THE IMPACT OF TECHNOLOGY ON ECONOMIC GROWTH IN TURKEY

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ABSTRACT

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The purpose of this thesis is to analyze the impact of technology on economic growth in Turkey between the years of 1980 and 2019. This phonemenon has been widely examined in economic literature for some time. Johansen Juselius (JJ) Cointegration Test, Vector Error Correction Model (VECM), VECM-Wald Test, Impulse-Response and Variance Decomposition analyses have been used to show the relationship between technology and economic growth. They indicate a positive relationship between these two variables especially in the long-run. On the other hand, there is a one way causality effect from technology to economic growth. In addition, increased research and development (R&D) expenditures contribute positively to technology thereby to economic growth. Turkish economy can certainly benefit from the manufacturing of technologically developed products which will increase in its international trade revenues. Turkish economy has been suffering from trade imbalance for a long time. Exporting high value-added products will decrease Turkey's dependence on foreign resources for capital and imported products. At the same time, it may be possible to divert more resources from Gross Domestic Product (GDP) to R&D funds. Appropriate and efficient usage of technology will help companies innovate and find new areas of employment. As a result, Turkish

economy may have a bigger chance of obtaining a sustainable economic growth for the longer term.

This study concludes that increased R&D expenditures increases technology and this increased technology contributes positively to economic growth.

Keywords: Technology, Total R&D Expenditure, Economic Growth, Endogenous Growth Models, Turkey.

ÖZET

TÜRKİYE'DE TEKNOLOJİNİN EKONOMİK BÜYÜME ÜZERİNDEKİ ETKİSİ

ERCAN, Merve
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Bu tezin amacı, 1980-2019 yılları arasında teknolojinin Türkiye'deki ekonomik büyüme üzerindeki etkisini incelemektir. Bu fonemenon bir süredir ekonomi literatüründe geniş çapta incelenmiştir. Teknoloji ile ekonomik büyüme arasındaki ilişkiyi göstermek için Johansen Juselius (JJ) Eşbütünleşme Testi, Vektör Hata Düzeltme Modeli (VECM), VECM-Wald Testi, Etki-Yanıt ve Varyans Ayrıştırma analizleri kullanılmıştır. Özellikle uzun vadede bu iki değişken arasında pozitif bir ilişki olduğunu gösterirler. Öte yandan, teknolojiden ekonomik büyümeye tek yönlü bir nedensellik etkisi vardır. Ayrıca artan araştırma ve geliştirme (Ar-Ge) harcamaları teknolojiye ve dolayısıyla ekonomik büyümeye olumlu katkı sağlıyor. Türk ekonomisi, uluslararası ticaret gelirlerini artıracak teknolojik olarak gelişmiş ürünlerin imalatından elbette faydalanabilir. Türkiye ekonomisi uzun süredir ticaret dengesizliği yaşıyor. Katma değeri yüksek ürünlerin ihraç edilmesi, Türkiye'nin sermaye ve ithal ürünler için dışa bağımlılığını azaltacaktır. Aynı zamanda, Gayri Safi Yurtiçi Hasıla'dan (GSYİH) Ar-Ge fonlarına daha fazla kaynak aktarılması mümkün olabilir. Teknolojinin uygun ve verimli kullanımı, şirketlerin yenilik yapmasına ve yeni istihdam alanları bulmasına yardımcı olacaktır. Sonuç olarak,

Türkiye ekonomisinin uzun vadede sürdürülebilir bir ekonomik büyüme elde etme şansı daha yüksek olabilir.

Bu çalışma, artan Ar-Ge harcamalarının teknolojiyi artırdığı ve bu artan teknolojinin ekonomik büyümeye olumlu katkı sağladığı sonucuna varmaktadır.

Anahtar Kelimeler: Teknoloji, Toplam Ar-Ge Harcamaları, Ekonomik Büyüme, İçsel Büyüme Modelleri, Türkiye.

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ABBREVIATION LIST

t	: the growth rate at time
N	: labor
$N_{(t)}$	: the growth rate at time t , including labor 'N' and external
Y	: the output level
K	: the function of physical capital
N_e	: the effective labor supply
h	: the average talent level
u	: working time
A	: fixed representing the technology level
K	: the capital stock
L	: the level of knowledge (physical capital)
S	: the rate of savings
n	: the rate of growth in labor supply
k	: infinite growth
y^*	: the long-term per capita income level
g_k	: the ratio of growing per capita income
d	: wear amount
H	: human capital (unskilled labor)
a	: the share of labor in total income
β	: the overall impact of an increase in employment
C	: consumption
I	: investment
%	: percentage
p	: page
pp	: page range
H_A	: total human capital employed in the R&D sector

