Comparison of the Effectiveness of Agricultural and Educational Policies in Indonesia, South Africa and the United States in Encouraging Agricultural Performance for National Food Security

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Abstract : This study compares the effectiveness of the Indonesian government's policies as one of the countries with the largest GDP in Southeast Asia, South Africa as one of the countries that has a fairly good economy on the African continent. And the United States is one of the countries that have the largest GDP in the Americas. We use quantitative research by conducting vector analysis on three key variables in employment and agriculture, namely the development of citizen human capital as indicated by education investment, Employment in agriculture and agriculture performance. We found that the accumulation of overall policies in general related to agriculture and education in the United States is effectively able to improve agricultural performance in the United States through investment in education that is still and has an impact on increasing the interest of Americans or people who work in the United States to work in the agricultural sector. In South Africa, the agricultural performance had increased very well but fell in 2008 and continued to decline as well as education investment which was also affected by a decline in education investment in South Africa. This indicates that agricultural income is getting worse due to a decrease in agricultural performance and an increase in employment in agriculture in South Africa. Indonesia, which is an agricultural country, is quite good at encouraging agricultural performance in Indonesia with the accumulation of policies taken by the Indonesian government related to agriculture and education. However, Employment in agriculture in Indonesia has decreased and this is very bad because if the younger generation is not interested in working in agriculture and the employment in agriculture graph in Indonesia continues to decline, there is a potential for the loss of this sector or a decline in agricultural performance due to a shortage of labor.

Keywords: Human Capital, Agriculture, Employment in Agriculture, Vector Analysis

JEL Classification : C01,E24,J24, J43

1 INTRODUCTION

Indonesia, with Southeast Asia's largest economy, has grown rapidly over the past decade, becoming a dynamic and decentralized electoral democracy with a fast-growing middle class. Indonesia has abundant fertile soil and is a major global producer of many tropical products, offering great prospects for smallholders. The emergence of the middle class results in a greater demand for diversified food products. However, millions of small farmers, agricultural workers, and fishermen are unable to take advantage of these opportunities due to their limited access to finance, services, and markets (Lim et al,2020).

South Africa has a highly developed economy and a developed economic infrastructure, making it the leading economy in Africa. South Africa continues to face rising public debt, the ineffectiveness of state-owned enterprises. and spending pressures, which have reduced the country's global competitiveness. In 2020, the South African economy collapsed due to the COVID-19 outbreak, resulting in a negative growth balance of 8%. According to the IMF's forecast for October 2020, growth will recover in 2021, at 3% of GDP, and stabilize in 2022 at 1.5%. In its latest World Economic Outlook report, the IMF revised its forecasts for South Africa's GDP growth, forecasting 2.8% in 2021 and 1.4% in 2022 (which is a difference from WTO forecasts) of -0.2% and -0. 1% each). The ANC government's post-COVID-19 crisis plans are based on the aggressive implementation of the Economic Recovery and Reconstruction Plan, which seeks to stimulate equitable and inclusive growth. The plan is based on mobilizing investment, creating new jobs, supporting current jobs, and accelerating industrialization. But also promote large-scale public investment in key sectors, and seek public-private partnerships (IMF,2021).

The agricultural sector is one of the cogs on which the functioning of the American economy is supported. Being a dynamic sector, it has been identified as one of the winners during the Covid-19 pandemic, because, although there was a quarantine order for most citizens, the consumption of fruits and vegetables not only remained but was an increase (Zhang et al,2021).

This study compares the effectiveness of the Indonesian government's policies as one of the countries with the largest GDP in Southeast Asia, South Africa as one of the countries that has a fairly good economy on the African continent. And the United States is one of the countries that have the largest GDP in the Americas. We use quantitative research by conducting vector analysis on three key variables in employment and agriculture, namely the development of citizen human capital as indicated by education investment, Employment in agriculture and agriculture performance.

2 LITERATURE REVIEW

Establishing the etymological origin of the word agriculture leads us to Latin because it is in that language that the starting point of the above is found. In particular, we can see that it comes from the word agriculture, which consists of a combination of two parts: the term agri, which is synonymous with "cultivating fields" and the concept of culture, which can be translated as "cultivation". or cultivated". So it can be said that agriculture is an effort to cultivate land. And the land is called agricultural land (Drean & Bawono,2021).

Education is one of the most influential factors for the progress and progress of people, society and the country, through it people acquire knowledge that they can apply in industry, which every day requires most of the trained people due to the rapidly accelerating scientific and technological changes. In particular, education should be considered as a work done between civil servants and society, but above all, it is an act of conscience and responsibility that must be taken by human beings to achieve economic growth as a country and achieve a better quality of life. Human resource education is considered as one of the most important factors in eradicating inequality, poverty, corruption, and illiteracy and consequently making people economically productive and competent in economic units (Mora,A.G.O & Afriani,2021).

Estimates of marginal welfare effects suggest that agricultural development has an important positive effect on national welfare, particularly in developing countries. Developing countries also benefit from agricultural growth, but non-agricultural production also has a marginal welfare effect, which is greater than that provided by agricultural activity. High-income industrialized countries derive positive marginal gains from their non-agricultural activities, but the agricultural effect is negative (Martey et al,2021).

3 RESEARCH OBJECTIVE AND METHODOLOGY

We derive an econometric model with a Vector Autoregressive approach that focuses on phenomena with the assumption that the autoregressive vector model does not differentiate between exogenous and endogenous variables. Therefore, one variable can be an independent variable in an equation and can also be a dependent variable in another equation. The basis for taking the key variables is the theory of human capital which becomes education as a mechanism in developing human capital. Where human capital has an impact on human work performance itself (Widarni & Bawono, 2021). This study using vectors which are generally used in a-theory research so that human capital theory is used as a determinant of key factors, not as the basis for econometric equations. The results of the vectoring carried out in this study can be described through the estimation of the IRF (impulse response function) estimation. The next step is to forecast the influence of each variable in the form of a forecasting graph so that it can be seen clearly the combination of the direction of the relationship or the influence of each variable.

Estimation using the VAR model requires all variables to be stationary at the level, if the variables are not stationary at the level, the estimation is carried out using the VECM model with the condition that all variables formed are cointegrated. The test is carried out in three stages, namely testing at the level, 1st difference, and 2nd difference. Each variable is tested starting at the level, if it is not stationary at this level it is continued at the 1st difference level, and if it is still not stationary it is continued to the 2nd difference level. Where in this study to test the stationarity of the data, the Augmented Dickey-Fuller test was used. One of the data stationarity is seen by comparing the alpha value with the

probability value. When the probability value is below the alpha value, it can be said that the variable is stationary and vice versa. Because in this study using an alpha value of 5%, the variables that are declared stationary are only variables that have a probability value below the 5% alpha. Cointegration test to see the long-term integration between variables. If there is cointegration between variables, the estimation is made using the Panel Vector Error Correction Model (VECM) method, but if there is no cointegration then the estimation is made using the vector autoregression (VAR) method.

