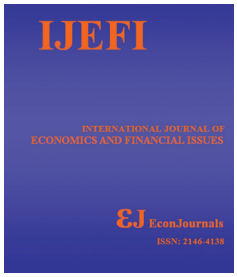

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The Relationship Economic Complexity and Education Expenditure: A Empricial Analysis on South Korea

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ABSTRACT

South Korea exhibited a noteworthy economic performance with development policies it carried out in 1962. The resources of this economic leap have been widely the subject of researches in the literature. It has been taken as an sample experience especially in the development projections of developing ccountries. This country, which was in a poor country position by 1960s has managed to get to developed country position within the period of 50 years. The relevant studies have shown that the sources of South Korean economic growth and development are the importance attached to education, innovation and R and D studies and development plans including structural changes in these areas. The production of products with high value added and having multinational companies producing these products, which is one of the most important sources which provide for developed countries to have a competitive advantage in the world economy, was considered significant for South Korean economic growth and development in the present study. In this context, the effects of expenditures for higher education on industrial production through the production of products with high value added was investigated. It was found as a result of this empirical study, in which Johenson cointegration analysis and vector error correction model and granger casualty methods were used, covered 1970-2015 period that educational expenditures has increased industrial production through econpmical complexity.

Keywords: South Korea, Economic Complexity, Education Expenditure
JEL Classifications: H52, I2

1. INTRODUCTION

South Korea made Korean war in the period of 1950-53, and was at the top of the countries with the lowest national income in the world by 1950s. South Korea, which spent the postwar period of 1953-62 with the assistance of USA, prepared the first 5-year development plan in 1962. Accordingly, the future of South Korean economy was projected by 5-year development plans that were prepared and put into practice.

The main elements of the country's development plans which have an importance place in the economic growth and development of the country were set as export-oriented growth, industrial investments increasing policies, outward-oriented economy model. Accordingly, with first and second development plans covering the period of 1962-71, it was aimed to achieve economic growth, getting out the vicious circle of poverty. In this context, with export-oriented growth model, the development of light industry and import-substitution industrialization was aimed. Subsequent to these plans that resulted in success, fourth and fifth development plans for the period of 1972-81 were prepared and put into practice. With these plans, for industry to have a more contemporary structure, and providing for technological progress and increasing efficiency were aimed, and to achieve this goal; making investments in heavy industries and chemical industry and expansion of social capital investments were targeted. Sixth and seventh development plans were prepared for the period of 1982-91 during the economic growth process created by South Korean succesfully prepared ecomic development plans. With these plans, it was aimed to increase economic competetive

power and accordingly to constitute the infrastructure of having a developed economy. In the line with this aim, it was aimed to create an outward oriented economy. South Korea aiming to become an important actor of global economy with its globalization and liberalization movements in its successfully growth process actualized a new economic plan that includes reform movements for the period of 1992-97.The Asian crisis occured in 1997 interrupted the South Korean economic growth, and short term plans aiming to overcome crisis and development plans to be applied after crisis is over were made as of this period (Çakmak, 2016. p. 161).

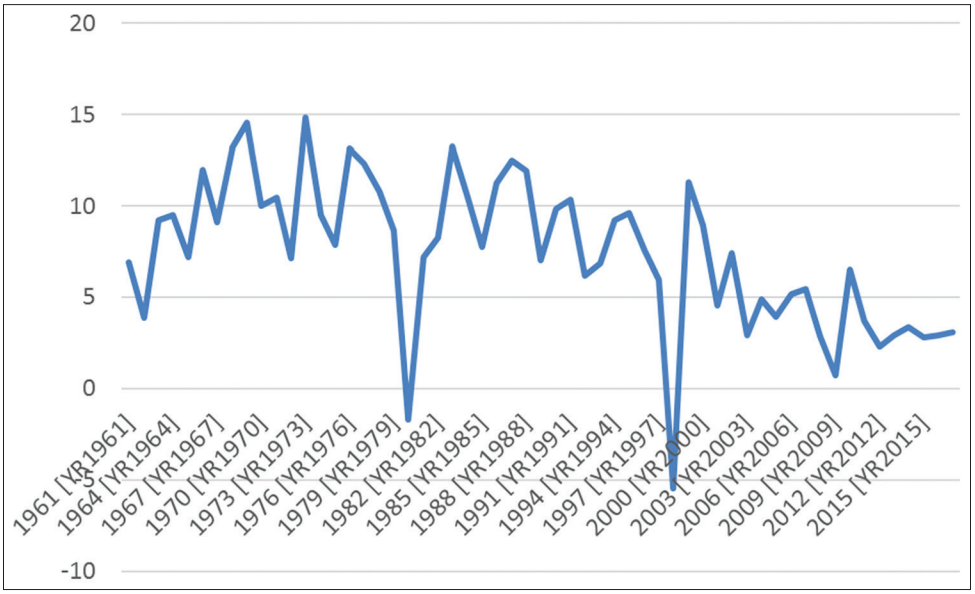
The course of South Korean economic growth in planned periods, achieved a succesfull economic performance projection with development plans put into practice, is given in Figure 1.