H1 : expenditure on technological innovations

H2 : the hypothesis of information leakage

IT : Information Technology

IPR : Intellectual Property Rights

ICT_s : Information and Communication Technologies

TSI : Turkey Statistics Institute

R&D : Research and Development

JJ : Johansen Juselius Cointegration Test

VECM : Vector Error Correction Model

GDP : Gross Domestic Product

GMM : the Generalized Method of Moments

OECD : the Organisation for Economic Co-Operation and Development

FDI : Foreign Direct Investment

EU : European Union

US : the United States of America

MENA : Middle East and North Africa

SSA : Sub-Saharan Africa

MIST : Mexico, Indonesia, South Korea, and Turkey

GMM : the Generalized Method of Moments

ARDL : Otoregressive Distributed Delay

VEC : Vector Error Correction

DANP : DEMATEL based Analytical Network Process

TFP : Total Factor Productivity

ROA : Return on Asset

ROE : Return on Equity

R&D : Research and Development

XUTEK : Istanbul Stock Technology Index

CCR : Charnes, Cooper, Rhodes

BCC : Banker, Charnes and Cooper

BRICS-T countries: Brazil, Russia, India, China, South Africa, Turkey

ADF : Augmented Dickey Fuller

PP : Phillips Perron

SME_s : Small and Medium Sized Enterprises

SPSS : Statistical Package for the Social Sciences

TIE : Technological Innovation Index

MGE : the Mean Group Estimator

DOLS : Dynamic Ordinary Least Squares

PMGE methods : Pooled Average Group Estimator

VAR_s : Structural Vector Autoregressive

ICA : Independent Components Analysis

LLC : Levin-Lin and Chu

TurkStat : Turkish Statistical Institute

TRIPS : Trade Related Aspects of Intellectual Property Rights

TOPSIS : Technique for Order Preference by Similarity to Ideal Solution

WB : World Bank

LRD : Total R&D Expenditures (TL)

LGDP : Gross Domestic Product (TL)

KPSS : Kwiatkowski-Phillips-Schmidth-Shin

SIC : Schwarz Information Criterion

VAR : Vector Autoregressive Analysis

LR : sequential modified LR test statistics

FPE : Final prediction error

AIC : Akaike information criterion

SC : Schwarz information criterion

SD : the Structural Decomposition

HQ : Hannan-Quinn information criterion

DLGDP : change in GDP ~ economic growth

DLRD : change in total R&D expenditures ~ technological improvements

INTRODUCTION

Economic growth which is one of foremost arbiters of prosperity level, is an important issue that will not be outdated for all countries. Technological development and innovation are among the most significant factors of economic growth in today's developed economies. R&D movements are foremost factors determining developments in technology and innovation. (Erdoğan & Canbay, 2016: 30)

Economics which has been an independent science since the 18th century, has never ignored the effect of technological innovations on the change of economic dynamics. However, although technology, innovation and R&D have been adopted as an important factor, most economists did not accept these factors as an input until the 20th century. In the models developed after the 20th century, these terms have been included in the analysis as they increasingly affect the results of the subjects related to the science of economics such as production, consumption, employment and growth. (Doğan & Öcal, 2007: 10)

In the literature of growth, the common goal from classical theory to internal growth models is to explain the source or sources of economic growth. A. Smith basically saw the division of labor as the source of growth and pointed out that international trade could increase economic growth by enabling specialization in production. Solow's neo-classical growth model emphasizes the act of physical capital accumulation in economic growth and importance of technological developments. (Solow, 1956: 65-94)

In the neo-classical model, externally assumed technological development is the only variable that can account for growth of soever head growth in maxi term. Therefore, trade relations with other countries have no impact on the maxi-run growth rates of economies. Again, long-term growth rate is determined within the model of internal growth models that arise from the problems of neo-classical growth

model, and international trade has an effect on economic growth in maxi-term. (Türker, 2009: 87)

Endogenous growth is the growth in which knowledge, human capital and technological development are internalized in growth models, just as in the labor and capital factors. Although it extends to A. Smith who emphasizes the role of knowledge, human capital and technological development in growth, A. Marshall who emphasizes externalities and J. Schumpeter who emphasizes innovation, the previous growth models are either not taken into account or considered external due to difficulty in measuring and intertwined with other inputs. The endogenous growth studies which gained momentum with the pioneering action of Romer (1986) and Lucas (1988), continued to increase in 1990s. Today, it is generally accepted that non-intrinsic growth models do not adequately reflect the facts.

The goal of this working is to find out how knowledge, human capital and technological development from the sources of internal growth are internalized in production processes. If this is achieved, it will be easier to identify strategies that will ensure long-term, satisfactory growth. In this study, endogenous growth will be presented in favor of some empirical evidence and an application will be made on Turkey.

This working is formed of five sections. Following introduction, second section provides information about internal growth models and especially R&D fundamental internal growth patterns. In third part of the study, there is literature review. In the fourth section, the data the methodology to be used in the analyzes and the analyzes revealing the causative connection between R&D and economic growth are given. Fifth chapter is conclusion and some suggestions are made based on the findings obtained from the analyzes.

CHAPTER I

CLASSIFICATION OF ENDOGENOUS GROWTH MODELS

The basis of the endogenous growth model is largely leaning against working of Romer (1986) and Lucas (1988). Studies in this area differ significantly from Neo-classical Growth Theory in terms of defending that economic growth takes place internally by the interaction of a number of factors in the internal functioning of the economic system. (Ercan, 2002: 130) According to Lucas, the Solow model describes the growth of the United States of America (US) rather than a model of economic growth and does not reflect the economic growth of developing countries. (Lucas, 1988: 7) There are some hypothesises in endogenous growth models. As regards endogenous growth models, essential fund of growth is technological improvement knowledge and human capital. The statute of attenuated yields in manufacture does not perform. There are an article of externalities. Accumulation of information courts to society. As a consequence, incomplete competition conditions are valid. Neo-classical growth theory is insufficient to clarify the variations in growing between countries and has brought new efforts. The prominent elements in this context are the roles of factors such as technological change and human capital, which are considered external in the neo-classical growth literature, in this process. In other words, recent studies on economic growth have concentrated on finding the "missing element" that can clarify the variation in growing between countries. There are five endogenous growth models.

