PROCEEDING BOOK

HELSINKI | 2017

ICNTEF CONFERENCE

3rd INTERNATIONAL CONFERENCE ON NEW TRENDS IN ECONOMETRICS & FINANCE

3rd International Conference on New Trends in Econometrics & Finance

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SCIENTIFIC COMMITTEE

ORGANIZATION COMMITTEE

Prof. Dr. Sevin Ugural
Eastern Mediterranean University, North Cyprus
Conference Chair

Dear Colleagues,
Eastern Mediterranean University Economic Research Center announces the 3rd International Conference on New Trends in Econometrics and Finance (ICNTEF'17) which will be held at Helsinki between April 28-29, 2017.

Like the previous two conferences, this conference serves as a forum for academics, practitioners, and central bank and government officials in Europe and all over the world to present and discuss research results about the evolution of the international economics and of the global financial system.

In the conference emphasis will be placed on the developments in emerging market economies, on the fate of the recent trends and of the impact of these developments on international trade, finance and regulation as well as on national economies and financial systems. Theoretical, empirical and policy-oriented papers are all welcome.

The organizers encourage submissions of papers and posters on any topic within the overall theme of the conference and in the following areas in particular:

Econometrics
Economics
Economic Policies
International Economics
Macroeconomics
Microeconomics
Industrial economics and regional economic issues

Finance
Risk Management
Financial Markets
Financial Crises
Quantitative Finance

All papers will be published in Conference Proceedings Book

We kindly wait for your participation in our conference in Helsinki, to be held in April 28-29, 2017, with the expectations to realize a fruitful discussion ground together with enjoying its social activities and hoping to leaving a trace on your memories.

Hoping to seeing you all in Helsinki.

With my kindest regards

Prof. Dr. Sevin Ugural
Eastern Mediterranean University, North Cyprus
Conference Chair

Contents

SCIENTIFIC PROGRAM

27 APRIL 2017

15:00 – 18:00 : REGISTRATION

28 APRIL 2017

08:30-17:00 : REGISTRATION

MAIN HALL : GRAND OPENING CEREMONY

09:30 – 10:00 : CONCERT / Live Performance by Young Musicians

10:00 –10:20	BREAK

HALL 1

10:20 – 11:20
Welcome Speech : Prof. Dr. Sevin UĞURAL / Eastern Mediterranean University
ICNTEF Conference Chair

KEYNOTE SPEAKER :Prof.Dr. NARAYANASWAMY BALAKRISHNAN
Title: Cure rate models and applications

11:20 –11:40	BREAK

HALL 1 / SESSION C

SESSION CHAIR	SEVİN UĞURAL	
TIME	**TITLE**	**PRESENTER**
16:00 – 16:20	TWIN DEFICIT PROBLEM AND FELDSTEIN HORIOKA HYPOTHESIS: THE ANALYSIS OF PANEL COINTEGRATON ON G-7 COUNTRIES	**Füsun ÇELEBİ BOZ**
16:20 – 16:40	MARKET CRASHES AND INVESTORS' ANTICIPATIONS	**Patrick LEONI**
16:40 – 17:00	THE IMPACT OF TECHNOLOGY AND SCIENCE ON CO2 EMISSIONS: THE CASE OF OECD	**Erhan İŞCAN** Neşe ALGAN Duygu SERİN
17:00 – 17:20	Am I Using the Right Data?	**Sıdıka Başçı**

29 APRIL 2017

09:00 - 17:00 : REGISTRATION

09:10 – 09:50
KEYNOTE SPEAKER : Prof.Dr. NARAYANASWAMY BALAKRISHNAN
Title: Meta Analysis of Censored Data

09:50 –10:00	**B R E A K**

HALL 1 / SESSION D

SESSION CHAIR	SEVİN UĞURAL	
TIME	**TITLE**	**PRESENTER**
10:00 – 10:20	ASSESSMENT OF THE RELATIONSHIP BETWEEN THE PATENT APPLICATIONS BY RESEARCHERS, INSTITUTIONS AND INVESTMENT IN EDUCATION: CASE OF TURKEY	**Müjgan DENİZ**
10:20 – 10:40	MARKOV SWITCHING RISK AVERSION AND ASYMMETRIES AT THE ZERO LOWER BOUND	**Riyad ABUBAKER**
10:40 – 11:00	ENDOGENEITY AND NONLINEARITY IN THE ENVIRONMENTAL KUZNETS CURVE: ACONTROL FUNCTION APPROACH	**Sinem Güler Kangallı UYAR** Ebru CAGLAYAN AKAY

ASSESSMENT OF THE RELATIONSHIP BETWEEN THE PATENT APPLICATIONS BY RESEARCHERS, INSTITUTIONS AND INVESTMENT IN EDUCATİON: CASE OF TURKEY

