The Role of Human Capital in Agriculture Development in Canada

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Abstract : This study examines the impact of the direction of the relationship of education and health development in Canada on agricultural development efforts in Canada. 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. We found that Canadian agriculture is increasingly productive and investment in education and health continues to increase. Of course, this is a good sign. The graph of employment in agriculture has increased up to the sixth period. However, it continues to decline. This indicates that there is a decrease in the number of people working in the agricultural sector. This could be due to an increase in agricultural technology so that the number of workers needed is decreasing or a sign of a large number of job options in Canada outside the agricultural sector.

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

JEL Classification : C01,E24,J24, J43

1 INTRODUCTION

Agriculture in Canada not only meets the food needs of the population but also plays an important role in Canada's foreign trade. Canadian agriculture is one of the most productive in the world with rapid productivity growth. Large areas of arable land, favorable climatic conditions contribute to the development of various agricultural sectors in Canada (Widarni & Drean,2021). Agriculture is developed in the southern regions of the country, while in the northern regions there are only deer farming, hunting, and fishing grounds. The most important agricultural areas are Central Canada and the Steppe Province, and they offer a wide variety of dishes. Central Canada, with its large population, is distinguished primarily by industries that cater to the needs of the urban population, suburban vegetable growing, horticulture, dairy farming, and poultry farming. Most of the products are sold in the local market, some of the livestock products are exported. The steppe province, due to the peculiarities of natural conditions, at the end of the 19th century began to turn into one of the leading grain specialty areas on a global scale. And to this day, the cultivation of cereals determines Canada's specialization in the world market for agricultural products.

Canada's higher education system is considered one of the best in the world. At the same time, the cost of studying at Canadian universities is much lower than in the US or Europe. There are 10 provinces in Canada, each of which independently establishes educational programs in schools and universities. In addition, the country has 2 official languages - English and French. Therefore, there is great freedom to choose what to study, according to what system and in what language. Canadian education is divided into preschool, secondary education, and higher education. With preschool, everything is simple from 4 to 6 years old, children go to kindergarten and get ready for first grade. We will consider secondary and higher education in detail. The advantage of Canadian school education is that the diversity and freedom of the child himself adds most of the subjects to his schedule. High school diplomas are issued after passing a number of compulsory subjects and elective subjects (Bennett,2020 ; Yang & Lesser, 2017).

Canada's healthcare system is considered one of the best in the world. Health care in Canada is funded primarily by taxes, both state and local income taxes and corporate income taxes. Some provinces use sales taxes and lottery revenues to fund health care systems. This additional income, however, does not play a large role in the financing of health care in Canada. Medicare is a government service and each province has its own health insurance program. In general, the programs are not much different, but there are certain peculiarities in the payment, for example, in some provinces, a monthly premium is paid for health insurance. However, newly arrived immigrants must immediately issue a Health Insurance Card. Health insurance cards are issued to each family member personally. The Health Insurance Card is a Canadian ID and is for personal use only (Deber,2018).

2 LITERATURE REVIEW

Human capital is everything on which a person's productive and high-quality labor depends, its

contribution to socio-economic development, namely, intelligence, health, knowledge, skills, and quality of human life. The "knowledge economy" took shape in developed countries in the second half of the 20th century and is a "complex of interconnected industries aimed at increasing the productivity and quality of human capital." The function of this complex is "the creation of knowledge, its dissemination through training, long-distance transmission, its transformation into skills and abilities, its use to increase efficiency, productivity, quality, for innovation." The "knowledge economy" includes R&D, all kinds of education, information and communication technology, as well as for biotechnology, health care (Mora & Afriani,2021 ; Widarni & Mora,2021).

This field of economics has been at the forefront of socio-economic dynamics over the last half-century. Its tremendous growth, in fact explosive, intensified by the advent of computers and the Internet, gradually replaced the real sector in the structure of GDP. In other words, the formation of a knowledge economy is part of post-industrial development, more precisely, "the highest stage of development of post-industrial society". At the same time, human capital has become the main factor of production. The most important property of the knowledge economy is that it has a significant multiplier effect on the development of all other industries. This largely explains the growing gap between developed countries and the rest. Thus, solving the problem of socio-economic development is not possible without the primary financing of the industries that create human capital (Rusmingsih et al.,2021). The success of developed countries is explained by changes in attitudes towards human resources from a public policy point of view in the form of government spending on social services, which are considered irreversible or considered as costs, starting to be seen as investments for the country's future prosperity. Investment in fixed assets in high-tech industry and infrastructure, combined with increased investment in human capital, will create a multiplier effect. Without the development of the knowledge economy, investment in hardware will be ineffective. The same parameters and investment directions are set in the medium-term socio-economic development program. The role of human capital is the driving force of non-human capital.