These are;

1.1. Growth Model Including Learning-by doing

1.2. Lucas' «Human Capital» Model

1.3. Public Policy Model

1.4. Rebelo's «AK» Model

1.5. Growth Model Including Research and Development

1.1. GROWTH MODEL INCLUDING LEARNING-BY DOING

The growth model including learning-by doing is also valued as the Arrow Model. Arrow has noticed that costs have dropped in progress of time, quality has risen and manufacture has accelerated in some sectors. Arrow told it learning-by doing. As companies make manufacture, they find out their business well, improve their products and manufacture ingoing products. Company has an investment not only remains the capital stock but also remains the information stock of the firm. In addition to increasing the physical outputs of the companies, ingoing opinions are produced. Firms' learning-by doing efforts will remain growth.

Arrow argues that the remain in information manufacture will promote to the whole economy through spillover and learning-by doing is more than the firm's own gains. With respect to Albelo, in business learning, human capital influences as much as formal education. (Albelo, 1999: 360) Romer believes that liberalization of foreign trade and economic integration with countries rich in human capital will affirmatively impress economic growth. (Ercan, 2002: 131-132)

Actually, Romer's theory is leaning against Arrow's (1962) idea of “learning-by doing ”. Arrow, in some sectors, as time goes by, production costs have decreased, quality has increased and production has accelerated and the reason for this is attributed to the accumulation of information, and he called on learning-by doing, as well. Appertaining to the use of knowledge in internal growth models, the following points are remarked. (Kibritçioğlu, 1998: 215)

- Consumers are not competitors in the use of information and no one is excluded.
- It is very important to what extent economic units benefit from the information resulting from technological development.
- If technological externalities are involved, it is a fact that the private sector will not approach the production of information and the market will be disrupted.

- There is one connection between technological development and physical and person fund hedges.

Arrow has established growth pattern that demonstrates relevance of technology and total fund stock. Within the neo-classical approach, it has internalized technological development by including it in the model of "learning-by doing". In this model, Arrow explained the emergence of technological development as the externalities resulting from investments. The source of increased returns in this model is learning-by doing. Over time, costs in the sectors decrease, product quality increases as a result of learning-by doing better, in other words, and production accelerates over time.

In the model, technological development is included in learning and it is assumed that learning has no cost. Investments made by firms remain fund recruitment and thus level of knowledge in economy.

This model shows the production function of the company:

$Y = A(K)F(K, L)$

At this place, technology is a function of capital stock. General representation of the model;

$Y = K^{a}(AL)^{1-a}$

A is the technological advancement that increases the productivity of labor.

When technology is internalized as a function of total capital stock:

$A = DK^{\delta}$ where in D and δ constant are counted. By the help of the workforce is stable and δ=1:

$Y = D^{1-a} KL^{1-a} = (DL)^{1-a} K$

$A = (DL)^{1-a}$ and is replaced by the parent equation:

$Y = AK$

Capital accumulation in the EC model led to continuous growth. $\delta = 1$ assumption eliminates the impact of diminishing yields. Technological development has made the Cobb Douglas function via fixed return to scope a function via increasing returns to scope. That is, since initial $Y = K^{a}(AL)^{1-a}$ is liable to diminishing yields ($1>a>0$) will be. $\delta = 1$ function reached by assumption;

$Y = (DL)^{1-a}K$ is shaped like this and $1-a+1>0$ (that is $a > 0$) is increasing returns to the scale. (Koksal, 2006: 25)

A.Young (1991), in which the importance of learning-by doing is emphasized, states that if an economy is rich in qualified labor supply, it will be realized at a high level and technology level will increase, provided that other conditions remain constant. In this model, considering the effects of international trade between countries A and B, it is assumed that both economies have similar characteristics except labor size and technological information stock. It is accepted that the technological stock of information is higher in developed countries. The general results of this model can be summarized as follows:

- Developed countries produce more sophisticated goods than developing countries.
- Companies in developed nations have greater incomes than companies in developing countries and therefore can consume more goods.
- In the case of free international trade, the growth rate of these countries will be either as high as or higher than the growth rate of autarchy, with developed countries reallocating their resources to goods with high learning potential.
- In the case of free international trade, the economic growth in these countries may not be higher or even lower than the autarchy, as developing countries allocate their resources to goods that do not have much learning potential.