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[1]*Bu çalışma İstanbul Üniversitesi BAP Birimi tarafından desteklenmiştir.*

Abstract
This paper quantifies the patent applications regarding the effect of increasing academic investments and education expenditures in Turkey. For the last fifteen years, number of universities, research institutions (both state and private) and university graduates has increased sharply. It is important to look for the pecuniary and non-pecuniary returns of education to individuals and society. As a growing trend in the world, innovation-based growth has occupied the most efficient part of the whole economic growth. For this reason, innovation that depends on science and technology has become more studied subject in economic growth models and economics of education. As a result of rising investments and support for scientific research and educational facilities; many new bright ideas and patent applications by Turkish university students or researchers has appeared. To sum-up, this study has considered the number of patent grants and applications for an invention or development of a scientific product by university departments or a research institution.. etc. Finally, the relationship between investment in education system as well as R&D and the number of patent grants throughout the last decade in Turkey has been further analysed.
Key Words: *Education; Research and Development; Innovation; Growth; Technology*

1.Introduction

Boost in patent applications and patent-driven innovations contribute to the growth with capital, labor and multi-factor productivity. Multi-factor productivity growth is an important indicator of economic growth. In practice, the effect of innovation on total factor productivity is used a measure of Research and Development (R & D) intensity. Expenditure on education and support for R&D facilities can be considered as an investment in knowledge and technological development. Thus, higher R&D expenditure would support the higher growth rates. In the empirical studies supports a positive and strong relationship between R & D investments and productivity growth. Considering the long years people devote to education, it should be asked: ''what is education for?'' and ''how much contribution does it make for patent applications and innovation facilities?'' Human capital is one of the major factors that can be improved by getting investment on education continuously. In order to increase number of universities, institutions and scientific activities etc. given the rising educational expenditures, the importance of education and its positive results have been recognized obviously.

As a growing trend in the world, innovation-based growth has occupied the most efficient part of the whole growth. Investment on innovation that depends on science and technology has become more crucial subject in economic growth models. The aim of this research is to examine the relationship between education level, innovation-based growth and investments on R&D facilities for Turkish economy for the last two decades Technology have become a curicial variable in economic development and growth process for any country; that is to say it is increasingly rising trend among developing countries. Namely, they allocate huge budgets for research and development as well as investment for academics and universities. Also, technological improvements leads to an increase in rates of per capita national income and Gross Domestic Products of those countires.

[1] Bu çalışma İstanbul Üniversitesi BAP Birimi tarafından desteklenmiştir.

Regarding the rising expenditures for education and R&D facilities all over Turkey during the last ten years, number of patent applications for innovative and technological products as a result of this process have increased much more. Academics, students and young researchers have begun to paid more attention to innovation and technology. With increasing potentials of public and private universities and their Research Centers and High-tech institutions, these developments have afford young creative brains an opportuniy to produce something innovative and technological. When compared to the number of patent in Japan, China, South Korea, and Turkey; one can easily recognized that Turkey shows how back in terms of number of patents from the others. It can also be said that when compared to the numbers of patents in South Korea and China with numbers in Japan with the initial of R & D activities and achievements in this field, number of patent grants is directly proportional to the results of R & D activities in these countries.

Japan earlier than South Korea and South Korea earlier than China has started the activities of research and development. In this context, according to World Intellectual Property Organization (WIPO) in ranking of patent grants, Japan is the first place, South Korea is the second and China takes the third place. To sum-up, Patent Office approval as competent, in the form of Japan, South Korea and China; countries starting research activities earlier forge ahead with the experience of R&D activities and lead the race for patent grants.

What can be done immediately as asserted in this article is to make more investment in educational system and allocate more resources to R &D activities, young researchers and research institutions. Major aim of this paper is to examine the long-run relationship between research & development, innovation and economic growth in Turkey.

1.1. Technology, Development and Growth Relationship

Technological innovation across the world is one of the driving forces behind productivity advance. Technological changes have two sides: on the one side, the technology is an object of change and on the other side, it is subject to change. Technological advances can produce important influences towards production processes and organization methods in economics, while providing with important effects in social life. In this context, sustainable economic, social and political transformation, while the socio-cultural effects bringing together technological developments, have made somekind a revolutionary effect for human history, for example; fire, the wheel and printing machine.. etc. Industrial revolution which is the starting point of the contemporary world after the steam power and electric energy has entered into third stage with Information and Communication Technologies. In the process of socio-economic development, agricultural revolution is the first wave, the second wave is the industrial revolution and the information revolution is accepted as the third wave. (Taban & Kar, 2008).

