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The relationship between knowledge based economy and agriculture's value added

Mirnaser Mirbagheri hir
Department of economic, Payame Noor University, Tehran, Iran
Seyyed Ali Paytakhti Oskooe
Associate Professor, Department of Economics, Tabriz Branch, Islamic Azad University, Tabriz, Iran

Abstract

Agriculture facilitates and accelerates the economic growth and development through creating economic surplus, providing foreign currency for imports of capital and intermediate goods and supply of raw material supply requirements of the industry. Regarding great potential and capabilities, science and technology can improve productivity of agriculture section, the aim of this paper is to investigate the relationship between knowledge based economy and agriculture's value added . The empirical results from employing panel data technique suggest the positive relationship between knowledge based economy and agriculture's value added in both developed and developing countries. In comparison, it can be noted that the impact of knowledge based economy agriculture's value added in developed countries is more than developing countries. This may be the result of the gap between production and application of knowledge and information in developing countries. Therefore, it can be suggested that developing countries should improve their performances in the knowledge based economy indicators and its application in agriculture sector to achieve higher value added.

Keywords: Agriculture, knowledge based economy, developed countries, developing countries, Panel cointegration

**Corresponding author: Mail:mirbagheri_hir@yahoo.com*
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1. Introduction

In recent years, knowledge has increasingly become an important means for value creation. Economics activities are becoming more knowledge based; accordingly productivity and growth have become more dependent on knowledge (OECD,1999). The knowledge based economy represents the type of economy based directly on the knowledge and information production, distribution and utilization (Chen and Dahlman, 2004). The key component of a knowledge based economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources (Dahlman, 2002). The four pillars of the knowledge based economy which have been proposed by the World Bank; are categorized as follow:

(i) Education for a skilled workforce
(ii) Science and technology, and innovation
(iii) ICT infrastructure
(iv) Policy and regulatory environment

Because of production of essential food crops; Agriculture plays a critical role in the entire life of a given economy. In addition to providing food and raw material, agriculture also provides employment opportunities to very large percentage of population especially in developing countries. Agriculture facilitates and accelerates the economic growth and development through creating economic surplus, providing foreign currency for imports of capital and intermediate goods and supply of raw material supply requirements of the industry (Ghatak and Ingersant, 1984). A stable agricultural sector ensures a nation of food security. It is generally believed that development of agricultural sector is precondition for economic development of any country; as long as the barriers to development in this section is not removed, other parts of economics will not achieve to prosperity, growth and development.

Knowledge application enables firms to respond timely to the technological changes by applying the knowledge generated into products or processes to innovative activities (Song et al., 2005 & Li 2009). The knowledge-based economy emphasizes not only on the production and distribution of information and knowledge, but the

important thing in its application, is the effective use and application of different kinds of knowledge in all economic activities. Knowledge is now becoming the one factor of production, sidelining both capital and labor (Drucker, 1998).

Over the past three decades with amazing growth of science and new technologies, the need to apply them in providing food for people around the world more evident, the importance of these key technologies (biotechnology, nuclear technology, information technology and nanotechnology) has improved in growth and sustainable development of agriculture sector. On the one hand, these developments would provide traditional agricultural modernization and the possibility of making a broader range of goods and services and on the other hand, have improved human domination and exploitation of natural resources.

In the knowledge-based economy, traditional production methods in agricultural sector would be replaced with new techniques. Through introducing new production tools with high degree of efficiency the production in agricultural sector would be evolved. The knowledge-based economy by empowerment of labor force leads to fall in production cost and increase in productivity of agricultural sector. This empowerment is created by promoting education, skills, creativity and entrepreneurship. Accordingly, the agricultural production system is modernized based on modern science.

In the knowledge-based agriculture, production decisions, production methods, employing production tools and marketing activities would be changed. It can be noted that in this situation majority of behaviors and decisions have been made through using knowledge of scientific and technological progress. In this kind of agriculture, employing high skilled labor and mechanized tools have been concerned to achieve high value added.

The emergence of concentrated agricultural production has been characterized by intensive application of new production inputs such as engine-powered electromechanical devices, agri-chemicals, and the use of new and/or modified plant and animal materials (such as high-yielding breeds/varieties). As a result, new agricultural practices, handling and processing techniques have been developed to meet

growing consumer demand for reliable supply of consistently high quality, safe, diverse and nutritious food products (Opera, 2004).