In this model, based on the role of international specialization on productivity, it is stated that political interventions can be allowed in the field of economy. Within this framework; for example, trade and industrial policies can be developed to encourage developing countries to specialize in goods with high learning potential. The model suggests that fast-growing East Asian economies implement such policies. In addition, A. Young stated that developed countries are more profitable than their trade with developing countries, while developing countries benefit more from their trade with each other. (Aghion & Howitt, 1998: 386-389)

Learning-by doing can lead to technological development and technological development can lead to increased productivity. Technological

development often involves costs while learning- by doing can occur without costs. When learning-by doing is the source of technological development, new knowledge may be produced from a known knowledge. In addition, the better the company adapts to the new technologies it chooses for production and the sooner it achieves it, the more effectively it can use the technology. (Parente, 1994: 346)

To get the most out of learning-by doing, firstly you must start with jobs that are highly likely to learn. In this way, with the efficiency and knowledge is provided, new technologies can be adapted more easily and comparative advantages can be obtained in foreign trade. (Sorensen, 1999: 429) It may be more useful for developing countries to prioritize jobs that are highly likely to learn in order to achieve successful industrialization and rapid export growth. (Moore, 1997: 515; Ambler, Cardia & Farazli, 1999: 748) It is suggested that countries known as Asian Tigers grow faster by paying great attention to education and following strategic foreign trade policies in areas where learning-by doing is high. (Lucas, 1993)

There is a mutual relationship between learning-by doing and foreign trade. Learning-by doing contributes positively to foreign trade, foreign trade learning, and growth together. As developing countries liberalize their foreign trade, the quality of the labor force and the return on human capital increase. (Pissarides, 1997: 17) In a country where are fixed natural resources, labor and information stock, if there is not learning, it is inevitable that the marginal efficiency of capital will diminish over time, investment opportunities will diminish and growth will become unsustainable.

1.2. LUCAS' «HUMAN CAPITAL» MODEL

As regards Lucas' Human Capital Model, fund of growth is person fund. Human capital is the only factor that provides long-term sustainable growth. As regards this model, human capital can be provided through education and learning. Governments can accelerate human capital and growth through policies.

The concept of human capital, which is the main source of economic growth, is operated to express all the themes such as information, talents, adroitnesses, wellness position, area in clubby connections and education degree.Firstly, As economists who are mentioned the concept of human capital, classical economists such as Adam Smith, J. Start Mill and Alfred Marshall are mentioned but their views did not affect modern human capital theory much. Later economists such as Denison,Schultz and Becker are sophisticated the theory of human capital based on Smith's views. (Han & Kaya, 1999) In the study conducted by Denison, it is emphasized that education improves the skills and productivity capacity of the work force and thus it contributes to the increase of national income. As to Shultz reached the same conclusions as Denison and clarified investments in education a significant part of the growth rate in the USA. (Han & Kaya, 1999: 126-127)

Education expenditures are expected to perform positive status in economic growth by impacting productivity of individuals and increasing their productive work. Educational expenditures have also led to the formation of human capital in internal growth models. Collaterally, the same can be said for health expenditures. Increased health expenses increase the life anticipation and expectations of individuals. (Kelly, 1997: 64) Long-term expectations have the power to positively affect economic growth by positively affecting private capital accumulation decisions. (Glomm & Ravikumar, 1997: 201)

In the very last past, Lucas (1988) and Rebelo (1991) considered human capital as one of elements of manufacture, such as substantial fund. In other words, as an economy needs physical capital investments, it also needs human capital investments. Although the concept emphasized as human capital generally arises through education, it can also occur spontaneously through learning-by doing in the working process. Investments in human capital are defined as the opportunity cost of the time spent in training. In fact, Lucas said that the rise in an individual's human capital contributes to the productiveness of all factors of production, as well as its own productivity. Lucas stressed that any investment is made by governments in

education and development of technological infrastructure would have an affirmative impact on human fund saving and would affect growth more than effect of investments in physical capital. Empirical studies have shown that human capital positively affects economic growth. (Cheng & Hsu, 1997; Grammy & Assane, 1996; Lucas, 1988; Barro, 1998)

These approaches show that human capital is one of foremost elements contributing to economic growth, aside from debate on how to measure it.

Contributions to the internal growth theory have been performed considering effect of externalities on economic growth. Neo-classical production based on constant yields according to the scale turned into an increased production type with positive externalities in the Romer Model. Romer's concept of positive externalities is dealt with as the saving of human capital in Lucas (1988) 's model. According to Lucas, economic growth is the result of hedges in person fund. Hedges in person fund accelerate economic growth by increasing productivity in other sectors.

In Lucas (1988)'s model, human capital is internalized and assumed as a production factor such as physical capital. Although human capital investments are considered as educational investments, they can occur spontaneously in the form of learning-by doing. In addition, health expenditures and good nutrition are included in human capital. (Aldan, 2005)

The assumptions of the model: The economy is closed and there are full competition market conditions. Economic decision-making units have rational anticipations. The technology in the economy has constant returns on the scale. The rate of technological development is external. The growth rate at time t, including labor "N", is $N_{(t)}$ and external.

The output level in the model is "Y"; it is the function of substantial fund "K" and penetrating workforce data "N_e".

$Y = f(K,N_e)$

When there are N workers, the average talent level is "h" and when each worker "u" spends the decision time for production, the effective labor supply is $N_e = u.h.N$. In this case, the output function;

$Y = f(K,uhN)$ is occured.

According to this function, as the working time "u" and the average skill level of the workers "h" increase, the output level increases. Time remaining in the capital accumulation "(1-u)" which it is related to the rate of schooling that determines the level of talent.

$h_t = (1-u_{(t)})$

In this function, when the working time $u_{(t)} = 1$, all of the time is spent on production, and the worker can not spend any time improving his or her ability. In such a case, human capital accumulation is zero. In the case of working time $u_{(t)} = 0$, all of the time was spent developing talent and human capital accumulation was maximum.