4 RESULTS AND DISCUSSION

The table below presents a summary of descriptive statistics of several variables used in this study during the period 2000 to 2019 in Indonesia.

Table 1. Descriptive statistics of agricultural performance in USD value in January 2021, education (investment in education in USD value in January 2021), and employment in agriculture (total working population).

	AGRICULTURE_VALUE_ADDED	EMPLOYMENT_IN_AGRICULTURE	EDUCATION
Mean	8.48E+10	43143235	2.14E+10
Median	9.38E+10	43672827	2.10E+10
Maximum	1.42E+11	46240097	4.43E+10
Minimum	2.57E+10	38703822	3.68E+09
Std. Dev.	4.31E+10	2267787	1.36E+10

Source: 2021 world bank data, processed

Based on Table 1. above, it appears that from the period 2000 to 2019, the average agricultural performance (Agriculture Value Added) in Indonesia is very high at around 84.8 billion USD which can be seen from the mean value in table 1. with a high level of volatility at 43.1 billion USD. With an average number of workers 43.1 million people with an average educational investment value of 21.4 billion USD. However, this statistical descriptive analysis table is not sufficient to provide a general description of human capital investment through educational mechanisms on agricultural performance as seen from the productivity of workers in Indonesia. If it is divided between the average performance in the study period and the average number of workers, it can be seen that the average productivity level of investment in human capital in Indonesia is 84.8 billion USD divided by 43.1 million workers, which is $1967.5 per worker. From the results of the average productivity per worker, it can be seen that the level of effectiveness of Indonesia's human capital investment in the agricultural sector is $1967.5 per worker divided by the investment per worker of 21.4 billion USD divided by 43.1 million people, which is $496.5 per worker. So every USD invested can generate $1967.5 divided by $496.5 = $3.96 per USD.

Estimation using the VAR model requires all variables to be stationary at the level, if the variable is not stationary at the level, the estimation is carried out using the VECM model on the condition that all variables formed are cointegrated with each other where the results are shown in table 2. below:

table 2. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			4.95E+01	0
ADF - Choi Z-stat			-5.93E+00	0
** Probabilities for Fisher tests are computed using an asymptotic Chi				
-square distribution. All other tests assume asymptotic normality.				
Intermediate ADF test results D				
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_VALUE_ADDED,2)	0.0038	0	3.00E+00	17
D(EMPLOYMENT_IN_AGRICULTURE,2)	0.0002	3.00E+00	3.00E+00	14
D(EDUCATION,2)	0.0000	0.00E+00	3.00E+00	17

From the results of stationarity testing with Augmented Dickey-Fuller, it can be seen that at the 2nd level the difference is stationary and vector estimation uses Vector Autoregressive. It can be seen that the probability is less than

0.05 in each tested variable. After doing the stationarity test, a cointegration test was conducted to see the long-term integration between variables. If there is cointegration between variables, the estimation is made using the Panel Vector Error Correction Model (VECM) method, but if there is no cointegration, the estimation is made using the Vector Autoregressive method. Cointegration test results are shown in table 3.

Table 3. Cointegration test results

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.6836	31.80851	2.98E+01	0.0289
At most 1	0.4413	11.09351	1.55E+01	0.2058
At most 2	0.0337	0.616358	3.84E+00	0.4324
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.6836	20.715	2.11E+01	0.0571
At most 1	0.4413	10.47715	1.43E+01	0.1824
At most 2	0.0337	0.616358	3.84E+00	0.4324
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

From the cointegration results, the critical value is smaller than the Trace Statistics value and the Max-Eigen Statistics value which indicates that there is a cointegration relationship in the variable equation so that the next method that can be used to determine long-term and short-term relationships is the Vector error correction model (VECM) method.

Optimum lag test is used to determine the time period of the influence of a variable on other variables which will give optimal results. This is because changes in the movement of a variable are not directly responded to by changes in other variables, but there is still a certain grace period. Therefore it is important to know the lag length. The optimum lag test can be seen in table 4.

Table 4. Optimum lag test

Chi-squared test statistics for lag exclusion:				
Numbers in [ ] are p-values				
	D(AGRICULTURE_VALUE_ADDED)	D(EMPLOYMENT_IN_AGRICULTURE)	D(EDUCATION)	Joint
DLag 1	13.1518	3.049225	2.24E+00	30.96492
	[0.0043]	[0.3841]	[0.5232]	[0.0003]
DLag 2	4.4413	1.842676	1.17E+00	23.34671
	[0.2176]	[0.6057]	[0.7606]	[0.0055]
df	3.0000	3	3.00E+00	9

From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector error correction model estimation are shown in table 5.

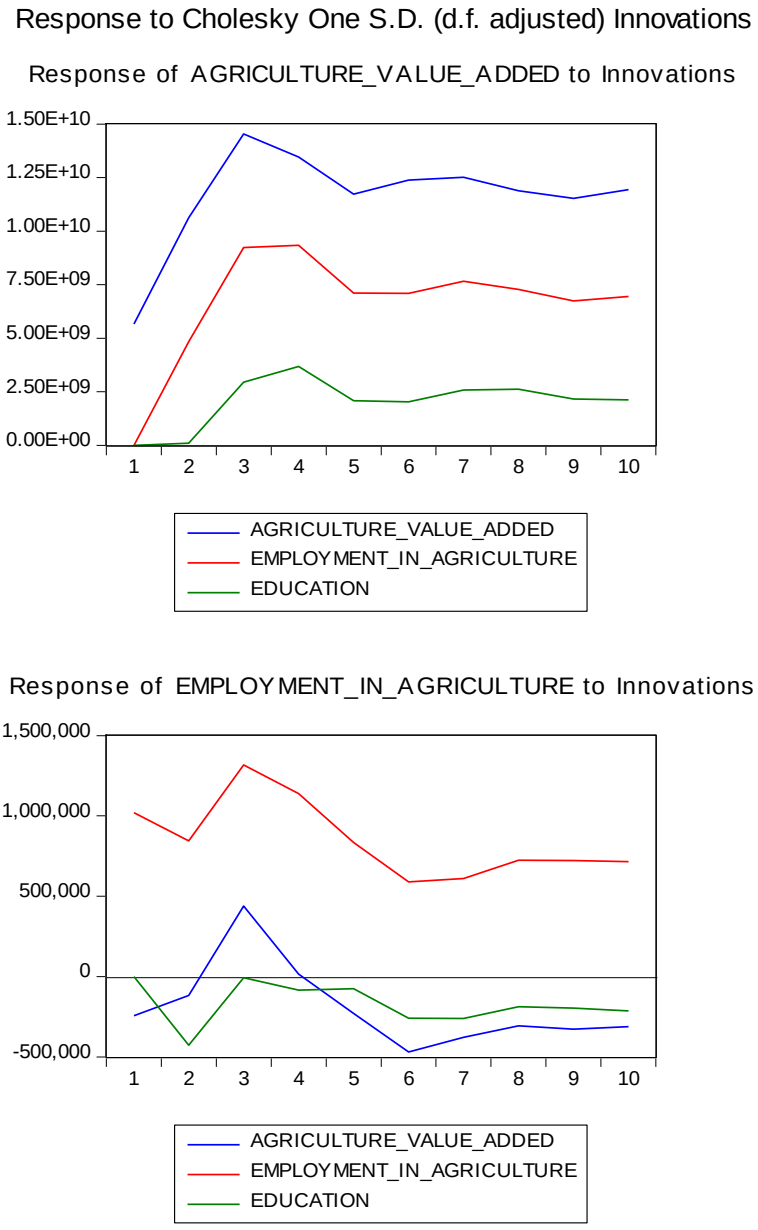
Table 5. The results of the Vector error correction model estimation