After the industrial revolution, the scale of technology which has become one of the most important criteria for development has been also an important factor on which emphasized by many economic thought flows strongly. Although Classical, Marxist, Neo-classical economists do not attribute a big importance for technological development, they accept that technological development plays a key role in achiving economic growth. (Tiryakioğlu, 2011).

Information society is emerged as a result of communicative and informative revolution. Different social structure and changes from industrial society gave way to some important problems, especially within developing countries. For example, Turkey is not a country which has passed through successfully all the stages of industrialization. There are no sufficient national production and technology to create a welfare society similar to those in western countries. Therefore, she is sorrowing from both the lack of industrialization and also from pre-conditions of information society. What can be done immediately, as asserted in this

article, is to make more investment in economical area and allocate more resources to the Turkish educational system.

Especially after the second world war, the emergence of rapid technological advancement in a wide range of fields has caused technological backwardness to become an element among the fundamental causes of underdevelopment. Applied technology in agriculture and industry in countries, along with the general technical level of information has been curicial factor for the last century. The issue from this perspective is that technological developments in the process of economic development of less developed countries is really vital.

In recent years, the share of the rapid technological developments in technology sector has led to increased significantly within the world economy. Technology-intensive and high activity with other sectors in the economy, the advanced technology sector completely different economic development has an important function in economic development. (Müslümov & Aras, 2002). Developing countries to need technology to increase the speed of their economic growth and development. However, it is very important to know that developing countries like Turkey would not achieve sustainable economic growth just through transferred technology. Obviously she needs to develop her own technology and to be an innovative country in the field of technology and science not a follower.

Under-developed or developing countries in general don't innovate new technology, they mostly need and try to transfer the advanced countries in this field of technology. In other words, less-developed countries, far behind to create new technologies and they are deprived of the current structural technological levels until they have to import technology. This technology transfering process has a price for importing countries and this is a way to get technology for developing countries, it can be realized as a contribution of underdeveloped countries to the technological research and development costs of developed countries. (Kutlu, n.d.).

Some major types of technology transfering process are: ''license and know-how agreements and production partnership, product and fixed capital goods exports, exchange of Scientific and technical personnel, training and learning, commercial visits, open literature, international aid and government support programs.''(Kiper, 2004) On the other hand, substantial investments on R & D activities and support for university students projects, university techno-parks and University industry collaborations, shortly investing on human capital within the borders of a country is much more effective than all of the above-mentioned types.

1.2. Theory and Literature Review

Many empirical studies have been made in this subject. Some of the studies support a positive and strong relationship between R & D investments and productivity and economic growth. Some of them could not find a significant relationship between R&D and patent grants and economic growth. Genç and Atasoy (2010) analysed the relationship between R&D expenditures and economic growth by using the data for the period between 1997-2008 and causality method, and found that there is an unilateral causality relationship from R&D expenditures to economic growth.

Ülkü (2004) in her paper: ''R&D, Innovation, and Economic Growth: An Empirical Analysis'' IMF Working Paper, No: WP/04/185, investigates the main postulations of the R&D based growth models that innovation is created in the R&D sectors and it enables sustainable economic growth, provided that there are constant returns to innovation in terms of R&D. The analysis employs various panel data techniques and uses patent and R&D data for 20 OECD and 10 Non-OECD countries for the period 1981–97. The results suggest a positive relationship between per capita GDP and innovation in both OECD and non-OECD countries, while the effect of R&D stock on innovation is significant only in the OECD

countries with large markets. However, there is no evidence for constant returns to innovation in terms of R&D, implying that innovation does not lead to permanent increases in economic growth.

Korkmaz, (2010) ''The Analyses of the Relationship Between R&D Investments in Turkey and Economic Development with VAR Model, Journal of Yasar University, 20(5), 3320-3330, analysed the relationship between R&D investments and economic growth with cointegration method by using the data for the period between 1990-2008 and came to the conclusion that *''there is a cointegration between both variants and both variants affect each other in the long term.*'' Taban and Sengür (2014) analysed the relationship between R&D and economic growth by using the data for the period between 1990-2012 in Turkey and cointegration models, and reached to the conclusion that R&D expenditures affect economic growth positively in the long term.

Similarly, Gülmez and Yardımcıoglu (2012) analysed the relationship between R&D expenditures and economic growth in OECD countries by using the data for the period between 1990-2010 and came to the conclusion that there is a significant interactive relationship between R&D expenditures and economic growth variants in the long term. Akıncı and Sevinç (2013), examined the period 1990-2011 for the relationship between R&D and Economic Development in Turkey with a Granger Casuality test. As a result of this analysis, unilateral causality was found between private R&D expenditures, R&D expenditures made by higher education and economic development.

