Human Capital and Agriculture in the Development of Food Security in Ecuador

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Abstract : This study investigates the relationship between agriculture performance, human capital investment in education mechanisms, and employment in agriculture for forecasting as a simulation of the state of agriculture in Ecuador. The period of this research is from 2000 - 2019 using the vector analysis method. We find that Ecuador has succeeded in successfully investing in education to improve agricultural performance. Even though employment in agriculture in Ecuador had shown 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 Ecuador because the graph with an upward trend in the employment in agriculture graph, shows that agricultural performance in Ecuador has the potential to continue to grow.

Keywords: Human Capital, Agriculture, Employment in Agriculture, Vector Analysis.
JEL Classification : C01,E24,J24, J43

1 INTRODUCTION

Integral farming is a production model in the Galapagos Islands, Ecuador, where farmers use the sufficient resources available on their farms to maintain their own consumption and supply of local produce (Puente-Rodríguez et al,2019).

In the insular region of Galapagos, Ecuador, a hundred families dedicated to agriculture maintain integral farms, plan their production, implement good agricultural management practices and reduce the use of agricultural chemicals to obtain clean agricultural production (Barrera et al,2021).

A pork and chicken producer has expanded its operations in northern Ecuador with funding from the World Bank's commercial lending agency, despite persistent complaints from local communities about food, air, and water quality, public health, and labor issues. The quality of the workforce can be improved through investment in human capital through education mechanisms (CANNON,2020).

2 LITERATURE REVIEW

To define human capital, we must talk about the economic value of the professional skills one has. It can be calculated as the value of the future benefits that a person is expected to derive from his work. If financial capital is added to human capital, a person's total wealth is obtained. This is the most important part of any organization. It refers to the productivity of workers depending on work experience and training. When it comes to opportunities, human capital represents the resources that a company has. This is related to the old concept that stipulates human capital as the main part of the factors of production and regardless of its formation (Widarni & Bawono, 2021).

Agriculture is a human activity that tends to combine different procedures and knowledge in tillage, with the aim of producing food of plant origin, such as fruits, vegetables, vegetables, cereals, etc. Agriculture is an economic activity that falls within the primary sector, and it includes all the actions that are carried out by humans, tending to change the environment that surrounds it, to make it more suitable and thus generate greater productivity from the land, and obtain good food for direct consumption. or for further industrial processing, which results in added value (Bláha, L. (2019).

Agriculture itself experienced its first explosion in the Stone Age, in the Neolithic period, although its beginnings go back to prehistory, developed independently by various cultures. The people who until then were in nomadic form, relying on an economy based solely on hunting, fishing, and gathering, began to work the land, gave birth to agriculture, and acquired their first crops such as wheat and barley, and included livestock as another basis. activities

for survival in society (Eltyeb et al, 2020).

3 RESEARCH OBJECTIVE AND METHODOLOGY

This research begins by conducting a study of the factors that affect agricultural performance. We carry out factor understanding through research conducted previously through qualitative methods in each country. In general, there are two dominant factors that are generally accepted in every country that we have studied, namely the human factor in the form of a collection of skills, experience, and knowledge of humans who become workers in the field of agriculture, labor absorption in the field of agriculture or called work participation and non-human factors in the form of capital and equipment resources and technology availability. In this study, we focus on analyzing human capital which is significantly affected by education and government investment in education. So that it can be generalized that the encouragement of human capital development is in the form of state investment in education. This is a key factor of human capital development. The second key factor is work participation. Employment participation itself reflects the interest of citizens of productive age to work in the agricultural sector. And the last is the performance of the agricultural industry itself.

In this study, we use secondary data from the world bank that we process and use to understand the effectiveness of human capital investment in each country and the interest of educated citizens in the agricultural sector in relation to the performance of the agricultural industry. The research period that we took was adjusted to our research period, which is from 2000 to 2019. We focused on the analysis before the covid-19 pandemic occurred to avoid biasing the analysis results. In accordance with the purpose of this study, namely to analyze the relationship model between the key variables, namely human capital represented by education investments made by the government, work participation in agriculture, and agricultural industry performance. 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 (Widarni & Bawono, 2021). Where human capital has an impact on human work performance itself. This study using vectors which are generally used in atheory 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.