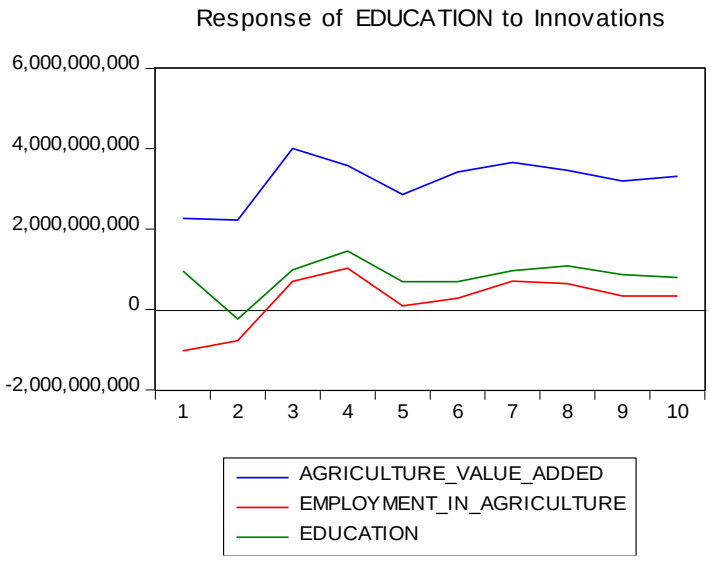
Cointegrating Eq:	CointEq1		
AGRICULTURE_VALUE_ADDED(-1)	1.000		

EMPLOYMENT_IN_AGRICULTURE(-1)	(7196.069)		
	(519.468)		
	[-13.8528]		
EDUCATION(-1)	(4.208)		
	(0.078)		
	[-54.2897]		
C	316000000000.000		
Error Correction:	D(AGRICULTURE_VALUE_ADDED)	D(EMPLOYMENT_IN_AGRICULTURE)	D(EDUCATION)
CointEq1	(1.067)	0.00015	0.0918
	(0.597)	(0.00011)	(0.2814)
	[-1.78750]	[1.35849]	[0.32633]
D(AGRICULTURE_VALUE_ADDED(-1))	2.112	0.00002	0.3569
	(0.629)	(0.00012)	(0.2966)
	[3.35579]	[0.21051]	[1.20351]
D(AGRICULTURE_VALUE_ADDED(-2))	(1.102)	(0.00006)	0.0978
	(0.705)	(0.00013)	(0.3323)
	[-1.56313]	[-0.46847]	[0.29427]
D(EMPLOYMENT_IN_AGRICULTURE(-1))	(2830.318)	0.45489	(352.0030)
	(2428.000)	(0.44919)	(1144.3400)
	[-1.16570]	[1.01269]	[-0.30760]
D(EMPLOYMENT_IN_AGRICULTURE(-2))	(2288.709)	0.29954	(671.3473)
	(1823.840)	(0.33742)	(859.5940)
	[-1.25488]	[0.88776]	[-0.78101]
D(EDUCATION(-1))	(4.391)	0.00018	(0.8620)
	(1.584)	(0.00029)	(0.7467)
	[-2.77150]	[0.62634]	[-1.15449]
D(EDUCATION(-2))	0.679	0.00022	(0.3925)
	(1.229)	(0.00023)	(0.5794)
	[0.55195]	[0.94575]	[-0.67739]
C	6840000000.000	(712759.70000)	1810000000.0000
	(2500000000.000)	(459149.00000)	(1200000000.0000)
	[2.75742]	[-1.55235]	[1.54522]
R-squared	0.653	0.49598	0.5314
Adj. R-squared	0.384	0.10397	0.1670
Sum sq. resids	28800000000000000000.000	9870000000000.00000	6410000000000000000.0000
S.E. equation	5660000000.000	1047430.00000	2670000000.0000
F-statistic	2.424	1.26521	1.4581
Log likelihood	(400.485)	(254.36750)	(387.6968)
Akaike AIC	48.057	30.86677	46.5526
Schwarz SC	48.449	31.25887	46.9447
Mean dependent	6490000000.000	(300122.10000)	2300000000.0000
S.D. dependent	7210000000.000	1106529.00000	2920000000.0000

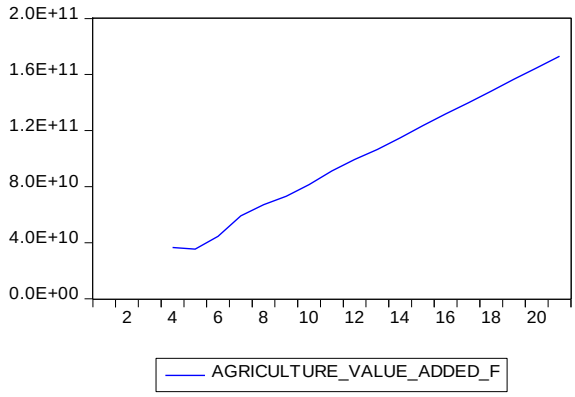
Agriculture performance (Agriculture Value Added) has a significant positive relationship with agricultural value-added itself in period one with a t-table of 3.35579 and a coefficient of 2.112. There is a significant positive correlation with employment in agriculture with a t-table of 0.21051 and a coefficient value of 0.00002. and a significant positive correlation with education investment as a means of developing human capital with a t-table of 1.20351 and a