Lucas (1988) conclusions of the studies are as follows;

- In a closed economy, even if a poor country has the same growth rate as a rich country, the relative poverty of the poor country continues. In addition, the determination of income and wealth distribution among countries continues.
- If the labor factor is not mobile between countries, the free movement of capital does not have an outstanding impression on foreign commerce. Nevertheless, when labor factor is mobile, its effect on foreign trade is subject to whether the effects of human capital, which increase the productivity of labor, are internal or not and provide external benefits by moving from one person to another.
- In a country of high human capital, people of all skill levels are more productive and have higher wages. Due to these wage differences, there will be migration from poor countries to rich countries.
- In countries with sufficient domestic market width to create economies of scale but with weak human capital, as long as there is a migration towards countries via high human capital, they will not be able to get rid of backwardness. (Kıraçlar, 2005: 80)

The basis of the internal growth model is largely leaning against working of Romer (1986) and Lucas (1988). It differs significantly from the Neo-classical Growth Theory in that it argues that economic growth occurs

internally by the interaction of a number of elements in the internal functioning of the economic system. (Ercan, 2002: 130) According to Lucas, the Solow model describes the growth of the United States of America (US) rather than a model of economic growth and does not represent economic growth of developing countries. (Lucas, 1988: 7)

The internal growth model in the first group, which considers population growth and human capital accumulation as a decision variable, is based on the 1990 study of Becker, Murphy and Tamura. The most significant assumption of the model is that with the internally determined fertility rate, the return on human capital rate increases as well. Fertility rate is an economic decision that varies in terms of the general degree of prices on the one hand and the income level on the other. New knowledge generation is considered as a rectilineal function of person fund accumulation provided by previous generations. In terms of human capital, in rich countries, the return on hedge in human beings is taller than the return on having children. In terms of human capital, the converse is the case in relatively poor countries. (Ercan, 2002: 131) Lucas argues that person fund performs an outstanding status in economic growth. (Lucas, 1988: 25) In addition, Lucas argues that the increase in the human capital rises the productivity of the individual factors with the productivity of the individual. (Kibritçioğlu, 1998: 224)

Lucas argued that human capital was the source of growth in the model and he modeled the physical capital accumulation and technological advances with the Neoclassical production function and took a different approach to internal growth. (Erdoğan & Canbay, 2016: 36)

1.3. PUBLIC POLICY MODEL

Public Policy Model is also valued as R. Barro Model. As regards this model, tax-funded public expenditures remain economic growth to a certain level of productivity. Infrastructure investments by common subdivision remain efficiency of private subdivision. R&D is promoted by the public sector that will assertively impress economic growth.

Internal growth theories developed in this context impose important duties on public policies in the field of growth. It is possible to classify public policies that will increase growth in three main areas. The first models developed in this sense emphasize the liberalization of foreign trade. (Renelt, 1991; Coe and Moghadam, 1993; Ghatak, Milner, and Utkulu, 1995) After foreign trade, a group of economists argued that economic growth would be affirmatively impressed by importance of public expenditures and their distribution to productive areas. (Barro, 1991; Devarajan, Swaroop and Zou, 1996; Kelly, 1997; Glomm and Ravikumar, 1997; Balcılar, 1997; Wang, 2002; Webber, 2002; Demir, 2002; Kar & Taban, 2003) In addition, many economists also believe that financial policies and development in this sector will ensure resource flow, reduce the costs of financial intermediation transactions and investments, and they will positively affect economic growth through these channels. (Greenwood & Jovanovic, 1990; Bencivenga and Smith, 1991; King and Levine, 1993a; 1993b; Roubini and Sala-i Martin, 1992; Pagano, 1993; Renelt, 1991; Hermes, 1994; Hermes and Lensink, 1996; Mihci, 1999; Kar and Tuncer, 1999)

Barro argued that public spending was a factor that accelerated the growth process. According to the author, the private sector fails to produce public goods that will increase the productivity of resources through out the economy. However, direct public services such as the promotion of R&D by government policies, education, health and other infrastructure investments reach socially appropriate levels. Government spending positively impacts economic growth through policies that maximize the benefit function of non-profit and representative households. Such policies have positive effect on economic growth and economic prosperity. The fact that public expenditures adversely affect economic growth that it is clarified by decrease in private savings arising from taxation in general. (Ercan, 2002: 134-135)

In the Barro (1990) model, it assumes that goods and services supplied by the public sector are one of the factors of production. It acknowledges that the production function depends on capital or this commodity. The government should also support the private sector with tax

incentives and subsidies by investing in economic growth. Investments to be made by the private sector increase tax revenues indirectly, which reduces the supply of public goods. In this way, private sector investments contribute to the economy from two different branches. Moreover, Barro states that connection between public expenses and economic growth is negative.

In pursuant of Public Policy Model, main duties of state are;

- To produce public goods and services,
- To rise investments in education and
- Provides the production and dissemination of information through incentives to R&D.

The state should pay attention to basic education for the training of individuals who will use this information.

The general solution of the internal growth theory is increasing the level of public services in the areas where efficient production is carried out and ensuring the spread of production by investing in R&D and education.