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_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
Mean	6.43E+09	2.96E+09	1.95E+06
Median	6.48E+09	2.93E+09	1.90E+06
Maximum	9.73E+09	5.49E+09	2.53E+06
Minimum	2.82E+09	2.11E+08	1.66E+06
Std. Dev.	2.61E+09	1.99E+09	2.32E+05

Based on Table 1 above, it appears that from the period 2000 to 2019, the average agricultural performance in Ecuador is very high at around 6.43 billion USD which can be seen from the mean value in Table 1. with a high level of volatility at 2.61 billion USD. With an average number of workers 1.95 million people with an average educational investment value of 2.96 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 2 below:

Table 2. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			3.93E+01	0.00E+00
ADF - Choi Z-stat			-5.14E+00	0.00E+00
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	4.00E-04	1.00E+00	3.00E+00	1.60E+01
D(EDUCATION,2)	1.40E-03	1.00E+00	3.00E+00	1.60E+01
D(EMPLOYMENT_IN_AGRICULTURE,2)	4.60E-03	1.00E+00	3.00E+00	1.60E+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 3.

Table 3. Cointegration test results

Hypothesized		Trace	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	5.63E-01	1.93E+01	2.98E+01	4.69E-01
At most 1	2.15E-01	4.43E+00	1.55E+01	8.66E-01
At most 2	3.89E-03	7.02E-02	3.84E+00	7.91E-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 4.

Table 4. Optimum lag test

Lag	LogL	LR	FPE	AIC	SC	HQ
0.00E+00	-1.02E+03	NA	7.20E+45	1.14E+02	1.14E+02	1.14E+02
1.00E+00	-9.54E+02	108.0013*	8.93e+42*	107.3888*	107.9824*	107.4706*
2.00E+00	-9.51E+02	3.79E+00	1.91E+43	1.08E+02	1.09E+02	1.08E+02

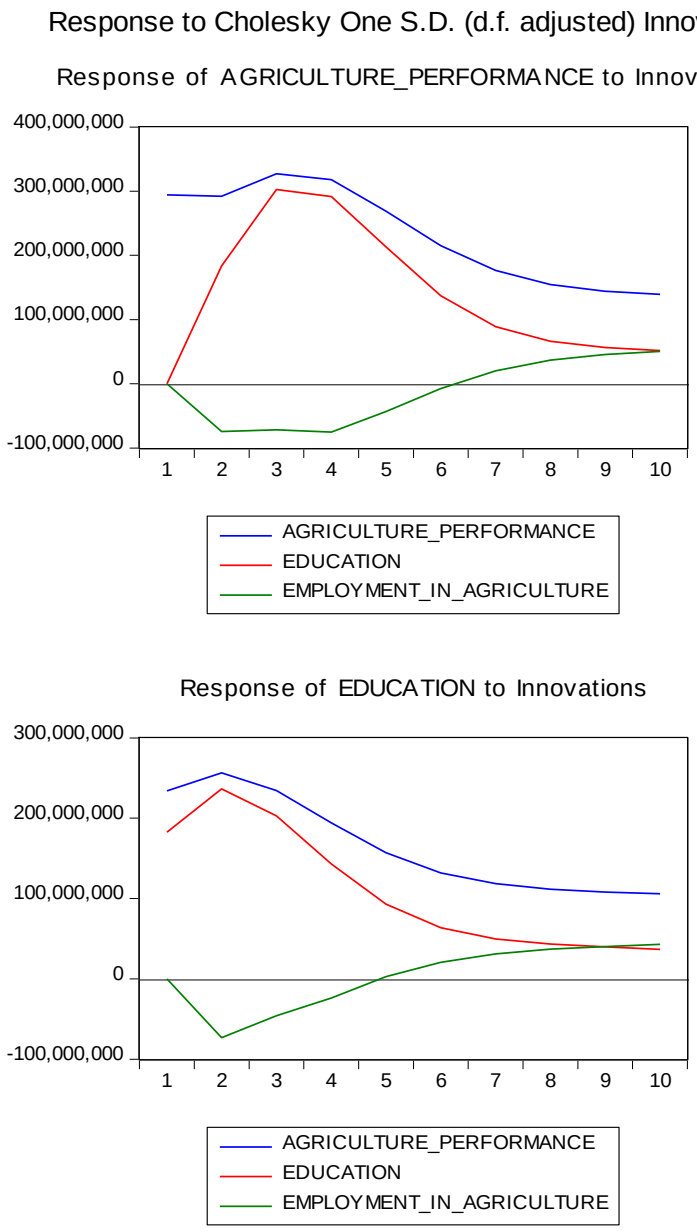
* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

