural added value, and technology jointly has significant effect on economic growth. Meanwhile, the agricultural added value model indicates that human capital, economic growth, government expenditure, non-agricultural added value, rural population, and technology variables has significant effect on agricultural added value. Empirically, the implications of the model used in this study are consistent which indicates that human capital is an exogenous variable in determining economic growth and agricultural value added. Meanwhile, economic growth and agricultural added value indicate that both of them has interrelationship with each other.

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