According to the paper written by Mercan, Göktaş & Gömleksiz titled as ''*Effects Of R&D Activities And Entrepreneurs On Innovation: Evidence From Patent Data''*; the effects of R & D spending of universities on rising patents in general is stronger compared to other sectoral variables. Conversely, effect of the increasing number of researchers on patent applications have been quite small. It is also important that R & D expenditure made by the private sector and higher educations resulted in positive effect on the number of patents, whereas it has found *a negative relationship* between the number of patents with its R & D spending of public sector. The reason for this may be due to the failure to obtain patent the public domain as a result of the innovations made public good characteristics as a result of R & D spending. Within the framework of the findings obtained in this study, regarding the coefficient between R&D activities and number of researchers, it was seen that the relationship between innovation and research activities is strong.

Technology have become a curicial variable in economic development and growth process for any country; that is to say it is increasingly rising trend among developing countries. Namely, they allocate huge budgets for research and development processes as well as investment for academics and universities. Also, technological improvements leads to an increase in rates of per capita national income and Gross Domestic Products of those countires.

Regarding the rising expenditures for education and R&D facilities all over Turkey during the last ten years, number of patent applications for innovative and technological products as a result of this process have increased much more. With increasing potentials of public and private universities and their Research Centers and High-tech institutions, these developments have afford young creative brains an opportuniy to produce something innovative and technological.

2. Methodology and Data

First of all, this study aims to examine the casuality between the ratio of R&D expenditures to GDP and labor force in R&D activities and GDP growth for Turkey. Research budget allocated from GDP to research activities which is recently be upward tendency should lead to innovation boost growth. However, it should be analyzed if there is a significant correlation

between R&D investments and number of researchers and economic growth in Turkey recently. This relationship should be considered analytically. In determining technology/innovation competence of countries, some indicators are used. These are the rate of Research and Development expenditures to GDP of a country, the number of working scientists and engineers in R & D services, and finally number of scientific publications and *patent applications*. When developing countries compared in terms of technology indicators it is seen that there is a huge difference between these two groups. Levels of development of countries means that less-developed countries should upgrade the level of the above indicators for catching pioneer countries. The number of beneficiaries of computer, internet and communication tools in comparing the ratio of high-tech product export out of total export topics. (Taban & Kar, 2008)

Growth rates (%/GDP) as a result of R&D activities is accepted as dependent variable for this study on the other hand; investment (expenditures) on R&D activities, number of researchers are independent variables of this study. Pairwise Granger Causality Tests were used to analyse and interpret the data. The parameters of subject variables were calculated by *VAR method and* findings of model were interpreted at the level of the variables and supported by suggestions. In this study, per capita R & D expenditures, investments for young scientists and researchers via universities, high-tech institutions and number of patent applications/grants are taken into consideration for econometric analysis.

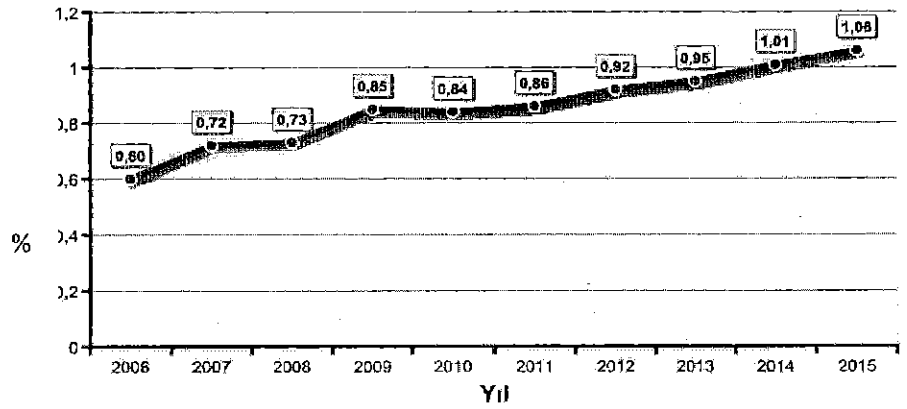
2.1. Procedures of Data Collection

The objectives of the study are: To find out the correlation, if there is, between rising expenditures and investment in university education, R&D activities and patent grants or tendency for innovation among young researchers; to find out the preference of university students' towards searching and developing new technology after getting support from their university or research institutes; to find out the effects of policies by governments including substantial investment in education system and research activities among university students.

To collect the requisite data related to various aspects of R&D expenditures and education investments, official statistics and figures were used and related data has been taken from TUIK (Turkish Statistical Institute). Based on these figures, it is possible to make a comparison of research spending and investment rates by public sector, higher education institutes and private sector. Share of Gross Domestic Expenditure on Research and Development (GERD) in GDP was 0.95%

According to the Research and Development Activities Survey 2013; results in public sector, foundation universities and business enterprise sector and calculations based on higher education sector registers for state universities, Gross Domestic Expenditure on Research and Development (GERD) increased in Turkey in 2013 compared to the previous year by 13.4% and reached to 14 billion 807 million TL. In Turkey, share of GERD in GDP was 0.95% in 2013. It was 0.92% in 2012.