The South Korean economic growth rates accelerated with the effect of development plans applied as of 1961. The economic liberalization aimed in the second development plan was promoted by both import-substitution industrialization and infrastructure investments and the importance attached to exchange rate stability was of vital importance for economic growth (Collins and Park, 1988). The private sector was continued to be promoted in the third plan covering the period of 1972-76, and studies for the removal of interregional development differences were performed. Agricultural production was encouraged. The third development plan, which resulted in a growth rate of 10.2% in average was continued with fourth development plan. The petroleum crisis experienced in this period hindered for expected result from fourth plan to be obtained. The inflation rate that rose up 25.6% and declined economic growth rate resulted in economic shrinkage by 8% in 1980. After the economic shrinkage, an export oriented industrialisation policy was adopted in South Korean economy developing in parallel to the globalization tendeny in the world, and economic growth was accelerated with fifth development plan put into practice. After this plan covering the period of 1982-86 was put into practice, economic growth realized 8.7%, above expectations (Tunçsiper and Fırat, 2016. p. 850). In the proceeding process, with sixth development plan covering the period of 1987-91 and revised in 1988, liberalization of import, supporting small and medium scaled enterprises and improvement of social rights of public were aimed and a growth rate of 7.3% was obtained (TMMOB, 2007. p. 75). The development plan prepared for the period of 1992-97 was revised due to government reshuffle, and was put as a new economic plan into practice, with the aim of increasing South Korean competitive power in global market. Economic growth actualized 7.7% within financial liberalization, technological progress, efficiency increase oriented plan period (Çakmak, 2016. p. 161). The economy plans of South Korean economy shrinking with the effect of Southern Asian crisis faced in 1997 replaced with economy programs from this date. South Korean economy growing by 4.7% in average by 2000s faced with the most significant decline in 2008 global economic crisis. This decline actualized in parallel to the shrinkage in world's economy was overcome by the year 2009. South Korean gross domestic product (GDP), actualized as 1 trillion dollars in 2010, 1.1 trillion dollars in 2011 increased by 6.1% in 2010, 3.1% in 2011.

While South Korea was an underdeveloped country with GDP of 2.3 billion US dollars (91 US dollars per capita) on the basis of fixed prices, having poor natural resources, a small market, and crowded population (25.7 million) in 1961; its GDP rose up 1.377 billion US dolars (27.538 US dollars per capita) and population 51 million in 2016. According to purchasing power parity, while its income per capita was 944$ in 1960, it rose up 22.086$, increasing 23.3 times. In the same period, Eastern, Asian and Pacific countries (except high income countries) could increase their income percapita by 13.9 times and Turkey 3.3 times (Çetin and Karadaş, 2018. p. 96).

When above mentioned South Korean economic growth dynamics were considered, three significant factors draw attention. These three factors were determined as the sources of South Korean economic growth journey.

Figure 1: Economic growth



Source: http://databank.worldbank.org/data/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators#

- Educational expenses
- R and D expenses and activities
- Production of product with high added value
- Educational expenses.

The relationship between educational expenses and economic growth has an important place in the theory of economics. The importance of education has been especially underlined in new economic development models created by inclusion of human capital factor in the economic growth of countries. The endegenous growth concept first suggested by Romer (1986) and Lucas (1988) and then developed by 1990s poits out that the sources of economic growth are included in endegenous dynamics of a country. In this sense, education is primary endegenous dynamics, and deemed as the most significant resource of human capital.

Capital is deemed as one of the production factors like physical capital, and the effect of education on economy is underlined in the human capital model developed by Lucas (1988) and Rebelo (1991). The growth model suggested by Romer (1990), Grossman and Helpman (1991), Aghion and Howitt'in (1998) in their study points out the importance of R and D studies. The public policy model created by Barro (1991)'s study assumes goods and services supplied by public sector as a production factor, and asserts that state should support production from educational and R and D aspect.