There was a time when industrial agriculture seemed like a panacea to a rapidly developing world. Synthetic fertilizers, chemical pesticides, and high-yielding grain hybrids promise to reduce hunger, increase populations, and spur economic prosperity. But not all hopes come true. Decades of industrial agriculture have dealt a heavy blow to the environment and raised serious concerns for future food production. Efficient agriculture is not only a matter of production, it is also about environmental sustainability, health care, and economic integration. Agricultural development is not only to improve agricultural performance but also to be environmentally friendly. Human capital acts as a driver and developer of non-human capital. With sufficient human capital, humans are getting smarter to develop agricultural technology that is more environmentally friendly. The role of education and health services are two important pillars in developing human capital (Drean & Bawono,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.

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 Canada.

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	HEALTH
Mean	2.35E+10	7.19E+10	3.47E+05	1.42E+11
Median	2.31E+10	7.63E+10	3.51E+05	1.57E+11
Maximum	3.50E+10	9.63E+10	4.08E+05	1.91E+11

Minimum	1.32E+10	3.66E+10	3.03E+05	6.14E+10
Std. Dev.	6.66E+09	2.13E+10	2.68E+04	4.70E+10

Based on Table 1. above, it appears that from the period 2000 to 2019, the average agricultural performance in Canada is very high at around 23.5 billion USD which can be seen from the mean value in table 1. with a high level of volatility at 6.66 billion USD. With an average number of workers 347 thousand people with an average educational investment value of 71.9 billion USD and Health investment 142 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 Canada.

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			6.21E+01	0.00E+00
ADF - Choi Z-stat			-6.61E+00	0.00E+00
Series	Prob.	Lag	Max Lag	Obs
D(AGRICULTURE_PERFORMANCE,2)	3.00E-04	0.00E+00	3.00E+00	1.70E+01
D(EDUCATION,2)	3.10E-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
D(HEALTH,2)	1.30E-03	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	6.58E-01	4.49E+01	4.79E+01	9.21E-02
At most 1	6.16E-01	2.56E+01	2.98E+01	1.41E-01
At most 2	3.21E-01	8.37E+00	1.55E+01	4.27E-01
At most 3	7.44E-02	1.39E+00	3.84E+00	2.38E-01

From the cointegration results, the critical value is higher than the Trace Statistics value and the Max-Eigen Statistics value which indicates that there is a no 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 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	-1.49E+03	NA	2.28E+67	1.66E+02	1.67E+02	1.66E+02
1	-1.43E+03	87.63576*	1.69e+65*	161.4852*	162.4746*	161.6217*
2	-1.42E+03	1.29E+01	3.32E+65	1.62E+02	1.64E+02	1.62E+02

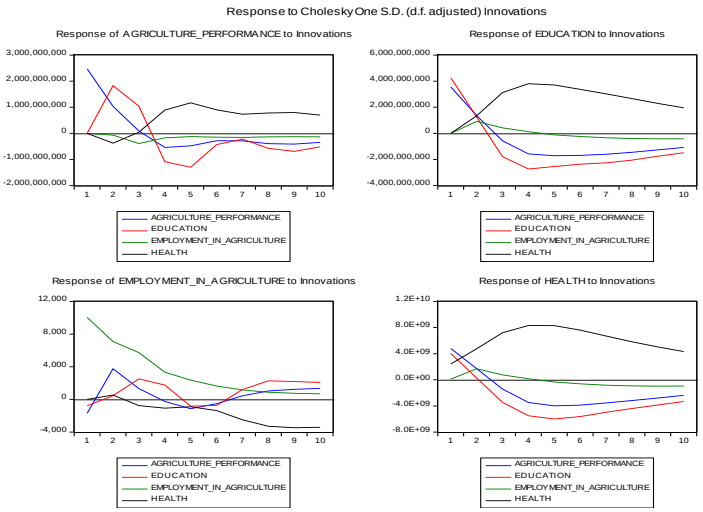
From the results of the Optimum lag test, it can be seen that the optimum lag is found in lag 1. The results of the Vector error correction model estimation are shown in table 5.