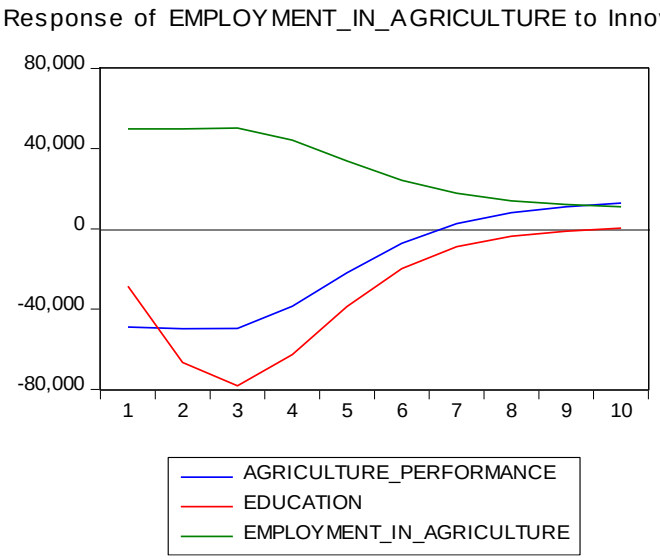
From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector Autoregressive estimation are shown in Table 5.

Table 5. The results of the Vector Autoregressive estimation

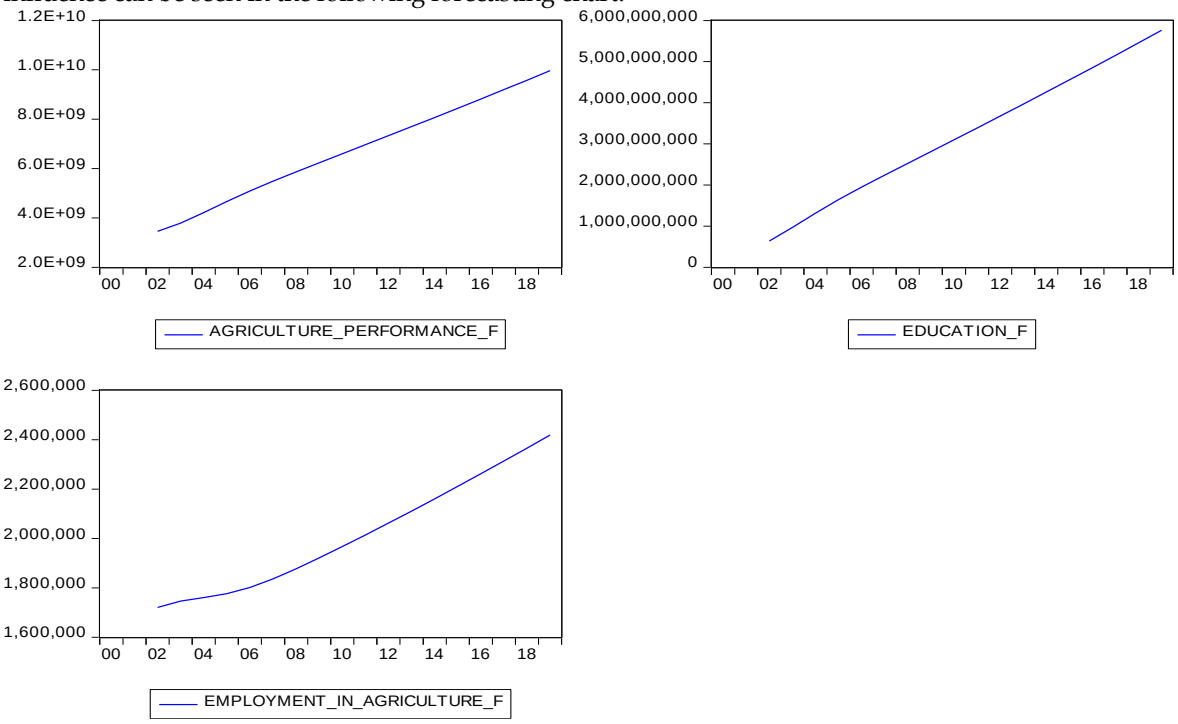
	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE
AGRICULTURE_PERFORMANCE(-1)	1.31E-01	-2.20E-01	1.63E-04
	-4.63E-01	-4.67E-01	-1.20E-04
	[0.28357]	[-0.47026]	[1.37120]
AGRICULTURE_PERFORMANCE(-2)	1.29E-01	3.76E-01	-1.61E-05
	-4.49E-01	-4.53E-01	-1.20E-04
	[0.28834]	[0.83102]	[-0.13988]
EDUCATION(-1)	7.69E-01	1.06E+00	-2.08E-04
	-4.95E-01	-4.99E-01	-1.30E-04
	[1.55519]	[2.13126]	[-1.63631]
EDUCATION(-2)	2.00E-01	-3.02E-01	3.36E-05
	-5.59E-01	-5.64E-01	-1.40E-04
	[0.35703]	[-0.53517]	[0.23427]
EMPLOYMENT_IN_AGRICULTURE(-1)	-1.50E+03	-1.47E+03	1.00E+00
	-1.70E+03	-1.71E+03	-4.36E-01
	[-0.88044]	[-0.85884]	[2.29594]
EMPLOYMENT_IN_AGRICULTURE(-2)	1.38E+03	1.79E+03	-5.45E-02
	-1.78E+03	-1.79E+03	-4.56E-01
	[0.77884]	[0.99792]	[-0.11959]
C	2.63E+09	-4.95E+08	-2.75E+05
	-1.60E+09	-1.70E+09	-4.21E+05
	[1.60407]	[-0.29906]	[-0.65322]
R-squared	9.91E-01	9.84E-01	9.25E-01
Adj. R-squared	9.86E-01	9.75E-01	8.85E-01
Sum sq. resids	9.52E+17	9.69E+17	6.27E+10
S.E. equation	2.94E+08	2.97E+08	7.55E+04
F-statistic	1.96E+02	1.10E+02	2.28E+01
Log likelihood	-3.72E+02	-3.72E+02	-2.23E+02
Akaike AIC	4.21E+01	4.21E+01	2.56E+01
Schwarz SC	4.25E+01	4.25E+01	2.59E+01
Mean dependent	6.81E+09	3.26E+09	1.99E+06
S.D. dependent	2.46E+09	1.87E+09	2.23E+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 0.986. This means 99% 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 1. This shows that in Ecuador 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 Ecuador. This indicates that Ecuador has succeeded in successfully investing in education to improve agricultural performance. Even though employment in agriculture in Ecuador had 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 Ecuador because the graph with an upward trend in the employment in agriculture graph, it shows that agricultural performance in Ecuador has the potential to continue to grow.

5 CONCLUSION

Ecuador has succeeded in successfully investing in education to improve agricultural performance. Even though

employment in agriculture in Ecuador had 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 Ecuador because the graph with an upward trend in the employment in agriculture graph, it shows that agricultural performance in Ecuador has the potential to continue to grow.

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