Communication Technology, Education, Health and Agriculture in USA

Seni Soniansih
UIN Syarih Hidayatullah Jakarta, Indonesia

Abstract : This study examines the direction of the relationship between human capital, Communication Technology and agriculture performance where education and health are indicators of human capital development in this study. This study uses vector analysis to see the direction of the relationship between education investment, health investment, inclusion of Communication Technology and agriculture performance. The data used is secondary data with an annual period from 2000 to 2019. We found that the growth of agricultural performance is in line with the inclusion of technology, education, and health investment in the United States. The inclusion of communication technology in the USA is indicated to be able to encourage agricultural performance which is supported by increased investment in health and education in the USA.

Keywords: Human Capital, Agriculture, Communication Technology, Vector Analysis

JEL Classification : C01,E24,J24, O14

1 INTRODUCTION

Agriculture and forestry are still some of the most important economic factors in the USA. 16% of the territory of the United States is used for agriculture. This makes the US the largest agricultural producer in the world with an area of 186 million hectares. This is characterized by the average land area of a farmer in the USA of about 170 ha, which is very high in international comparisons, which allows the use of large and sophisticated machinery. Therefore, someone talks about "agribusiness", where, in addition to family businesses, large multinational companies also produce agricultural products (Nijs,2014). The United States has long been a farming country. The Homestead Act, written by Abraham Lincoln, allowed anyone 22 years of age and over to acquire land by cultivating it for five years. This structure collapsed with the fall in food prices in the middle of the last century, and Agriculture Minister Wallace finally adopted the motto "Get it big or get it out" in the 1970s (Edwards et al,2017). The US now has the strongest farm in the world. Although environmental impacts have been a topic of discussion for two decades, the issue of soil erosion and drinking water plays little role in politics. In the US, several global companies dominate the market. They are now largely dependent on genetically modified organisms (GMOs). On the other side of the Atlantic, for example, four out of five sugar beets grown are genetically modified. The trend of organic cultivation continues to increase in the USA, especially maize cultivation. The trend of environmentally friendly agriculture continues to be developed in the USA.

Information technology has made a very high contribution to the return on investment in the USA. The global IT sector is dominated by US companies. Information technology in the USA enters various lines of the economy, including agriculture (Twumasi et al,2020 ; Mueller et al,2021).

The development of technology in the USA is inseparable from the role of education in the USA. School education usually lasts 12 years. The first professional qualifications can be obtained in high school. Most secondary schools offer vocational courses in grades 9-12 that are optional. There are also high schools (vocational high schools, technical high schools, career centers) that specialize in vocational programs. Both regular high school and vocational high school receive a high school diploma upon successful completion of school. As a rule, it is noted on the certificate whether a student has completed a professional specialization. Only the International Baccalaureate Diploma is different from the High School Diploma because the learning content here is based on international standards (Collins & Halverson,2018 ; Mpanga & Idowu,2021).

Americans live the "American Dream" and believe that hard work and ambition lead to prosperity and freedom. In the USA the task of maintaining the health of citizens is not in the hands of the state but is a private matter. Only older Americans and those in need are covered by federal health insurance (Medicare) or health care (Medicaid). There is no uniformly regulated health system in the US. There is a large number of private health insurance and the laws and

regulations regarding insurance are constantly changing. To protect themselves from the high costs, many US citizens take out private insurance instead, which they can find through the market. More than half of US citizens are insured through their employer, but only as long as they work there. Those who are uninsured pay for themselves or avoid unnecessary visits to the doctor (Powers,2018).

2 LITERATURE REVIEW

Today's modern communication systems are computer networks and computer networks with local units for human-machine communication. Even small phones are devices with multiple processors that need to communicate with each other. This process is very complex and can only be managed by modern software engineering methods. Information and communication technology is the key technology of the 21st century. It drives the digitization of economies and societies and, as a cross-sectoral technology, makes a decisive contribution to value creation in various application areas (Wijayana & Achjari, 2020).