Internal growth theory imposes important duties on public policies in the field of economic growth. Theoretically, this requirement stems from the positive externalities of manufacture and investments, the importance of human capital in manufacture and the direct consequences of public policies such as infrastructure and stability. Another point is added here in terms of public policy is that how important energy policies are for public policies. Because as mentioned before, energy has an outstanding status in economic growth process. Importance of energy policies will also emerge here and investments in energy will directly affect the economic growth process. Barro (1990) states that research and development activities may be realized by virtue of long-lasting efforts and investments but they are in the exclusion group, it is that a newly developed product can be imitated by other companies as soon as it is released and therefore R&D actions should be implemented by the community. Barro (1990) also states that it is more beneficial to remain competence of private section by way of studies in fields of education, health, preservation of spiritual ownership justifications and infrastructure works instead of entering private sector. (Taşar, 2015: 14-21)

Barro (1990) argues that in the model, what a representative household benefit function aims to maximize and which will contribute positively to the growth and prosperity of a non-profit well-intentioned government, while a government that considers its own benefit without worrying about election will adversely affect growth and prosperity. (Ercan, 2000: 135)

1.4. REBELO'S «AK» MODEL

It is disputed that even in the absence of external technological improvement, per capita growth can be achieved in the long run. Fixed return conditions are valid in respect of the scale. Y = AK is expressed by the manufacture function. In this function, parameter A is the fixed representing the technology level and K parameter is the capital stock. The AK pattern is leaning against the fact that return on capital will not diminish while the capital stock remains. (Rebelo, 1991)

The AK model provides a transition between the interior growth models and the Solow model. If the production function did not meet the requirements of the neo-classical approach, the economy could not reach a stable state. In endogenous growth models, there is not static degree of income. In other saying, although countries have the same accumulations and growth rates, per capita income differences between countries can be continuoue. Although this model did not do a clear distinction between capital saving and technological progress, it brought jointly physical and human capital, taking into account capital and innovation. Accordingly, as the capital accumulation of firms increases, certain of the enhanced capital will be the ideational capital that leads to technological advancement and this duration will compensate for the marginal efficiency of the capital. (Aghion. et al., 1998: 25; Durlauf & Blume, 2008: 836)

In Rebelo (1991) 's AK pattern, assumption of fixed returns to scope was maintained. By way of something decreasing marginal productivity assumption, the constant productivity assumption was replaced.

$Y = AK^aL^{1-a}$ while in the production function (1>a>0), a=1 is assumed. Production function with this assumption;

Y=AK give way to this.

According to this production function, only capital is sufficient for production.

If we divide both sides into L in the function:

y = Ak=f(k) Values obtained in terms of per worker.

Average return on capital: Ak/k=A.

Return on capital (Ak/k) , $\Delta k = k^1/k = s.f(k)/ k – (n+d)$ when put in the equation;

$\Delta k = s.A-(n+d)$

(the rate of savings "s" is expressed as the rate of growth in labor supply "n").

When s.A-(n+d) occures, growth $\Delta k > 0$ is independent of k. Capital fund forever will rise at a constant rate such as s.A-(n+d). In other words, capital will continuously grow at a stagnant state growth rate. In addition, the growth rates of income and consumption per employee are as much as the growth rate of capital. (Altan, 2006: 27)

The dynamics of the AK model:

$\Delta k = s.f(k)/ k – (n+d)$ the fact that Δk is in a positive stagnant state in the equation means that k is infinite growth. The positive of Δk is conditional on the fact that the mean return of capital (f(k)/ k) is greater than (n+d /s) as k approaches infinity.

When $k=\infty$ is $f(k) = \infty$ (and $\lim_{k=\infty} f^l(k)$ exists), the average return and marginal return of capital will be equal. In other words, $f^l(k)$ should be greater than zero for internal growth.

$Lim_{k=\infty} f(k) /k = \lim_{k=\infty} f^l(k) > n+d /s > 0$.

In the AK model, there is not transition dynamicals since income, capital and consumption grow at a constant and equal speed. Besides, capital and consumption levels affect the growth rate. (Altan, 2006: 28)

The AK model varies from the Solow model at several points:

In contrast to neo-classical growth pattern, an increase in accumulation rate (s) in AK model increases the long-term per capita income level (y*). When technology level (A) does not increase and fall once, per capita income level (y*) increases. In other words, $g_y=g_a+g_k$ happens. Even if the technology level (A) is constant ($g_A = 0$), per capita income grows at the ratio of "g_k". Thus, while the other hypothesis of the AK model are identical as the Solow model, it has been shown that if there is not decrease in the marginal productivity of capital, there may be continuous growth even if there is not technological development. In addition, changes in population growth rate (n) and wear amount (d) have effects on y*. Changes in "n" and "s" in the Solow model led to the transition effect whereas in the AK model these variables changed the long-term growth rate. Another result of the AK model predicts that there will not be convergence. When s.a.k > n.k occurs, "k" will not equal zero and no steady state balance will occur. (Köksal, 2006: 24)

Person fund can be stated as a total of information, experience and talents of workforce input. A community via an elevated degree of training contributes significantly to increasing productivity. There is also a need for trained individuals for the construction, maintenance and repair of machinery used in production. In Rebelo (1991) and Lucas (1988) models, human capital is considered as one of factors of manufacture such as substantial fund. In other words, Just as an economy requires physical capital investments, so it does human capital investments. Although human capital investments are generally considered as educational investments, they can also occur spontaneously in the process of working through "learning-by doing".

According to Shaw (1992: 617), countries that are rich in human capital stock or have access to the stock of information through international trade provide faster economic growth.