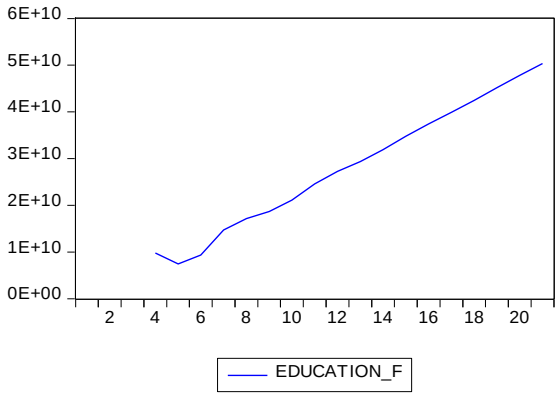
coefficient value of 0.3569. However, employment in agriculture has a negative and insignificant correlation in periods one and two with agriculture performance with a t-table value in the first period of -1.16570 and a coefficient of -2830.318. Has a significant positive relationship with employment in agriculture itself with a t-table value of 1.01269 and a coefficient value of 0.45489. However, employment in agriculture has a negative and insignificant relationship with education investment with a t-table value of -0.30760 with a coefficient value of 352.003. Education investment is not significantly negatively related in period one with agriculture performance with t-table -2.77150 and coefficient value -4.391. However, the correlation was not significant in the second period with a t-table value of 0.55195 and a coefficient of 0.679. There is a significant positive relationship with employment in agriculture in both periods one and period two and an insignificant negative relationship with education itself. The value of the coefficient of determination (Adj. R-Square) shows the degree of truth of the estimate of 0.384. This means 38% accuracy of the calculation rate of the vector error correction model. Impulse Response Function (IRF) describes the response of an endogenous variable to shock that occurs in other variables in a dynamic VAR system. IRF can be used to see the effect of fluctuations or shocks from one variable on the value of another variable either now or in the future. The results of the Impulse Response Function (IRF) of the Infrastructure variable against other variables are shown by the following Impulse Response graph:

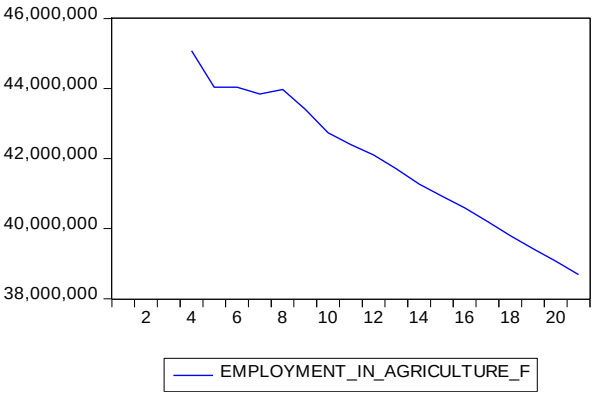




Based on the response and impulse graphs, it can be seen that each variable responds to each other since the first time period with a lag of 2. This shows that in Indonesia the three variables influence each other. To see the direction of influence can be seen in the following forecasting chart:







From the forecasting results, it can be seen that education investment has a positive relationship with agricultural performance which was driven by agricultural performance in the previous period and negatively related to employment in agriculture. However, from this it can be seen that productivity which is the result of developing human resources through education mechanisms is getting bigger. Where labor productivity increases over time. However, looking at the graph of labor absorption in the agricultural sector which continues to decline very sharply, it becomes a threat in itself in the future. Because there is a decline in performance in the future due to labor shortages and it is possible that the agricultural sector will be completely destroyed when there is a shortage of labor in this

sector if the interest of the Indonesian youth in the agricultural sector is not invested.

The table below presents a summary of descriptive statistics of several variables used in this study during the period 2000 to 2019 in South Africa.

Table 6. Descriptive statistics of agricultural performance in USD value in January 2021, education (investment in education in USD value in January 2021), and employment in agriculture (total working population).

	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
Mean	6.94E+09	1.62E+10	1.20E+06
Median	7.13E+09	1.66E+10	1.20E+06
Maximum	9.52E+09	2.40E+10	1.63E+06
Minimum	3.91E+09	5.85E+09	8.85E+05
Std. Dev.	1.65E+09	6.02E+09	2.17E+05

Source: 2021 world bank data, processed

Based on table 6 above, it appears that from the period 2000 to 2019, the average agricultural performance in South Africa is very high at around 6.9 billion USD which can be seen from the mean value in table 6. with a high level of volatility at 4.73 billion USD. With an average number of workers 1.2 million people with an average educational investment value of 16.2 billion USD. To see a more detailed and careful relationship of influence, vector analysis is carried out, namely Vector Autoregressive. Before estimating using Vector Autoregressive, there are several conditions that must be met from several observed variables, namely Stationarity Test, and Optimum Lag Test.

Cointegration test to see if there is a long-term relationship between variables and a causality test to see a reciprocal relationship between variables. Estimation using the VAR model requires all variables to be stationary at the level, if the variable is not stationary at the level, the estimation is carried out using the VECM model on the condition that all variables formed are cointegrated with each other where the results are shown in table 7 below:

Table 7. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			5.91E+01	0.00E+00
ADF - Choi Z-stat			-6.61E+00	0.00E+00
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	0.00E+00	1.00E+00	3.00E+00	1.60E+01
D(EDUCATION,2)	2.30E-03	1.00E+00	3.00E+00	1.60E+01
D(EMPLOYMENT_IN_AGRICULTURE,2)	0.00E+00	0.00E+00	3.00E+00	1.70E+01

From the results of stationarity testing with Augmented Dickey-Fuller, it can be seen that at the 2nd level the difference is stationary and vector estimation uses Vector Autoregressive. It can be seen that the probability is less than 0.05 in each tested variable. After doing the stationarity test, a cointegration test was conducted to see the long-term integration between variables. If there is cointegration between variables, the estimation is made using the Panel Vector Error Correction Model (VECM) method, but if there is no cointegration, the estimation is made using the Vector Autoregressive method. Cointegration test results are shown in table 8.

Table 8. Cointegration test results

Hypothesized		Trace	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	8.40E-01	4.35E+01	2.98E+01	8.00E-04
At most 1	4.40E-01	1.05E+01	1.55E+01	2.42E-01
At most 2	5.75E-03	1.04E-01	3.84E+00	7.47E-01

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From the cointegration result, the critical value is higher than the Trace Statistics value and the Max-Eigen Statistics value which shows that there is no cointegration relationship in the variable equation so that the next method that can be used to determine the long-term and short-term relationship is the Vector Autoregressive method.

Optimum lag test is used to determine the time period of the influence of a variable on other variables which will give optimal results. This is because changes in the movement of a variable are not directly responded to by changes in other variables, but there is still a certain grace period. Therefore it is important to know the lag length. The optimum lag test can be seen in table 9.