Education is the key to the future. Education expands the creative possibilities of society and is the basis for economic development, cultural richness, and social cohesion. Education can thus also be described as capital for individuals, society, and the state. Health is a state of complete physical, mental and social well-being, and not merely the absence of disease or illness. With this in mind, the notion of health does not only include the state of the body itself but also includes the mind and social relationships. Health is not only necessary for personal happiness, but vice versa. Personal happiness makes healthy (Mora & Afriani,2021).

Human resources are labor potential (work capacity), which is based on education and training. The term human capital is explained by the high financial expenditures required to develop these skills and the resulting profitability. In doing so, use internal human capital appropriately in accordance with company goals. Thus, human capital has a decisive influence on increasing firm value and is therefore an important economic variable. Human capital, or human capital, is the economic value of working on skills and qualities that affect productivity, such as education. Investing in these qualities leads to higher economic performance. Human capital recognizes intangible assets and qualities that improve worker performance and benefit the economy. These qualities are inseparable from those who receive or possess them (Widarni & Mora,2021).

Agriculture is generally a part of primary production where in addition to labor, capital, and knowledge, land and livestock are also involved as factors of production. The principle of agriculture is simply that people grow crops and raise animals to feed themselves and others (Drean & Bawono,2021). Agricultural holding is a technical and organizational unit managed by a farmer. Its aim is to produce animal and vegetable agricultural products. If the agricultural business is run full time and the income from this activity is more than half, it is called the main profit. Apart from owners, farmers, family workers and/or non-family workers are often employed on the farm. Due to specialty crops such as hops or asparagus, agricultural businesses often rely on seasonal workers. With the growing world population and rapidly increasing global incomes, the demand for agricultural products continues to increase. Natural resources are constantly under pressure. Hunger and malnutrition not only harm the health of individuals but also significantly the development of the country. The entire food value chain from the fields where food is produced, through storage and processing, markets, trade, and transportation to consumption on the plate, is paramount to humanity. Sustainable agriculture that ensures healthy diets and conserves biodiversity is the basis for ensuring the human right to adequate nutrition.

3 RESEARCH OBJECTIVE AND METHODOLOGY

This study uses vector analysis to see the direction of the relationship between education investment, health investment, Technology Inclusion and agriculture performance. The data used is secondary data with an annual period from 2000 to 2019.

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	HEALTH	TECHNOLOGY_INCLUSION
Mean	1.62E+11	7.49E+11	2.41E+12	2.19E+08
Median	1.57E+11	7.29E+11	2.40E+12	2.23E+08
Maximum	2.24E+11	1.07E+12	3.64E+12	2.92E+08
Minimum	1.06E+11	4.84E+11	1.29E+12	1.22E+08
Std. Dev.	3.13E+10	1.75E+11	7.02E+11	4.58E+07

Based on Table 1 above, it appears that from the period 2000 to 2019, the average agricultural performance in USA is very high at around 162 billion USD which can be seen from the mean value in Table 1. with a high level of volatility at 31.3 billion USD. With an average number of people who use technology communication 219 million people with an average educational investment value of 749 billion USD, and Health investment 2410 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 2 below:

Table 2. stationarity test

Method			Statistic	Prob.**
ADF - Fisher Chi-square			6.54E+01	0.00E+00
ADF - Choi Z-stat			-6.76E+00	0.00E+00
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	1.00E-04	0.00E+00	3.00E+00	1.70E+01
D(EDUCATION,2)	5.60E-03	0.00E+00	3.00E+00	1.70E+01
D(HEALTH,2)	2.20E-03	0.00E+00	3.00E+00	1.70E+01
D(TECHNOLOGY_INCLUSION,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 3.