Table 5. The results of theVector Autoregressive estimation

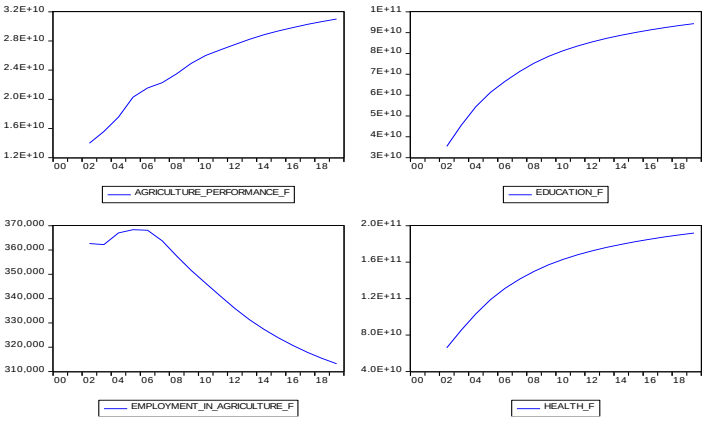
	AGRICULTURE_PERFORMANCE	EDUCATION	EMPLOYMENT_IN_AGRICULTURE	HEALTH
AGRICULTURE_PERFORMANCE(-1)	-1.12E-01*	-1.57E-01*	1.53E-06*	-4.79E-01
	-4.31E-01	-9.67E-01	-1.80E-06	-1.17E+00
	[-0.25869]	[-0.16224]	[0.86172]	[-0.40868]
AGRICULTURE_PERFORMANCE(-2)	-3.31E-01*	-2.79E-01*	-6.83E-07*	-7.24E-01*
	-2.77E-01	-6.21E-01	-1.10E-06	-7.53E-01
	[-1.19568]	[-0.44937]	[-0.59749]	[-0.96185]
EDUCATION(-1)	5.76E-01*	-2.14E-01*	2.07E-08*	-1.76E+00
	-3.22E-01	-7.23E-01	-1.30E-06	-8.77E-01

	[1.78788]	[-0.29611]	[0.01558]	[-2.01107]
EDUCATION(-2)	1.34E-01*	-6.16E-01	4.94E-07*	-2.73E-01
	-5.45E-01	-1.22E+00	-2.30E-06	-1.48E+00
	[0.24554]	[-0.50426]	[0.21932]	[-0.18436]
EMPLOYMENT_IN_AGRICULTURE(-1)	-5.25E+03	8.50E+04	7.04E-01*	1.48E+05
	-4.66E+04	-1.05E+05	-1.93E-01	-1.27E+05
	[-0.11267]	[0.81271]	[3.65465]	[1.16735]
EMPLOYMENT_IN_AGRICULTURE(-2)	-6.17E+04	-9.61E+04	5.26E-02*	-2.03E+05
	-5.42E+04	-1.22E+05	-2.24E-01	-1.47E+05
	[-1.13748]	[-0.79021]	[0.23499]	[-1.37457]
HEALTH(-1)	-1.56E-01*	5.54E-01*	2.25E-07*	1.96E+00*
	-2.53E-01	-5.67E-01	-1.00E-06	-6.88E-01
	[-0.61591]	[0.97656]	[0.21551]	[2.85078]
HEALTH(-2)	-1.17E-02*	2.79E-01*	-6.84E-07*	3.97E-03*
	-3.51E-01	-7.86E-01	-1.40E-06	-9.53E-01
	[-0.03329]	[0.35454]	[-0.47251]	[0.00416]
C	3.13E+10	3.08E+10	8.63E+04	6.32E+10
	-1.80E+10	-4.10E+10	-7.60E+04	-5.00E+10
	[1.69996]	[0.74485]	[1.13523]	[1.26225]
R-squared	9.13E-01	9.55E-01	9.02E-01	9.85E-01
Adj. R-squared	8.36E-01	9.14E-01	8.16E-01	9.72E-01
Sum sq. resids	5.51E+19	2.77E+20	9.40E+08	4.07E+20
S.E. equation	2.47E+09	5.55E+09	1.02E+04	6.73E+09
F-statistic	1.18E+01	2.37E+01	1.04E+01	7.61E+01
Log likelihood	-4.09E+02	-4.23E+02	-1.85E+02	-4.27E+02
Akaike AIC	4.64E+01	4.80E+01	2.16E+01	4.84E+01
Schwarz SC	4.68E+01	4.85E+01	2.21E+01	4.88E+01
Mean dependent	2.46E+10	7.56E+10	3.44E+05	1.51E+11
S.D. dependent	6.11E+09	1.90E+10	2.38E+04	4.06E+10

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 0.988. 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 2. This shows that in Canada 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 of the agriculture performance graph, education and health continue to increase. This indicates that Canadian agriculture is increasingly productive and investment in education and health continues to increase. Of course, this is a good sign. The graph of employment in agriculture has increased up to the sixth period. However, it continues to decline. This indicates that there is a decrease in the number of people working in the agricultural sector. This could be due to an increase in agricultural technology so that the number of workers needed is decreasing or a sign of a large number of job options in Canada outside the agricultural sector.

5 CONCLUSION

Canadian agriculture is increasingly productive and

investment in education and health continues to increase. Of course, this is a good sign. The graph of employment in agriculture has increased up to the sixth period. However, it continues to decline. This indicates that there is a decrease in the number of people working in the agricultural sector. This could be due to an increase in agricultural technology so that the number of workers needed is decreasing or a sign of a large number of job options in Canada outside the agricultural sector.

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