Figure 1. Gross Domestic Expenditure on R&D (GERD) as a percentage of GDP



Source: Turkish Statistical Institute, Survey 2013.

Year

In this context, the ratio of research expenditure › observed after 2013. Correspondingly in 2014 and 2015, the share of GERD in GDP has been steadily increased. Namely, the GERD ratio was ***1.01*** in 2014 and ***1.06*** in 2015 as a percentage of GDP.

Table 1. Distribution of Patent Applications in Turkey by the Years

	Domestic					**Foreigners**						
Year	TPE	PCT	EPC	Total	Rate of Increase	TPE	PCT	EPC		Rate of Increase	Cumulative Total	Increasing Rate
1995	170	0	0	**170**	-	1520	0	0	**1520**	-	**1690**	-
1996	189	0	0	**189**	**11,18%**	687	26	0	**713**	**-53,09%**	**902**	**-46,63%**
1997	202	1	0	**203**	**7,41%**	598	730	0	**1328**	**86,26%**	**1531**	**69,73%**
1998	201	6	0	**207**	**1,97%**	596	1680	0	**2276**	**71,39%**	**2483**	**62,18%**
1999	265	11	0	**276**	**33,33%**	524	2220	0	**2744**	**20,56%**	**3020**	**21,63%**
2000	258	19	0	**277**	**0,36%**	442	2714	0	**3156**	**15,01%**	**3433**	**13,68%**
2001	298	39	0	**337**	**21,66%**	119	2756	2	**2877**	**-8,84%**	**3214**	**-6,38%**
2002	387	27	0	**414**	**22,85%**	88	1335	37	**1460**	**-49,25%**	**1874**	**-41,69%**
2003	454	35	1	**490**	**18,36%**	43	305	314	**662**	**-54,66%**	**1152**	**-38,53%**
2004	633	49	3	**685**	**39,80%**	68	167	1342	**1577**	**138,22%**	**2262**	**96,35%**
2005	895	33	7	**935**	**36,50%**	75	143	2308	**2526**	**60,18%**	**3461**	**53,01%**
2006	979	93	18	**1090**	**16,58%**	71	89	3915	**4075**	**61,32%**	**5165**	**49,23%**
2007	1747	60	31	**1838**	**68,62%**	71	139	4141	**4351**	**6,77%**	**6189**	**19,83%**
2008	2159	69	40	**2268**	**23,39%**	68	107	4694	**4869**	**11,91%**	**7137**	**15,32%**
2009	2473	74	41	**2588**	**14,11%**	69	105	4479	**4653**	**-4,44%**	**7241**	**1,46%**
2010	3120	60	70	**3250**	**25,58%**	77	100	4916	**5093**	**9,46%**	**8343**	**15,22%**
2011	3962	43	82	**4087**	**25,75%**	120	100	5934	**6154**	**20,83%**	**10241**	**22,75%**
2012	4360	74	109	**4543**	**11,16%**	78	154	6824	**7056**	**14,66%**	**11599**	**13,26%**
2013	4345	54	129	**4528**	**-0,33%**	95	175	7257	**7527**	**6,68%**	**12055**	**3,93%**
2014	4654	112	95	**4861**	**7,35%**	149	183	7182	**7514**	**-0,17%**	**12375**	**2,65%**
2015	5302	50	160	**5512**	**13,39%**	251	238	7957	**8446**	**12,40%**	**13958**	**12,79%**
2016	6153	88	204	**6445**	**16,93%**	407	211	9715	**10333**	**22,34%**	**16778**	**20,20%**

Source: It was prepared by the report date on 17th of January in 2107.

2.2. Statistical Techniques Used

Pairwise Granger Causality Tests were used to analyse and interpret the data.

Pairwise Granger Causality Tests results are as the following.