Table 3. Cointegration test results

Hypothesized		Trace	5.00E-02	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	8.14E-01	4.85E+01	4.79E+01	4.34E-02
At most 1	5.49E-01	1.82E+01	2.98E+01	5.49E-01
At most 2	1.34E-01	3.90E+00	1.55E+01	9.11E-01
At most 3	7.06E-02	1.32E+00	3.84E+00	2.51E-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 less than the Trace Statistics value and the Max-Eigen Statistics value which shows that there is have 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 Error Correction Model 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	-1.82E+03	NA	4.21E+78	1.92E+02	1.93E+02	1.92E+02
1	-1.73E+03	132.4413*	1.86e+75*	184.6146*	185.6088*	184.7829*

* 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

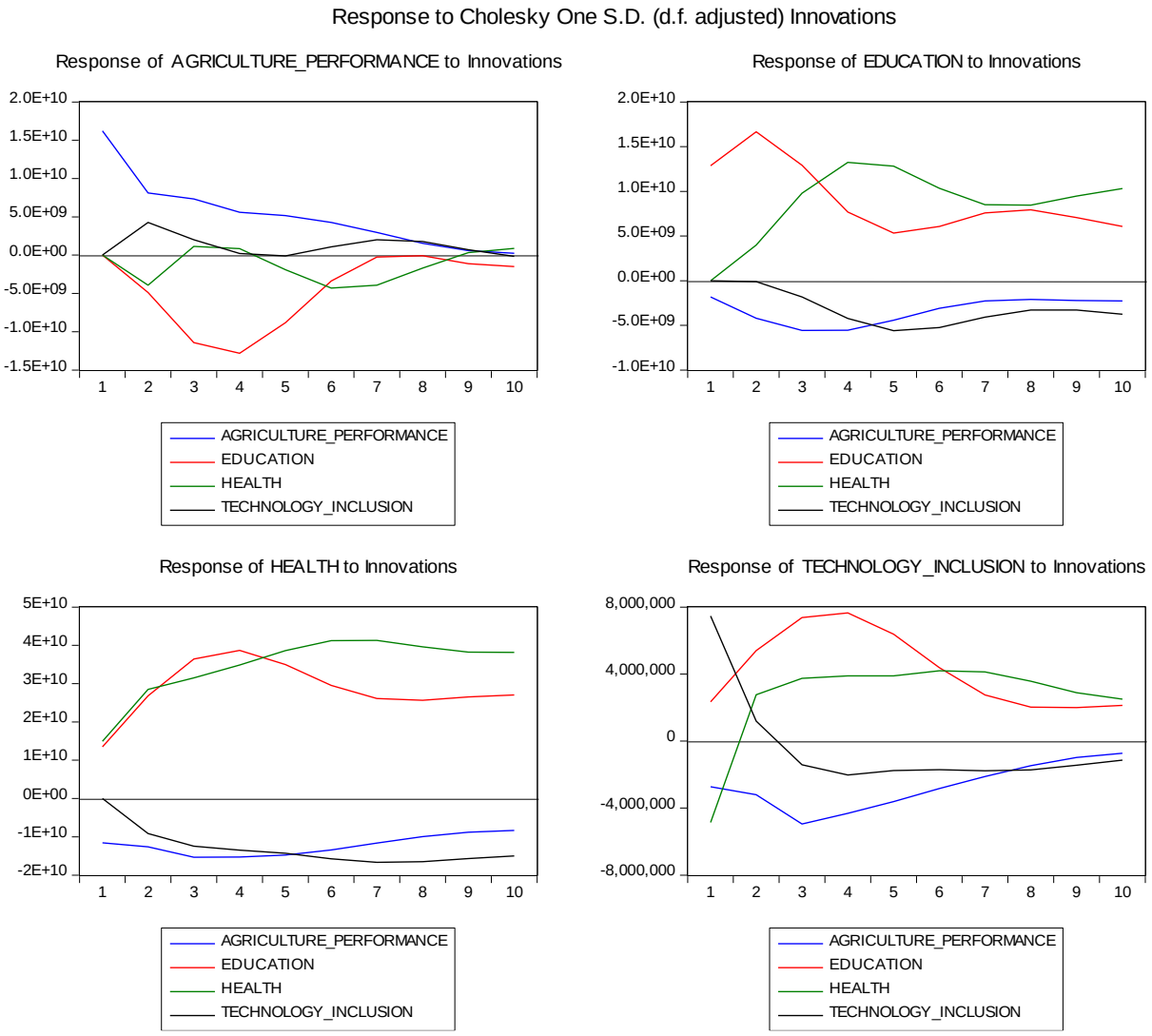
From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector Autoregressive are shown in Table 5.