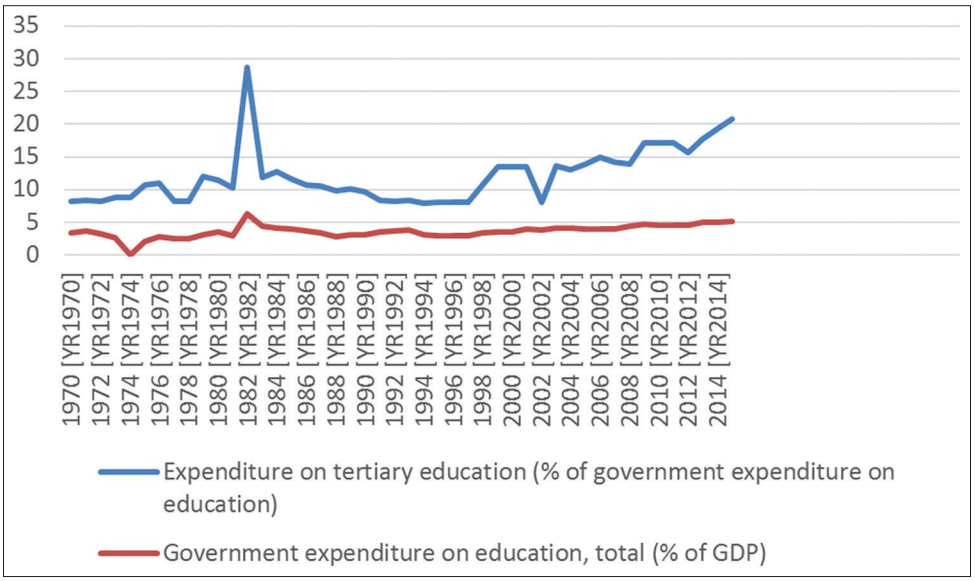
The importance attached to education and R and D studies throughout economic growth process, promoted by endegenous growth models, and as a result, high economic growth through production of product with high added value was deemed significant in South Korean economic growth process and found worthsearching experientially by this study, in the framework of theory and South Korean experiences. Because, South Korea, which has managed to grow economically has attached importance to education by years. In this sense, the rate of educational expenses in public expenses is given in Figure 2.

As is seen from the graph, the rate of educational expenses in GDP increased by years in South Korean economy. While educational expenses constituted only 25% of total budget in 1951, it rose up above 17% in 1966. This permanent increase has continued from mid 1980s to today, and about 15% of total public expenditures was allocated for educational expenses in the period of 2000-2008. South Korea is among the countries with highest rate of literacy, in parallel to the educational expenses. Besides, it is seen that the majority of the pupulation of South Korea are highschool and university graduates.

The rate of educational expenses in GDP constantly increased since 1975. And consequently, the number students enrolled to secondary education (high scholl) and higher education, and their rate in total population constantly increased. For instance, the rate of students enrolled to higher education was 16% in 1980, it rose up 52.5% in 2000, 70% in 2016. The number of enrolled students reached to 81,000 in 1960, 647,000 in 1980, and 3.5 million in 2008. While a large portion of educational expenses was incurred by public in organisation for economic co-operation and development (OECD) countries, the contribution of private section to education takes very important place in South Korea. The share of 7.3% that was allocated from South Korean families' budgets for their children's educational expenses is pretty above of the avareage of OECD countries' (Güngör and Göksu, 2013). For example, the shares that were allocated by families in USA and Japan for their children's educational expenses were 2.6% and 2.2%, respectively, these shares were of 1.4%, 0.8%, 0.8% in United Kingdom, France and Germany respectively (Çetin and Karadaş, 2018. p. 106).

According to UNESCO, educational system in Korea is explained by the concepts of democratization, autonomy, localization and globalization (Levent and Gökkaya, 2014). In the study by Lee 2008, the prominent characteristics of South Korean education system are expressed as fast extension of schooling at all levels, putting efficieny policy into practice, high amount resource

Figure 2: Educational expenditure



Source: http://databank.worldbank.org/data/source/world-development-indicators#

allocation to education, willingness in education, higher private lesson expenses, excessive central education management, lack of diversity, dilemma between perfection and owners' equity, having low confidence in school education, maximum competition to get accepted into colleges.