Application of knowledge in agriculture is accompany with improving in efficiency and productivity of involved production factors; leading to rise in agricultural products. In this context, value added of agricultural sector would be increased and employed resources in this sector have been effectively used. This can be lead to realization of allocative efficiency in this sector of economy. It should be noted that concerning knowledge in the process of agricultural production through increasing quantities of products with the specialized amount of inputs (utilize labor, land, intermediate inputs, and capital) would be realized technical efficiency in this sector.

Regarding to useful potential outcomes of application of knowledge in agriculture sector, the aim of this paper is to examine the relationship between knowledge based economy and agriculture's value added in the both developing and developed countries. The rest of the paper is organized as follows. Section 2 reviews the empirical literatures. In section 3, the methodology and the data are presented. Section 4 includes the empirical results, and in the last section, conclusions and implications are presented.

2. Review of literature

Investigating the influence of knowledge on value added of agriculture has less been the subject of empirical studies. Most of empirical studies have been concerned economic growth or productivity of economic activities. This section attempts to survey the empirical studies related to knowledge based economy.

Scherngell et al. (2014) examine the effects of knowledge capital on manufacturing total factor productivity (TFP) in China through the lens of the regional knowledge capital model (KCM). The results from using panel data on 29 Chinese regions for the years 1988–2007 confirm the impact of knowledge capital on regional TFP.

Poorfaraj et al. (2011) estimate the impact of Knowledge Index consists of R&D, human resources and diffusion of ICT on economic growth in developing countries. Their findings for the period 2000-2008 for 16 developing countries based on panel data econometrics method indicate that the impact of knowledge index on economic growth is positive and significance.

In the case of OECD countries, Pessoa (2010) show the role of R&D intensity in improving aggregate productivity. Coe et al. (2009) examine the role of international R&D spillovers and institutions in total factor productivity of OECD. Results for the period 1970-2004 show the positive effect of R&D and human capital on total factor productivity. Based on U.S. data for the 48-year-period 1953–2000, Geol et al.(2008) show importance of R&D for economic growth.

Karagiannis (2007) investigate the effect of knowledge based economy on economic growth in European Union for the 1990–2003 period. Results suggest that R&D expenditure originating from abroad affect GDP growth rates significantly and positively. Employing data for Central and Eastern European (CEE) countries and Russia (CEER) during the 1990s, Piatkowski and Ark (2005) show that investment in ICT had a considerable effect on economic growth. In the investigation by Chen and Dahlman (2004) for 92 countries over the period 1960-2000, empirical results imply that knowledge is the main factor in achieving to long term economic growth.

3. Methodology

In this paper, the relationship between knowledge based economy and agriculture's value added for 16 selected countries (8 developing countries[1] and 8 developed countries[2]) is examined during 2002-2014. In order to estimate this relationship, the panel technique with the dynamic ordinary least squares (DOLS) method has been employed. Based on the theoretical background and empirical studies the econometric model has been modified as follow:

$$nAV_{it} = ?_0 + ?_1 LnKE_{it} + ?_2 LnAX_{it} + ?_3 LnAK_{it} + ?_4 LnAF_{it} + ?_{it} \quad (1)$$

Where:

$LnAV_{it}$: agriculture's value added

$LnKE_{it}$: Composite Index of knowledge-based economy. This index is calculated by employing unweighted Morris index[3]. To this end, government's training expenditures, expenditures of information and communication technology, patented inventions and innovations, research and development expenditures, quality control, Internet users

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1 . Colombia, Costa Rica, Ukraine, Romania, Iran, Mexico, Bulgaria and Turkey

2 . England, Denmark, Finland, France, USA, Netherlands, Sweden and Luxembourg

3 . For more details see Gallopin& Raskin (2000)

and scientific papers published in the scientific data bases have been used.

$LnAX_{it}$: export of agriculture products

$LnAK_{it}$: fixed gross capital formation in agriculture section

$LnAF_{it}$: fertilizer consumption in agriculture section

$?_{it}$: random error term

Ln represents the natural logarithm. Data on all variables have been extracted from the World Bank Indicator.

4. Empirical Results

4.1. Stationary Test

Tables 1and 2 report empirical result from the Levin, Lin and Chu (LLC) panel unit root test. As it can be seen from table 1 for selected developed countries, agriculture's value added, Composite Index of knowledge-based economy, export of agriculture products and fertilizer consumption in agriculture section variables are stationary at the level (I(0)), where variable of fixed gross capital formation in agriculture section gets stationary with the first difference (I(1)). In the case of developing countries according to table 2, results are the same.