Date: 04/24/17 Time: 20:40
Sample: 1 27
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GRW does not Granger Cause EXPO	26	2.20055	0.1515
EXPO does not Granger Cause GRW		0.00769	0.9309
PAT does not Granger Cause EXPO	26	1.02311	0.3223
EXPO does not Granger Cause PAT		2.59839	0.1206
RD_LF does not Granger Cause EXPO	26	0.36536	0.5515
EXPO does not Granger Cause RD_LF		2.80950	0.1073
RD_GDP does not Granger Cause	26	0.47488	0.4976
EXPO does not Granger Cause RD_GDP		**8.50322**	**0.0078**
PAT does not Granger Cause GRW	26	0.83593	0.3701
GRW does not Granger Cause PAT		0.90878	0.3503
RD_LF does not Granger Cause GRW	26	0.01384	0.9074
GRW does not Granger Cause RD_LF		0.00776	0.9306
RD_GDP does not Granger Cause GRW	26	0.01515	0.9031
GRW does not Granger Cause RD_GDP		2.48398	0.1287
RD_LF does not Granger Cause PAT	**26**	**5.33705**	**0.0302**
PAT does not Granger Cause RD_LF		1.52164	0.2298
RD_GDP does not Granger Cause PAT	**26**	**7.94713**	**0.0097**
PAT does not Granger Cause RD_GDP		0.11110	0.7419
RD_GDP does not Granger Cause RD_LF	26	0.24342	0.6264
RD_LF does not Granger Cause RD_GDP		**14.0603**	**0.0010**

At this level of the sudy, RD/GDP patent numbers is the granger cause of RD_LF patent number, and export RD/GDP is the cause of RD_LF RD/GDP.

Considering the stability levels at this model, two methods were used. One is Augmented Dickey Fuller and the other is Philips Peron.

	Unit Root Test Probability								
		ADF	PP		ADF	PP		ADF	PP
LEVEL	GRW	**0.0009**	**0.0001**	1 st Difference			2 nd Difference		
	EXP	0.9949	0.9893		**0.0017**	**0.0015**			
	PAT	0.8994	0.9706		0.0611	0.0879		**0.0017**	**0.0000**
	RD_LF	1.0000	1.0000		0.0789	0.0789		**0.0000**	**0.0000**
	RD_GDP	0.9922	0.8907		**0.0000**	**0.0000**			

Stability Levels is as the following;

GRW	LEVEL
EXP	1st Difference
PAT	2nd Difference
RD_LF	2nd Difference
RD_GDP	1st Difference

Regarding stabilities, if we look at casualities;
Pairwise Granger Causality Tests
Sample: 1 27
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GRW does not Granger Cause D(EXPO)	25	2.45297	0.1316
D(EXPO) does not Granger Cause GRW		0.20270	0.6570
D(D(PAT)) does not Granger Cause D(EXPO)	24	0.02624	0.8729
D(EXPO) does not Granger Cause D(D(PAT))		0.16578	0.6880
D(RD_GDP) does not Granger Cause D(EXPO)	25	0.00186	0.9660
D(EXPO) does not Granger Cause D(RD_GDP)		3.61129	0.0706
D(D(RD_LF)) does not Granger Cause D(EXPO)	24	4.13337	0.0549
D(EXPO) does not Granger Cause D(D(RD_LF))		0.48467	0.4939
D(D(PAT)) does not Granger Cause GRW	24	0.03529	0.8528
GRW does not Granger Cause D(D(PAT))		1.45436	0.2412
D(RD_GDP) does not Granger Cause GRW	25	1.70773	0.2048
GRW does not Granger Cause D(RD_GDP)		0.75062	0.3956
D(D(RD_LF)) does not Granger Cause GRW	24	0.82730	0.3734
GRW does not Granger Cause D(D(RD_LF))		0.21480	0.6478
D(RD_GDP) does not Granger Cause D(D(PAT))	24	0.02121	0.8856
D(D(PAT)) does not Granger Cause D(RD_GDP)		0.62933	0.4365
D(D(RD_LF)) does not Granger Cause D(D(PAT))	24	0.02746	0.8700
D(D(PAT)) does not Granger Cause D(D(RD_LF))		0.09866	0.7565
D(D(RD_LF)) does not Granger Cause D(RD_GDP)	**24**	**5.31906**	**0.0314**
D(RD_GDP) does not Granger Cause D(D(RD_LF))		0.17815	0.6773

Only RD_LF RD/GDP is the granger casuality.
If we set a Model;

$$GRW = \beta_0 + \beta_1 D(D(PAT)) + \beta_2 D(RD\_GDP) + \beta_3 D(D(RD\_LF))$$
$$D(EXPO) = \beta_0 + \beta_1 D(D(PAT)) + \beta_2 D(RD\_GDP) + \beta_3 D(D(RD\_LF))$$

Dependent Variable: GRW
Method: Least Squares
Sample (adjusted): 3 27
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.486592	0.871088	5.150561	0.0000
D(D(PAT))	0.002097	0.001473	1.423677	0.1692
D(RD_GDP)	-21.39804	12.93032	-1.654874	0.1128
D(D(RD_LF))	0.000326	0.000162	2.008011	0.0577