The importance attached to education and investments, and to research and development activities have yielded productive results in South Korean rapid economic development progress. South Korea has followed a planned science an technology policy since 1960s. It has been intended to establish scientific and technological infrastructure, centralized technology transfer management and to transfer technology to large companies, be undertaken important duties in production, restrict technology transfer with advanced technology, improve conventional technologies with domestic R and D studies.

R and D studies, which are supported by private companies and education in South Korea, emphasis laid on vocational training, and technological progresses which is core element of development plans have reflected on the number of researchers in the country as indicated in Figure 3.

The number of researchers, deemed as an output of human capital investments in South Korea, show a constant increase by 1996. As is shown in Figure 3, the number of researchers which was about 2000/1 million people in 1996, rose up about 7000 people in 2015. In parallel to the mentioned development, the course of research and development expenses by years is given in Figure 4.

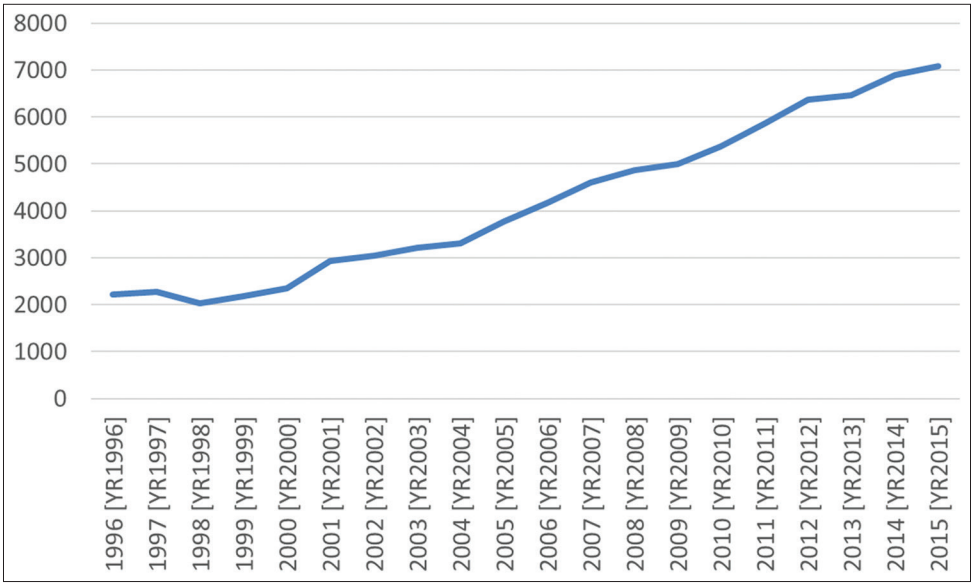
The share of R and D expenses in GDP was about 2% in 1996, it rose up about 4% in 2015. With transformation South Korea faced in 1980s, The majority of R and D studies was undertaken by private sector, which made product development, sales and marketing easier, and provided for private sector to have a competitive structure in international markets (Arslanhan and Kurtsal, 2010).

While the share of private sector in R and D expenses was 32% in 1971, it rose up 80% in 2008. The factors such as the application of state's inovation policy independently from governments, constantly increasing invetment in education, transformation of R and D investments into an economy policy, industry and private sector's high amount investment in R and D, labor with high educational level and global companies in competition with the world, fast adaptation capability to technological and industrial innovations have made contribution to the development of. Large companies awaring the positive effect of R and D studies on economy have developed special strategies, and followed proceeding-oriented polies. 4 large chaebol, including Hyundai, LG, Samsung ve SK spent 4,731 billion Korean Wonfor R and D studies in 2000, and continued to behave like that in 2001 as well. While private enterprises tended to expand their R and D investments by 20% in 2000, public driven universities, institutions and laboratories only by 9%. South Korea is ranked as the fifth in respect to total patent number, and has 5% of total patents in the world. The importance attached to R and D and education, and successfull results obtained have positively affected the economy. The development of industrial production index in South Korean economy by 1960 is shown in Figure 5.

The graph shows the reflections of development plans applied in South Korean economy by 1962 on real economy. It is seen from Figure 5 that industrial production constantly increased from 1960 to 2017.