Table 9. Optimum lag test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1.05E+03	NA	1.54E+47	1.17E+02	1.17E+02	1.17E+02
1	-1.01E+03	5.81E+01	6.77E+45	1.14E+02	1.15E+02	1.14E+02
2	-1.00E+03	17.06240*	4.35e+45*	113.4694*	114.5082*	113.6127*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

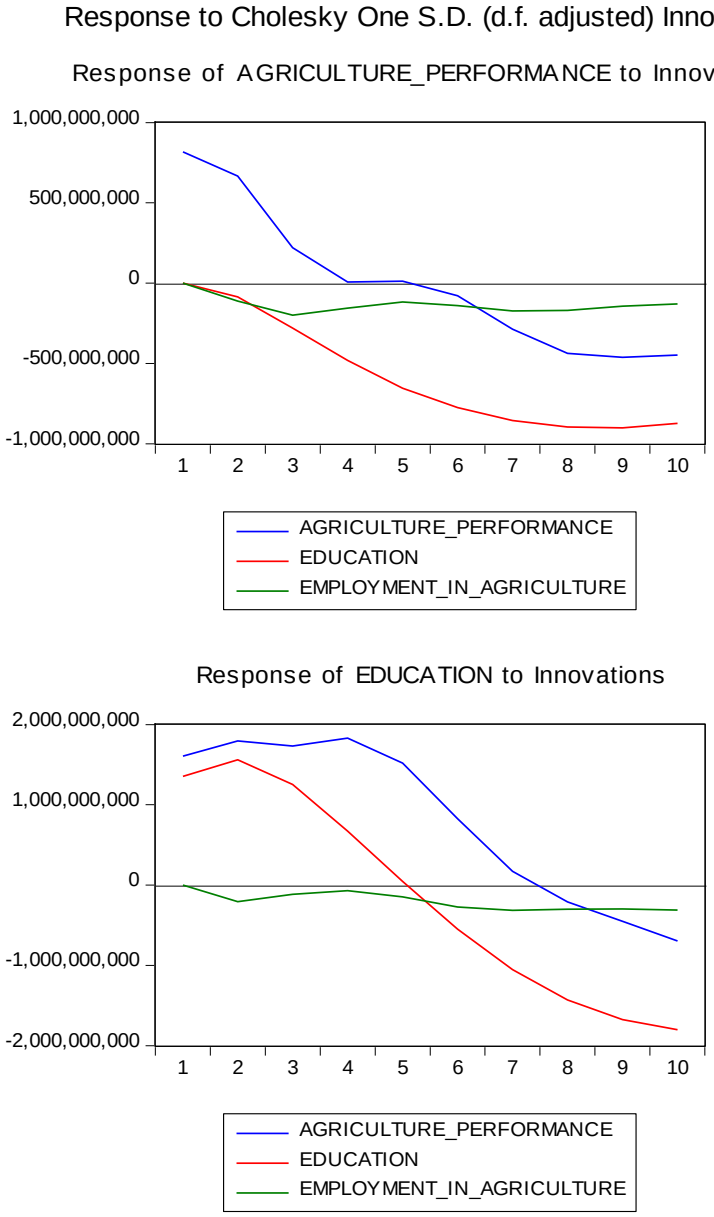
From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 2. The results of the Vector Autoregressive estimation are shown in table 10.

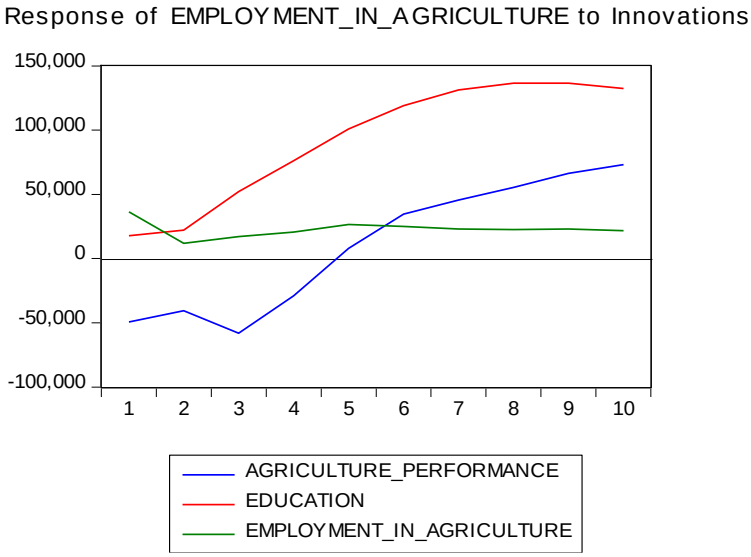
Table 10. The results of the Vector Autoregressive estimation

	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
AGRICULTURE_PERFORMANCE(-1)	6.73E-01	-5.58E-01	-5.38E-05
	-4.83E-01	-1.24E+00	-3.80E-05
	[1.39355]	[-0.44935]	[-1.42699]
AGRICULTURE_PERFORMANCE(-2)	-4.31E-01	7.77E-01	-4.57E-05
	-4.73E-01	-1.22E+00	-3.70E-05
	[-0.91050]	[0.63951]	[-1.23742]
EDUCATION(-1)	-2.23E-02	1.23E+00	1.21E-05
	-1.61E-01	-4.13E-01	-1.30E-05
	[-0.13913]	[2.97004]	[0.96575]
EDUCATION(-2)	-5.44E-02	-4.78E-01	1.23E-05
	-1.52E-01	-3.89E-01	-1.20E-05
	[-0.35907]	[-1.22857]	[1.03800]
EMPLOYMENT_IN_AGRICULTURE(-1)	-3.09E+03	-5.70E+03	3.25E-01
	-4.24E+03	-1.09E+04	-3.31E-01
	[-0.72922]	[-0.52340]	[0.98223]
EMPLOYMENT_IN_AGRICULTURE(-2)	-2.54E+03	3.95E+03	2.68E-01
	-3.73E+03	-9.60E+03	-2.91E-01
	[-0.67990]	[0.41110]	[0.91864]
C	1.33E+10	5.22E+09	7.61E+05
	-6.90E+09	-1.80E+10	-5.38E+05
	[1.93189]	[0.29460]	[1.41573]
R-squared	7.75E-01	9.01E-01	9.16E-01
Adj. R-squared	6.52E-01	8.47E-01	8.70E-01
Sum sq. resids	7.35E+18	4.86E+19	4.48E+10