If a country's human capital accumulation is high, people learn more quickly and become more productive. Moreover, the large amount of human capital increases the physical capital stock and makes it more efficient.

While Model Romer (1986) has similarities with the internal growth approach based on technological development, it differentiates itself here with the steady-state growth approach under the assumption of constant returns. (Ateş, 1998: 75)

1.5. GROWTH MODEL INCLUDING RESEARCH AND DEVELOPMENT

Growth model including Research and Development is also valued as the P. Romer Model. The internal growth models pioneered by P. Romer (1986), in contrast to neo-classical growth theories identify technology within and outside the model, and also emphasize the increased return on capital. (Parker, 2014: 2) This model is ground on monopolistic competition markets. When companies determine their prices, they attach R&D expenditures to their costs. Monopoly profits arising from innovations provide the continuity of companies' search for innovation. There are two sectors in pattern: manufacturing sector and R&D sector. As consumption and investment goods are produced in the manufacturing sector and ingoing opinions and techniques are produced in the R&D sector. Innovation of R&D secture constitutes fundamental force of accretion in the economy.

The theory of internal accretion, which was founded and developed by Romer (1986) in the late 1980s, rejected the externality of technological developments and began by incorporating it into the model. Another assumption of the “new” theory of growth relates to the return of capital. While the neo-classical growth theory accepts the declining return of capital, internal growth models acknowledge that there may be an increasing return on capital, including human capital, and that this remaining yield will not diminish growth in maxi-run. (Sala-i Martin, 1990) In internal growth models, it is said that economic growth will have internal economic fundamentals and the thesis is destroyed that the income levels of countries will approach each other spontaneously On the contrary neo-classical theory; internal growth theory proposes that if the fewer sophisticated nations do not take essential dimensions, variation between them and sophisticated nations will remain. In the new growth theories, technology is internalized and

mechanisms of public policies affecting economic growth are emphasized. There are found various recommendations for source of fixed or increased returns. In particular, Lucas (1988) argues human capital, Rebelo (1991) suggests cumulative capital, Romer (1986, 1990) argues R&D studies, Barro (1990) argues public expenditures and Pagano (1993) suggests increasing returns. As It can be understood from the discussions, in fact the theory of inherent growth is based on a small mathematical detail, but its conclusions are broad. In other words, internal growth models clearly indicate the importance of sectors that affect the growth of an economy. In this content, internal growth models can be classified as information overflow models, public policies and human capital models. The first group consists of information overflow models based on knowledge and R&D activities. This theory was first introduced in 1986 by Paul Romer's essay, "Increasing Returns and Long Run Growth" and this model was sophisticated as an atypical to neo-classical model. In the Romer model for the internal growth theory suggests that the investments made increment technological knowledge as a by-product, this new knowledge is used as free information input in other production processes and this spread to the secture eventually of diffuse. Thus, hedges are made at dropping costs and returns are higher than neo-classical models. According to Sala-i Martin (1990), it is accepted that a large return of fund, involving person fund , may have a remaining yield and this increased yield will not diminish growth in maxi-run.

Emphasizing that the information is public domain, Romer states that information cannot be perfectly patented and stored and emphasizes hat new information produced by one company will create positive externalities on the production possibilities of other companies. At this place, it is argued that the theoretical framework in which knowledge and technological development is associated in this way can explain the difference in development between countries. Therefore, the resource allocated to R&D expenses contributing to accumulation of information will contribute to increasing the growth rate.

Much of the growth in developed countries stems from technological progress, but technology is supposed to be external in the Neo-classical model. Romer's (1990) study criticizes the theory of Neo-classical growth depend on the law of decreasing yields. Only collecting homogeneous capital goods and ensuring S=1 equality is impossible to achieve continuous growth. The market which consists of homogeneous goods, reaches the Neo-classical saturation point after a while, but growth is ending. Romer (1994) prioritizes the determinants of growth over the determination of macro policies and predicts that growth is provided by internal dynamics. (Kıraçlar, 2005: 74)

In Romer's model, the efficiency of investment in capital goods prevents the economy from entering a decreasing trend with time development and prevents the decreasing efficiency of capital accumulation. Because manpower is defined as capital and the use of information in the production process is becoming widespread.

In the production function of the Romer Model, there are four basic inputs: labor (L), capital (K), technology (A) and human capital (H). In this model, there are two main components of knowledge, human capital and technological development.

As for the sector in this pattern, there are three sectures as search secture, intermediate products secture and ultimate products secture. In Research and Development (R&D) sector, consisting fund of information is used to manufacture human capital and ingoing information. In intermediate products secture, in light of the information provided by the research sector, it produces the existing products to be used in the production of ultimate products. In ultimate products secture, it promotes existing capital goods, workforce and person fund to obtain the ultimate thruput. The thruput is either used up or accumulated as ingoing fund. (Kıraçlar, 2005: 75)

Physical capital refers to consumption goods. In the measurement of human capital, personal education is taken into consideration. The competitive part (H) of the information and the non-competitive part (A) are separated from each other and included in the model.

Representation of the company's manufacture function:

$Y = A(K)F(K, L)$

In this place, technology is a function of capital fund.

General representation of model:

$Y= K^{a}(AL)^{1-a}$

A is the technological advancement that increases the productivity of labor.