Table1. LLC Panel Unit Root Test- developed countries

Variable	At level	At first differences
LnAV	0.0002 -2.9425	-
LnKE	0.0002 -3.5273	-
LnAX	0.0061 -2.5054	-
LnAK	0.1441 -1.1118	0/0001 -3.7096
LnAF	0.0088 -2.3751	-

Table2. LLC Panel Unit Root Test- developing countries

Variable	At level	At first differences
LnAV	0.0000 -4.4298	-
LnKE	0.0000 -4.6323	-
LnAX	0.0001 -3.6225	-
LnAK	0.2718 -0.6070	0.0002 -3.4168
LnAF	0/0000 -5.9794	-

Regarding to the I (1) property of some variables, cointegration or long-run equilibrium relationship between variables should be

investigated. To this end, the Kao cointegratio test results have been shown in the tables3 and 4. From the tables 3 and 4 it can be concluded that there is cointegration or long-run equilibrium relationship between variables.

Table3. Panel kao cointegration test- developed countries

ADF	t-Statistic	prob
	-4.7656	0.0006

Table4. Panel kao cointegration test- developing countries

ADF	t-Statistic	prob
	-2.2292	0.0129

4.2. Estimation of models

The fixed effect test has been employed to determine the type of model (panel or pooling method). The empirical results of the fixed effect test in tables 5 and 6 suggest that the panel method must be used in the estimation process.

Table 5. Results of the fixed effects test- developed countries

	Test Statistic	d.f	Prob
Cross -Section F	69.6861	70/92	0.0000
Cross-section Chi-square	191.4536	7	0.0000

Table 6. Results of the fixed effects test- developing countries

	Test Statistic	d.f	Prob
Cross -Section F	48.598	70.85	0.0000
Cross-section Chi-square	160.2838	7	0.0000

The Hausman test is employed in order to specify the type of estimation in terms of the fixed or random effects. Empirical results from Hausman test in tables 7 and 8, implying use of the fixed effects method in estimation of the modified model.

Table7. Results of the Hausman test- developed countries

	Test Statistic	d.f	Prob
Cross-section random	187.3161	4	0/0000

Table8. Results of the Hausman test- developing countries

	Test Statistic	d.f	Prob
Cross-section random	157.7403	4	0.0033

The empirical results from estimating model have been reported in tables 9 and 10. Based on the research findings in the case of developed countries, there is positive relationship between knowledge based economy and agriculture's value added. It seems that knowledge based economy improvement leads to rise in value added

of agriculture sector. Furthermore the effects of other variables (export of agriculture products, fertilizer consumption in agriculture section and fixed gross capital formation in agriculture section) on agriculture's value added are positive and significance.

As it can be seen from the table 10, positive relationship between knowledge based economy and agriculture's value added is confirmed in developing countries. The impacts of other variables are also positive.

In comparison, it can be noted that the impact of knowledge based economy agriculture's value added in developed countries is more than developing countries. This may be the result of the gap between production and application of knowledge and information in developing countries.

Table9. The estimation results of model - developed countries

Variables	Coefficient	Std. Error	t-Statistic	Prob
C	5.5041	0.3149	17.4766	0.0000
LnKE	0.1392	0.0147	9.4607	0.0000
LnAF	0.0220	0.0063	3.4587	0.0008
LnAK	0.0844	0.0260	3/2396	0.0017
LnAX	0.3477	0.0308	11.2687	0.0000
R^2	0.9863			
Adjusted R-squared	0.9847			
Durbin-Watson stat	1.5999			

Table10. The estimation results of model - developing countries

Variables	Coefficient	Std. Error	t-Statistic	Prob
C	20.7387	7.0952	2.9229	0.0042
LnKE	0.0713	0.0186	3.8285	0.0002
LnAF	0.0118	0.0053	2.2209	0.0290
LnAK	0.0379	0.0156	2.4317	0.0171
LnAX	0.1020	0.0412	2.4759	0.0153
R2	0.9861			
Adjusted R-squared	0.9843			
Durbin-Watson stat	1.8828			

5. **Concluding Remark**

Employing panel cointegration technique this paper examines the relationship between knowledge based economy and agriculture's value added in both developed and developing countries over the period 2002-2014. Empirical findings show that knowledge based economy has positive impact on the value added of agriculture sector in these countries. In other words, the results support the importance role of the knowledge based economy in creating value added of agriculture sector.

Regarding the less relationship between knowledge based economy and agriculture's value added in developing countries in comparison with developed countries, it is suggested that the developing countries should improve their performances in the knowledge based economy indicators and its application in agriculture sector to achieve higher value added.

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