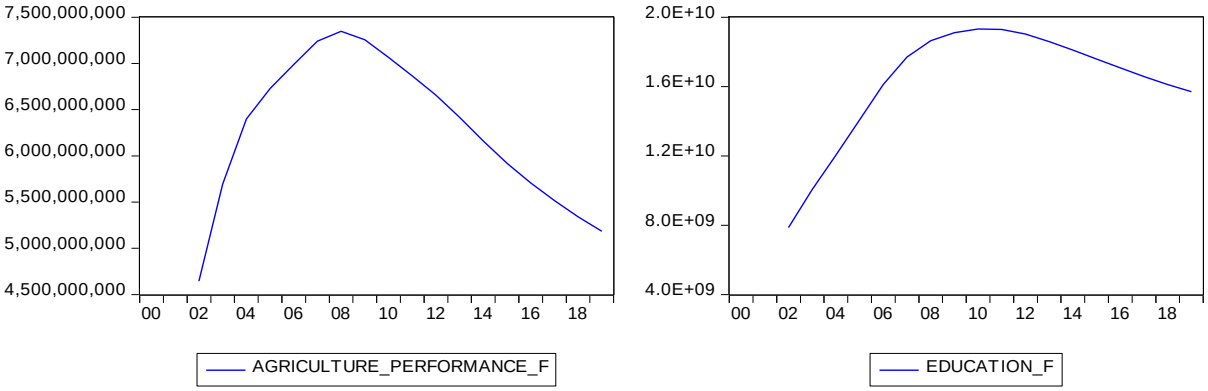
S.E. equation	8.18E+08	2.10E+09	6.38E+04
F-statistic	6.31E+00	1.67E+01	1.99E+01
Log likelihood	-3.91E+02	-4.07E+02	-2.20E+02
Akaike AIC	4.42E+01	4.61E+01	2.53E+01
Schwarz SC	4.45E+01	4.64E+01	2.56E+01
Mean dependent	7.26E+09	1.73E+10	1.15E+06
S.D. dependent	1.39E+09	5.38E+09	1.77E+05

Based on the results of the estimated output, it can be indicated the direction of the relationship, and the significance of each variable and each period. Negatively related variables are marked (-). Significant relationships are marked with a sign (*). The value of the coefficient of determination (Adj. R-Square) shows the degree of truth of the estimate of 0.652. This means 65% accuracy of the calculation rate of the vector error correction model. Impulse Response Function (IRF) describes the response of an endogenous variable to shock that occurs in other variables in a dynamic VAR system. IRF can be used to see the effect of fluctuations or shocks from one variable on the value of another variable either now or in the future. The results of the Impulse Response Function (IRF) of the Infrastructure variable against other variables are shown by the following Impulse Response graph:





Based on the response and impulse graphs, it can be seen that each variable responds to each other since the first time period with a lag of 2. This shows that in South Africa the three variables influence each other. To see the direction of influence can be seen in the following forecasting chart:



Based on the results of forecasting graphs, agriculture performance decreased in period 8. Until the end of the research period, it continued to decline. This is of course bad because the performance of agriculture in South Africa continues to decline. If this continues, it can lead to hunger or food dependence on imports. Likewise, the education graph also decreased in period 10. This is very bad because education is an important component in educating the nation's children which has an impact on the development of human capital of the population in the future. However, employment in agriculture has increased in period 8. This is very strange. The possibility of wrong policies where the number of people working in the agricultural sector should improve agricultural performance. However, what

happened was the opposite. More and more people in South Africa are working in the agricultural sector, but the performance of agriculture has actually decreased, coupled with a decrease in investment in education.

The table below presents a summary of descriptive statistics of several variables used in this study during the period 2000 to 2019 United State Of America.

Table 11. Descriptive statistics of agricultural performance in USD value in January 2021, education (investment in education in USD value in January 2021), and employment in agriculture (total working population).

	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
Mean	1.62E+11	7.49E+11	2.22E+06
Median	1.57E+11	7.29E+11	2.23E+06
Maximum	2.24E+11	1.07E+12	2.39E+06
Minimum	1.06E+11	4.84E+11	2.00E+06
Std. Dev.	3.13E+10	1.75E+11	9.85E+04

Source: 2021 world bank data, processed

Based on table 11 above, it appears that from the period 2000 to 2019, the average agricultural performance in United State of America is very high at around 162 billion USD which can be seen from the mean value in table 11. with a high level of volatility at 31.3 billion USD. With an average number of workers 2.22 million people with an average educational investment value of 749 billion USD. To see a more detailed and careful relationship of influence, vector analysis is carried out, namely Vector Autoregressive. Before estimating using Vector Autoregressive, there are several conditions that must be met from several observed variables, namely Stationarity Test, and Optimum Lag Test. This book will also include a cointegration test to see if there is a long-term relationship between variables and a causality test to see a reciprocal relationship between variables. Estimation using the VAR model requires all variables to be stationary at the level, if the variable is not stationary at the level, the estimation is carried out using the VECM model on the condition that all variables formed are cointegrated with each other where the results are shown in Table 12 below:

Table 12. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			48.23	0
ADF - Choi Z-stat			(5.83)	0
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	0.00	0.00	3.00	17
D(EDUCATION,2)	0.01	0.00	3.00	17
D(EMPLOYMENT_IN_AGRICULTURE,2)	0.00	0.00	3.00	17

From the results of stationarity testing with Augmented Dickey-Fuller, it can be seen that at the 2nd level the difference is stationary and vector estimation uses Vector Autoregressive. It can be seen that the probability is less than 0.05 in each tested variable. After doing the stationarity test, a cointegration test was conducted to see the long-term integration between variables. If there is cointegration between variables, the estimation is made using the Panel Vector Error Correction Model (VECM) method, but if there is no cointegration, the estimation is made using the Vector Autoregressive method. Cointegration test results are shown in table 13.

Table 13. Cointegration test results

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.40	15.30	29.80	0.7601
At most 1	0.26	6.13	15.49	0.6799
At most 2	0.04	0.81	3.84	0.3669

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From the cointegration result, the critical value is higher than the Trace Statistics value and the Max-Eigen Statistics value which shows that there is no cointegration relationship in the variable equation so that the next method that can

be used to determine the long-term and short-term relationship is the Vector Autoregressive method.

Optimum lag test is used to determine the time period of the influence of a variable on other variables which will give optimal results. This is because changes in the movement of a variable are not directly responded to by changes in other variables, but there is still a certain grace period. Therefore it is important to know the lag length. The optimum lag test can be seen in table 14.

Table 14. Optimum lag test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	(1170.69)	NA	8.69E+52	130.4095	130.5579	130.4299
1	(1115.90)	85.22950*	5.48e+50*	125.3216*	125.9152*	125.4035*
2	(1110.16)	7.01	8.77E+50	125.6843	126.723	125.8275

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector Autoregressive estimation are shown in table 15.