R-squared	0.277609	Mean dependent var	4.144000
Adjusted R-squared	0.174410	S.D. dependent var	4.561253
S.E. of regression	4.144445	Akaike info criterion	5.827061
Sum squared resid	360.7048	Schwarz criterion	6.022081
Log likelihood	-68.83827	Hannan-Quinn criter.	5.881152
F-statistic	2.690044	Durbin-Watson stat	2.073104

Prob(F-statistic)	0.072409

Dependent Variable: D(EXPO)
Method: Least Squares
Sample (adjusted): 3 27
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.93E+09	1.51E+09	3.269014	0.0037
D(D(PAT))	950091.0	2548729.	0.372771	0.7131
D(RD_GDP)	-2.21E+10	2.24E+10	-0.985874	0.3354
D(D(RD_LF))	132326.4	280736.7	0.471354	0.6422

R-squared	0.054516	Mean dependent var	4.52E+09
Adjusted R-squared	-0.080554	S.D. dependent var	6.90E+09
S.E. of regression	7.17E+09	Akaike info criterion	48.36989
Sum squared resid	1.08E+21	Schwarz criterion	48.56491
Log likelihood	-600.6236	Hannan-Quinn criter.	48.42398
F-statistic	0.403613	Durbin-Watson stat	1.704896
Prob(F-statistic)	0.751908		

As a result, It is seen that both models are insignificant. In order to make VAR analysis, when we look at length of lagging, it has seen that lagging is ideal level.

Endogenous variables: D(EXPO) GRW D(D(PAT)) D(RD_GDP) D(D(RD_LF))
Exogenous variables: C D(EXPO) GRW D(D(PAT)) D(RD_GDP) D(D(RD_LF))
Sample: 1 27
Included observations: 23

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3164.592	NA*	3.1e-125*	-272.5732*	-271.0921*	-272.2007*
1	3117.228	-49.42259	2.4e-122	-266.2807	-263.5654	-265.5978
2	3049.414	-41.27836	2.6e-118	-258.2099	-254.2603	-257.2166

* 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

Model belonging to VAR analysis is the following;
Vector Autoregression Estimates
Sample (adjusted): 5 27
Included observations: 23 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(EXPO)	GRW	D(D(PAT))	D(RD_GDP)	D(D(RD_LF))
D(EXPO(-1))	1.88E-16	0.000000	-2.98E-23	1.37E-27	2.13E-22
	(1.1E-15)	(3.5E-25)	(2.2E-23)	(2.2E-27)	(2.3E-22)
	[0.17280]	[0.00000]	[-1.34336]	[0.61528]	[0.91931]
D(EXPO(-2))	2.96E-15	8.51E-25	-3.40E-23	-1.17E-27	-3.88E-22
	(1.6E-15)	(5.3E-25)	(3.3E-23)	(3.3E-27)	(3.5E-22)
	[1.81915]	[1.61057]	[-1.02702]	[-0.35331]	[-1.12062]
GRW(-1)	-1.43E-06	-7.41E-17	6.64E-14	-5.79E-18	-5.50E-13