South Korea achieved economy success with development plans put into practice after 1962. In this sense, the role of production of product with high value added, as a transfer canal in the specifity of higher education expenses, on the resourse of the increase in industrial production in South Korea by years was investigated in the study.The aim of the study is to put forward the importance attached to higher education for South Korean economy, and as an output from here, the effect of the production of sophisticated product on industrial production and accordingly to propose a

Figue 3: Researchers



Source: http://databank.worldbank.org/data/source/world-development-indicators#

Figure 4: R and D expenditure

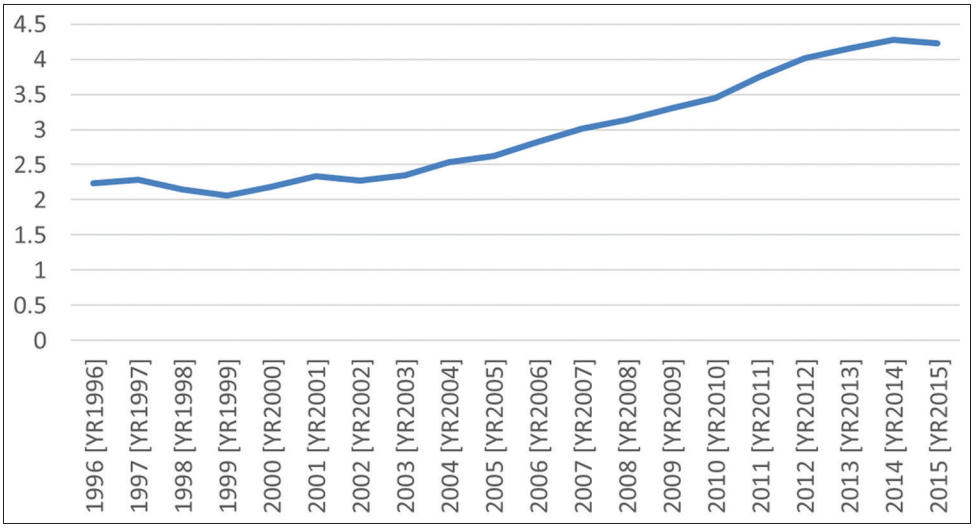


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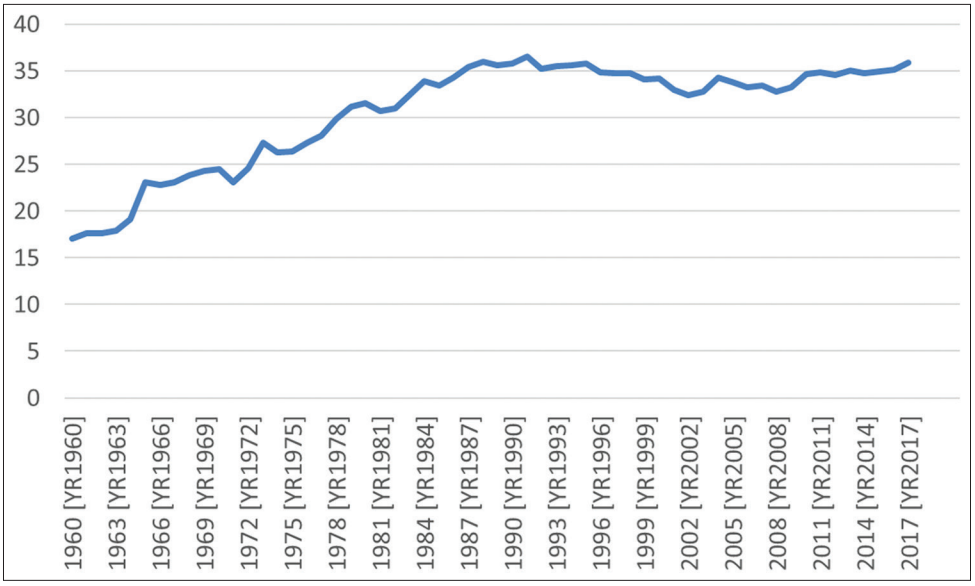
Figure 5: Sınai production index



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development plan that will provide the production of sophisticated product for developing countries.

2. EMPRICIAL ANALYSIS

Whether economic complexity has a transfer role while higher education expenses for the period of 1970-2015 has effect on industrial production index was empirically investigated in the study.

2.1. Data

The data of the study and symbols used in the analysis and their references are given in Table 1.