Table 5. The results of the Vector Error Correction Model estimation

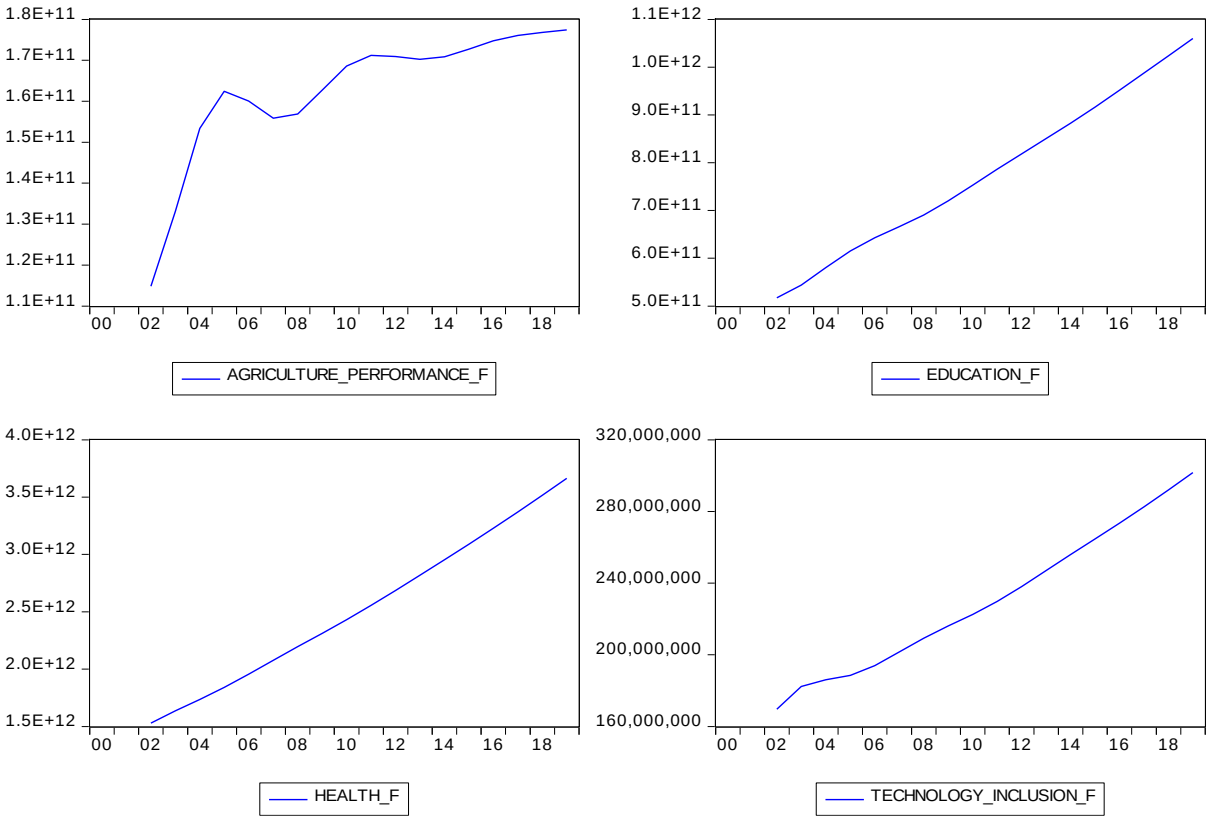
	AGRICULTURE_PERFORMANCE	EDUCATION	HEALTH	TECHNOLOGY_INCLUSION
AGRICULTURE_PERFORMANCE(-1)	4.97E-01*	3.96E-02*	1.73E-01*	1.45E-05*
	-4.14E-01	-3.31E-01	-5.92E-01	-2.40E-04
	[1.20022]	[0.11950]	[0.29260]	[0.05913]
AGRICULTURE_PERFORMANCE(-2)	2.64E-01*	-2.82E-02*	-2.99E-01*	-2.13E-04*
	-3.72E-01	-2.98E-01	-5.32E-01	-2.20E-04
	[0.70981]	[-0.09490]	[-0.56079]	[-0.96530]
EDUCATION(-1)	-4.04E-01*	1.02E+00*	7.24E-01*	1.41E-04*
	-4.44E-01	-3.55E-01	-6.36E-01	-2.60E-04
	[-0.91025]	[2.88141]	[1.13893]	[0.53774]
EDUCATION(-2)	-5.21E-01*	-7.76E-01*	-1.00E-01*	7.60E-05*
	-4.60E-01	-3.68E-01	-6.58E-01	-2.70E-04
	[-1.13252]	[-2.11126]	[-0.15263]	[0.27956]
HEALTH(-1)	-7.68E-02*	2.61E-01*	1.51E+00*	2.38E-04*
	-3.01E-01	-2.41E-01	-4.31E-01	-1.80E-04
	[-0.25527]	[1.08545]	[3.50414]	[1.33425]
HEALTH(-2)	2.88E-01*	-7.79E-02*	-5.95E-01	-2.43E-04*
	-3.01E-01	-2.40E-01	-4.30E-01	-1.80E-04
	[0.95800]	[-0.32416]	[-1.38298]	[-1.36674]
TECHNOLOGY_INCLUSION(-1)	5.73E+02*	-1.65E+01	-1.22E+03	1.59E-01*
	-5.31E+02	-4.25E+02	-7.60E+02	-3.14E-01