	(1.8E-06)	(6.0E-16)	(3.8E-14)	(3.8E-18)	(3.9E-13)
	[-0.77764]	[-0.12375]	[1.77017]	[-1.53829]	[-1.40324]
GRW(-2)	-4.67E-06	3.40E-16	1.12E-13	-6.84E-18	-7.09E-13
	(2.6E-06)	(8.3E-16)	(5.2E-14)	(5.2E-18)	(5.5E-13)
	[-1.81992]	[0.40771]	[2.14246]	[-1.30327]	[-1.29817]
D(D(PAT(-1)))	8.07E-09	-8.55E-19	-3.06E-16	1.87E-20	2.28E-15
	(1.1E-08)	(3.6E-18)	(2.3E-16)	(2.3E-20)	(2.4E-15)
	[0.72092]	[-0.23465]	[-1.34268]	[0.81676]	[0.95426]
D(D(PAT(-2)))	-4.68E-09	-3.35E-18	-3.43E-16	4.71E-20	5.15E-15
	(1.7E-08)	(5.4E-18)	(3.4E-16)	(3.4E-20)	(3.6E-15)
	[-0.27994]	[-0.61680]	[-1.00838]	[1.38016]	[1.44711]
D(RD_GDP(-1))	4.86E-05	-5.82E-14	-1.45E-12	0.000000	2.56E-11
	(0.00012)	(3.8E-14)	(2.4E-12)	(2.4E-16)	(2.5E-11)
	[0.41491]	[-1.52799]	[-0.60716]	[0.00000]	[1.02899]
D(RD_GDP(-2))	-0.000225	2.69E-14	3.44E-12	-1.87E-16	-3.37E-11
	(0.00013)	(4.2E-14)	(2.6E-12)	(2.6E-16)	(2.7E-11)
	[-1.74605]	[0.64302]	[1.31405]	[-0.71053]	[-1.22925]
D(D(RD_LF(-1)))	6.04E-09	1.20E-18	-4.73E-17	-4.62E-21	-7.07E-16
	(3.1E-09)	(1.0E-18)	(6.2E-17)	(6.3E-21)	(6.5E-16)
	[1.96857]	[1.20563]	[-0.75809]	[-0.73784]	[-1.08308]
D(D(RD_LF(-2)))	4.76E-09	1.98E-19	-4.39E-17	-4.85E-21	-2.16E-16
	(2.3E-09)	(7.5E-19)	(4.7E-17)	(4.7E-21)	(4.9E-16)
	[2.06512]	[0.26407]	[-0.93539]	[-1.02858]	[-0.44057]
C	2.74E-05	-6.19E-15	-4.95E-13	3.02E-17	5.94E-12
	(1.7E-05)	(5.4E-15)	(3.4E-13)	(3.4E-17)	(3.6E-12)
	[1.64334]	[-1.14111]	[-1.45746]	[0.88658]	[1.67326]
D(EXPO)	1.000000	-5.08E-25	2.71E-24	3.43E-27	4.33E-22
	(1.6E-15)	(5.0E-25)	(3.2E-23)	(3.2E-27)	(3.3E-22)
	[6.4e+14]	[-1.00624]	[0.08568]	[1.08147]	[1.31154]
GRW	-2.09E-06	1.000000	4.09E-14	-4.16E-19	-4.36E-13
	(1.8E-06)	(5.8E-16)	(3.6E-14)	(3.6E-18)	(3.8E-13)
	[-1.17173]	[1.7e+15]	[1.12753]	[-0.11431]	[-1.15065]
D(D(PAT))	2.55E-08	-3.30E-18	1.000000	4.22E-20	6.19E-15
	(1.8E-08)	(5.8E-18)	(3.6E-16)	(3.6E-20)	(3.8E-15)
	[1.43735]	[-0.57135]	[2.8e+15]	[1.16185]	[1.63530]
D(RD_GDP)	2.26E-05	1.20E-14	-8.13E-13	1.000000	1.75E-11
	(0.00011)	(3.7E-14)	(2.3E-12)	(2.3E-16)	(2.4E-11)
	[0.19881]	[0.32619]	[-0.35143]	[4.3e+15]	[0.72297]
D(D(RD_LF))	2.35E-09	5.14E-19	0.000000	-6.03E-21	1.000000
	(2.0E-09)	(6.5E-19)	(4.1E-17)	(4.1E-21)	(4.2E-16)
	[1.17613]	[0.79266]	[0.00000]	[-1.47806]	[2.4e+15]
R-squared	1.000000	1.000000	1.000000	1.000000	1.000000
Adj. R-squared	1.000000	1.000000	1.000000	1.000000	1.000000
Sum sq. resids	3.16E-09	3.34E-28	1.31E-24	1.32E-32	1.43E-22
F-statistic	1.68E+29	6.79E+29	2.83E+30	3.35E+30	2.16E+30
Log likelihood	228.5238				581.8634
Akaike AIC	-18.48053				-49.20551
Schwarz SC	-17.69042				-48.41560

Mean dependent	4.66E+09	3.952609	41.69565	0.026522	-66.60870

3. Conclusion

Countries, the need to provide sustainable economic developments on international basis to prove their presence in the rapid change of technological change and also it is required to stay up-to-date on innovation process through R&D activities and crucial investments on education.

Technological innovations and improvements in the countries' competitiveness in the international arena, has an important place. Developed countries, interested in new technology; developing countries is transferred from developed countries to adapt their technologies to economic policies of the country's economic growth, that is to say development is the acceleration effort. However, instead of consuming transferred technology, it is necessary for developing countries to invest in R&D and higher education to improve new technologies by combining to the production process.

New technology for manufacturing basically should be targeted and R&D activities and patent grants as well should be supported by the State. In developed countries, investment in R&D has an important place in their GNP, whereas in developing countries with low R&D investments and lack of high technology, desirable growth rates could not be achieved so far. The increase of R & D spending expected to provide business growth and support the technological development and innovation process.

It is important to look at whether the R&D investments and expenditures on educational activities in Turkey has end up with a substantial economic development or growth rate. The analysis uses patent and R&D data for Turkey for the period 1995-2016, in order to determine the causal links between the variables, Granger causality test is used and the findings shows that there is no evidence that increasing R&D investments has enabled sustainable economic growth for Turkish economy for the last decades. This implies that expenditures on R&D does not lead to permanent increases in economic growth provided that there are constant returns to patent grants in terms of R&D facilities.

In this study, no significant causality found between R&D expenditures, researcher numbers and economic growth for the last fifteen years in Turkey.

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