Table 15. The results of the Vector Autoregressive estimation

	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
AGRICULTURE_PERFORMANCE(-1)	0.80	0.16	-3.98E-07
	(0.31)	(0.21)	-1.20E-06
	[2.53934]	[0.75116]	[-0.32478]
AGRICULTURE_PERFORMANCE(-2)	(0.16)	(0.02)	1.07E-06
	(0.34)	(0.23)	-1.30E-06
	[-0.47716]	[-0.09578]	[0.79578]
EDUCATION(-1)	(0.14)	1.25	-1.78E-06
	(0.38)	(0.25)	-1.50E-06
	[-0.37768]	[4.91560]	[-1.20184]
EDUCATION(-2)	0.19	(0.25)	1.85E-06
	(0.38)	(0.25)	-1.50E-06
	[0.48608]	[-0.99647]	[1.24527]
EMPLOYMENT_IN_AGRICULTURE(-1)	1770.37	23420.70	6.09E-01
	(73022.70)	(48640.40)	-2.84E-01
	[0.02424]	[0.48151]	[2.14516]
EMPLOYMENT_IN_AGRICULTURE(-2)	9807.87	59615.84	4.41E-02
	(67568.50)	(45007.30)	-2.63E-01
	[0.14515]	[1.32458]	[0.16789]
C	10900000000.00	(177000000000.00)	6.63E+05
	(140000000000.00)	(92000000000.00)	-5.36E+05
	[0.07935]	[-1.93044]	[1.23683]
R-squared	0.71	1.00	5.67E-01
Adj. R-squared	0.54	0.99	3.31E-01
Sum sq. resids	429000000000000000000.00	190000000000000000	6.49E+10

		0000.00	
S.E. equation	19800000000.00	13200000000.00	7.68E+04
F-statistic	4.39	416.91	2.40E+00
Log likelihood	(447.82)	(440.51)	-2.24E+02
Akaike AIC	50.54	49.72	2.56E+01
Schwarz SC	50.88	50.07	2.60E+01
Mean dependent	166000000000.00	778000000000.00	2.21E+06
S.D. dependent	29300000000.00	160000000000.00	9.39E+04

In the first period, Agriculture performance has a significant positive relationship with agriculture performance itself with a t-table value of 2.53934 and a coefficient value of 0.80. Has a significant positive relationship with education with a t-table value of 0.75116 and a coefficient value of 0.16. There is a significant negative correlation with employment in agriculture with a t-table value of -0.32478 and a coefficient value of 0.000000398.

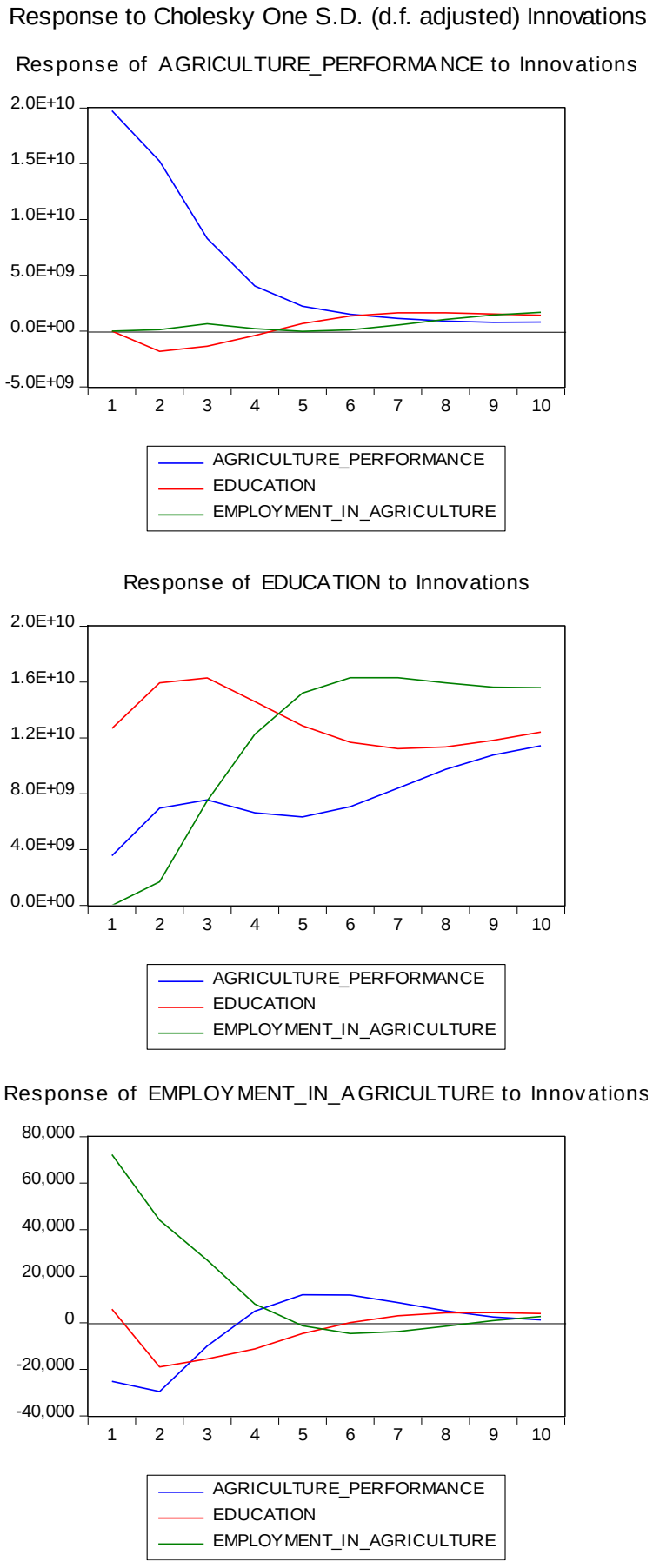
In the second period, Agriculture performance has a significant negative relationship with agriculture performance itself with a t-table value of -0.47716 and a coefficient of -0.16. There is a significant negative correlation with education with a t-table value of -0.09578 and a coefficient value of -0.02. It has a significant positive correlation with employment with a t-table value of 0.79578 and a coefficient value of 0.00000107.

In the first period, education has a significant negative correlation with agriculture performance with a t-table value of -0.37768 and a coefficient value of -0.14. Has a significant positive relationship with education with a t-table value of 4.91560 and a coefficient value of 1.25. It has a significant negative correlation with empolymnet in agriculture with a t-table value of -1.20184 and a coefficient value of 0.00000178.