	[1.07744]	[-0.03886]	[-1.61042]	[0.50679]
TECHNOLOGY_INCLUSION(-2)	-2.06E+02	7.26E+01	2.90E+02	6.95E-02*
	-4.26E+02	-3.41E+02	-6.10E+02	-2.52E-01
	[-0.48230]	[0.21309]	[0.47484]	[0.27551]
C	1.62E+11	1.05E+11	1.89E+10	3.45E+07
	-7.60E+10	-6.10E+10	-1.10E+11	-4.50E+07
	[2.13780]	[1.73927]	[0.17457]	[0.77113]
R-squared	8.37E-01	9.97E-01	9.99E-01	9.63E-01
Adj. R-squared	6.93E-01	9.93E-01	9.99E-01	9.30E-01
Sum sq. resids	2.37E+21	1.52E+21	4.85E+21	8.30E+14
S.E. equation	1.62E+10	1.30E+10	2.32E+10	9.60E+06
F-statistic	5.79E+00	3.21E+02	1.58E+03	2.91E+01
Log likelihood	-4.42E+02	-4.38E+02	-4.49E+02	-3.09E+02
Akaike AIC	5.02E+01	4.97E+01	5.09E+01	3.53E+01
Schwarz SC	5.06E+01	5.02E+01	5.13E+01	3.57E+01
Mean dependent	1.66E+11	7.78E+11	2.53E+12	2.29E+08
S.D. dependent	2.93E+10	1.60E+11	6.34E+11	3.62E+07

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 0.837. This means 84% 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 USA the three variables influence each other. To see the direction of influence can be seen in the following forecasting chart:



Based on the forecast graph, it can be seen that the growth of agricultural performance is in line with the inclusion of technology, education, and health investment in the United States. The inclusion of communication technology in the USA is indicated to be able to encourage agricultural performance which is supported by increased investment in health and education in the USA.

5 CONCLUSION

The growth of agricultural performance is in line with the inclusion of technology, education, and health investment in the United States. The inclusion of communication technology in the USA is indicated to be able to encourage agricultural performance which is supported by increased investment in health and education in the USA.

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