Table 1: Variables

Code	Variables	References
EK	Ekonomic comlexity	Atlas media
EHT	Expenditure on tertiary education	World bank
SUE	Sınai production index	World bank

Table 2: Unit root test results

Variables	ADF		PP	
	I (0)	I (1)	I (0)	I (1)
EHT	−4.20*	−10.55*	−4.40*	−14.33
EK	1.07	−7.08*	3.37	−8.88*
SUE	−6.57*	−8.06*	−11.47*	−16.61*

*0.01 sigificiant level

Economic complexity is an index created by Atlas media on countries' production of products with high value added. In the study, this index is used to interrogate whether educational expenses can be used as a transfer tool to reflect economy. Educational expenses represents the share of higher education expenses in total educational expenses of the country. Industrial

Table 3: Johenson cointegration test results

Hypothesized number of CE (s)	Eigen.V.	Trace statistic	0.05 critical value	Max-eigen statistic	0.05 critical value	Probability**
None*	0.691134	87.69265	29.79707	49.34356	21.13162	0.0000
At most 1*	0.446271	38.34910	15.49471	24.82538	14.26460	0.0000
At most 2*	0.275297	13.52371	3.841466	13.52371	3.841466	0.0002

production index refers to the annual change in industrial production.

2.2. Research Results

Empirical analysis was fictionalised for the investigation of casualty relationship between variables. In this sense, VAR model was created, and granger casualty analysis was used as the method of the study.

According to unit root test results, educational expenses and industrial production index I (0) are stationary stationary at the level of economic complexity I (1). The presence of the relationship between variables containing unit root at different levels were investigated with cointegration tests. The fact that all relevant variables became stationary at I (1) level is seen in Table 2. In other words, this situation makes possible to use cointegration method. In this sense, applied Johenson cointegration test results are given in Table 3.

Johenson cointegration test results show that there are 3 cointegrated vector among variables. In this case, a statistical long term relationship was determined between higher education expenses, economic complexity and industrial production index in South Korean economy at 0.05 significance level.

Vector error correction model (VECM) was established through variables and Granger casualty analysis was applied in order to determine short term course of the long term relationship determined between variables. The findins of VECM are given in Table 4.

The error correction term obtained through VECM results was found significant and with negative sign, which shows that imbalances occured in long term in the model were balanced in short term.

Following VECM, Granger casualty test results that allow the determination of the course of statistically significant relationships between variables are given in Table 5.

According to granger casualty analysis results; bidirectional casualty relationship was determined between educational expenses and industrial production index; unidirectional casualty relationship from educational expenses to economic complexity; unidirectional casualty relationship from economic complexity to industrial production index.

Table 4: VECM results

Cointegrating Eq	Coint Eq1
DEK (−1)	−19.78664
	(7.76314)
	(−2.54879)
DSUE (−1)	0.640374
	(0.10194)
	(−6.28187)
C	0.376713
CointEq1	−1.454342
	(0.24292)
	(−5.98682)

VECM: Vector error correction model

Table 5: Granger causulty test rsults

Excluded	χ^2	df
Dependent variable: EHT		
DEK	2.641572	2
DSUE	30.93412*	2
All	33.17698	4
Dependent variable: EK		
EHT	5.340803*	2
SUE	1.065235	2
All	6.141250	4
Dependent variable: SUE		
EHT	14.63813*	2
EK	30.04995*	2
All	37.07326	4

*%1 siginificiant level

3. CONCLUSION

South Korea has entered into a great growth process, through development plans it put into operation since 1962. The dynamics of South Korean economic growth process are listed as educational expenditures, R and D activities, and production of product with high value added. As well as South Korea directs its economy pursuant to development plans, it also attaches importance education especially vocational education, research and development activities, and increase industrial production through outputs obtained as a result of these activities.

In this regard, the mediator role of production of sophisticated product was investigated in the process of transformation of educational expenditures of the period of 1970-2015 into industrial production in South Korean economy. The first finding of the study is that educational expenditures, economic complexity and industrial production index are all cointegrated. In other words, there are statistically significant relationships between long term educational expenditures, industrial production index and economic complexity in South Korean economy. Besides, according to error correction model established and obtained granger casualty test results; educational expenditures are granger reason of economic complexity and industrial production. Moreover, economic complexity is the granger reason of industrial production.

The analysis findings shows that educational expenditures allocated for higher education in South Korea affects economic

complexity and accordingly industrial production. In this regard, industrial production in developing countries can be increased by increase of educational expenditures and development of industry-supported higher education, and accordingly, an effective economic growth process can be entered.

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