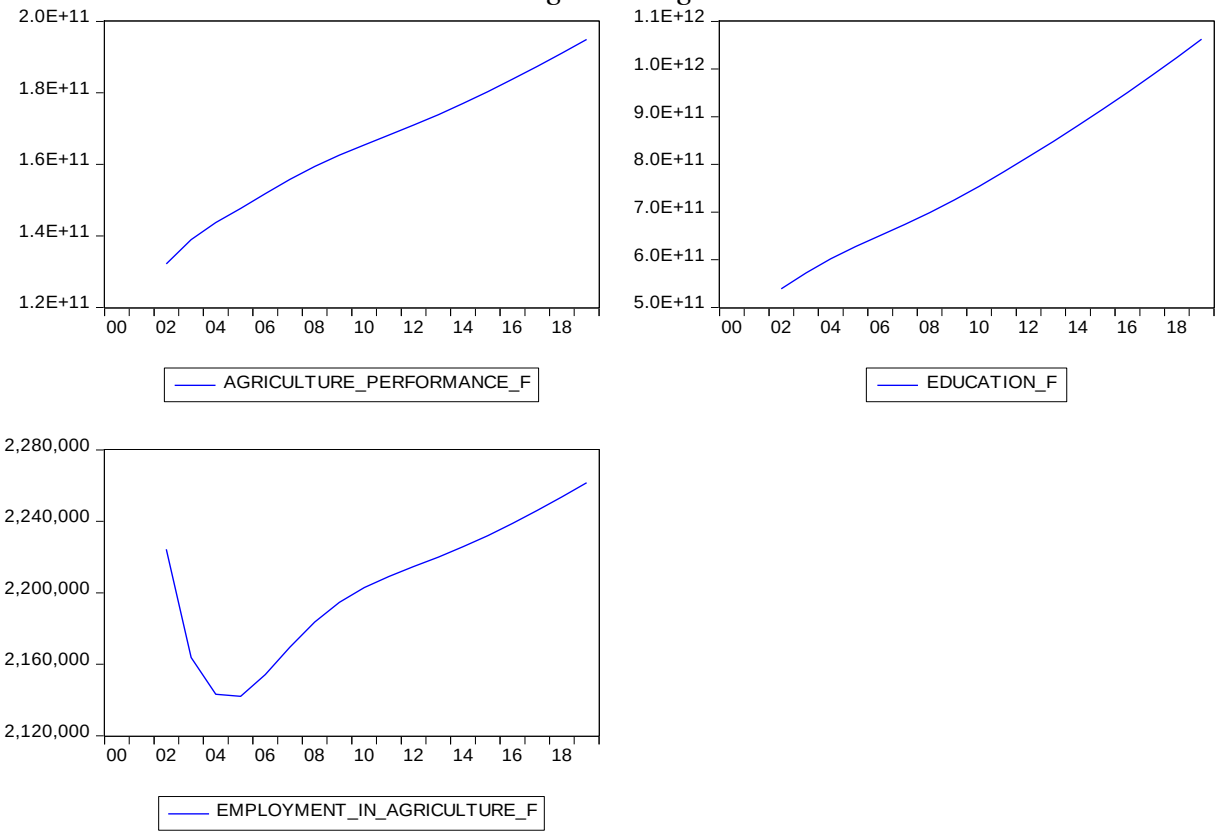
In the second period, education is positively related to agriculture performance with a t-table value of 0.48608 and a coefficient value of 0.19. It has a significant negative relationship with education with a t-table value of -0.99647 and a coefficient value of -0.25. There is a significant positive correlation with employment in agriculture with a t-table value of 1.24527 and a coefficient value of 0.00000185.

In the first period, employment in agriculture has a positive and insignificant correlation with agriculture performance with a t-table value of 0.02424 and a coefficient value of 1770.37. There is no significant positive correlation with education with a t-table value of 0.48151 and a coefficient value of 234210.70. There is a significant positive correlation with employment in agriculture itself with a t-table value of 2.14516 and a coefficient value of 0.609.

In the second period, employment in agriculture is positively and insignificantly related to agriculture performance with a t-table value of 0.14515 and a coefficient value of 9807.87. There is no significant positive correlation with education with a t-table value of 1.32458 and a coefficient value of 59615.84. Not significant positive relationship 0.16789 and coefficient value 0.044. The value of the coefficient of determination (Adj. R-Square) shows the degree of truth of the estimate of 0.54. This means 54% accuracy of the calculation rate of the vector error correction model. Impulse Response Function (IRF) describes the response of an endogenous variable to shock that occurs in other variables in a dynamic VAR system. IRF can be used to see the effect of fluctuations or shocks from one variable on the value of another variable either now or in the future. The results of the Impulse Response Function (IRF) of the Infrastructure variable against other variables are shown by the following Impulse Response graph:


Response to Cholesky One S.D. (d.f. adjusted) Innovations
Response of AGRICULTURE_PERFORMANCE to Innovations
2.0E+10
1.5E+10
1.0E+10
5.0E+09
0.0E+00
-5.0E+09
1 2 3 4 5 6 7 8 9 10
AGRICULTURE_PERFORMANCE
EDUCATION
EMPLOYMENT_IN_AGRICULTURE
Response of EDUCATION to Innovations
2.0E+10
1.6E+10
1.2E+10
8.0E+09
4.0E+09
0.0E+00
1 2 3 4 5 6 7 8 9 10
AGRICULTURE_PERFORMANCE
EDUCATION
EMPLOYMENT_IN_AGRICULTURE
Response of EMPLOYMENT_IN_AGRICULTURE to Innovations
80,000
60,000
40,000
20,000
0
-20,000
-40,000
1 2 3 4 5 6 7 8 9 10
AGRICULTURE_PERFORMANCE
EDUCATION
EMPLOYMENT_IN_AGRICULTURE

Based on the response and impulse graphs, it can be seen that each variable responds to each other since the first time period with a lag of 1. This shows that in United State of America the three variables influence each other. To see the direction of influence can be seen in the following forecasting chart:



Based on the forecasting graph, it can be seen that the growth of agriculture performance is in line with or in line with education investment in United State of America. This indicates that United State of America has succeeded in successfully investing in education to improve agricultural performance. Even though employment in agriculture in the United States had experienced a significant decline, it reversed direction in the 5th period and showed the direction of increasing employment in agriculture every year until the end of our research period in 2019. This is a very good thing for the United States because the graph with an upward trend after period 5 in the employment in agriculture graph, it shows that agricultural performance in the United States has the potential to continue to grow.

5 CONCLUSION

Based on the forecasting results from the vector analysis results from the three countries, it can be concluded that the accumulation of overall policies in general related to agriculture and education in the United States is effectively able to improve agricultural performance in the United States through investment in education that is still and has an impact on increasing the interest of Americans or people in the United States. -people who work in the United States to work in the agricultural sector. In South Africa, the agricultural performance had increased very well but fell in 2008 and continued to decline as well as education investment which was also affected by a decline in education investment in South Africa. However, the agricultural sector absorbs more and more workers. Of course, this is a sign of danger when labor continues to be absorbed in the agricultural sector but the agricultural sector actually experiences a decline in agricultural performance. This indicates that agricultural income is getting worse due to a decrease in agricultural performance and an increase in employment in agriculture in South Africa. Indonesia, which is an agricultural country, is quite good at encouraging agricultural performance in Indonesia with the accumulation of policies taken by the Indonesian government related to agriculture and education. However, Employment in agriculture in Indonesia has decreased and this is very bad because if the younger generation is not interested in working in agriculture and the employment in agriculture graph in Indonesia continues to decline, there is a potential for the loss of this sector or a

decline in agricultural performance due to a shortage of labor.

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