When technology is internalized as a function of total capital stock:

$A = DK^{\delta}$, here you D and δ are considered constant. Assuming the workforce is stable and δ=1:

$Y = D^{1-a}KL^{1-a}=(DL)^{1-a}K$

$A=(DL)^{1-a}$, it is defined and put into place in the upper equation:

$Y=AK$

Capital accumulation in the AK model ensures continuous growth. The assumption δ=1 eliminates the impact of diminishing yields. Technological development has made the Cobb-Douglas function with fixed yields to scope a function via increased yields to scope. That is, since initial $Y=K^{a}(AL)^{1-a}$ is subject to decreasing yields, it will be (1>a>0). The function reached with the assumption δ=1, $Y=(DL)^{1-a}K$ is the incremental return on the scale (1-a+1>0).

In the Cobb-Douglas production function ($Y=AK^{a}L^{1-a}$), Romer did not assume a=1/3, (1-a)=2/3 as in the neo-classical model, and increased the value of a. In other words, by decreasing important of making labor in production, decreased yields have enabled a slower effect. (Köksal, 2006: 26)

This is the denominator of (1-a=2/3) labor from total income. When this value is reduced in pattern, it is ensured that incremental thrift of workforce reproductivity takes more shares and the productivity of capital takes less shares. To explain this, Romer has established a model in which technology is determined by information overflow. In this model, capital investments assumed that the level of technology increased with information overflow in all firms along with the physical capital stock. The increase in labor supply in the model leads to a negative overflow because it argues that firms' incentives to save labor will be reduced. Thus, he has shown the

technology (A) as the function of K and L (A(K, L)). In case production of the company:

$Y=A(K,L)K^{1-a}L^{a}$ is expressed as.

a shows the impact of an increase in employment on production.

On the purpose of simplicity, the relationship between K and L,

$A(K,L)=K^{\alpha}L^{-\alpha}$ and $\alpha>0$ assumed to be shaped like this. When $K^{\alpha}L^{-\alpha}$ is substituted in the production function:

$Y=K^{\beta}L^{-\beta}$ is obtained. In this place, β shows the overall impact of an increase in employment. It also includes α and β. Thus, β is less than the share of labor in total income (α). In this way, the marginal productivity of labor has been shown to have a high share of incremental reproductivity of workforce. Additively, it got an affirmative connection between investment and growth in model and found an adverse connection between growth and preliminary revenue. (Köksal, 2006: 27)

A refers to the design (new information) for each new production of goods. In other words, the total number of designs, A, can grow infinitely.

The R&D secture manufactures ingoing information (design) promoting the existing information recruitment and person fund. The intermediate goods sector produces durable inputs to be used by the final sector by using designs from R&D secture. In case ultimate products secture manufactures final goods by using the durable goods input from the intermediate goods sector, labor and human capital.

New information production is provided by the amount of labor, capital and technology level allocated to the research.

It is assumed that the labor and capital used in the production of information are fixed-income according to the scale and the R&D is the declining income.

Population and labor force are accepted as external and fixed in the model.

$L_{(t)} = n.L_{(t)} \quad n \geq 0.$

The person fund stock and person fund stock entering market in the total population are at a constant rate. (Kıraçlar, 2005: 76-77)

Romer's long-term growth in the R&D model contingents upon number of researchers that economy produces. In other words, economic researchers came to how much this and how much R&D sector in the development of technologies using them-if it provides new product, it will have a growth rate of magnitude.

There are three pillars of this view of Romer;

The first of these; technological development is the main dynamic of growth. Technological growing supports economic decision-making agents to collect fund, thereby increasing production per labor force.

Secondly; the formation of technological growing is realized through precedences of economic decision-making units. The internality of technology stems from encouraged initiatives. In other words, technological development is that new knowledge is used in the production of a new good that can create market value.

Thirdly; the information used in the production of a good is once a cost of production, they do not add any other cost to production. New information can be used multiple times without wear. The production of other new information only increases the total fixed cost. Thus, the quality of the technology is defined. Moreover, with this assumption, companies can take the price as data.

In Romer Model, as the market expands, R&D activities and thus growth increase. When the market expands, the size of the population is not taken into consideration and human capital stock is taken as a measure. Economies with a large human capital stock show greater growth rates. That is to say, growth does not depend on the total population but on the size of human capital.

According to Romer (1990), technology is a non-competitive commodity. Competitive property is property acquired by the individual. The use of the property by the person who owns the property is prevented by the use of other individuals. A non-competitive product is a product that can be used by all individuals. On the other hand, if a good is excluded, it can only be used by the owner.

With these assumptions, technological developments are partly excluded. According to Romer, growth stems from non-competitive and partially excluded technological development.

Companies work for profit and create technological innovations and put them on the market. Other companies benefit from this technology in part. In this respect, designs differ from the concept of human capital. Because human capital is at the disposal of the leasing company. It is that there is a single place at the same time. (Kıraçlar, 2005: 78)

Technological developments in Romer's model for patients with persistent snow to future costs are folded into the moment. In this respect, it can be said that the level of technological development is directly proportional to profit rates. Furthermore, economies with larger capital stock lead to higher economic growth. In other words, countries with falling degrees of person fund increase are less developing and nations with greater levels of person fund increase are developing more. This situation helps explain the differences in development between countries.

Romer's (1986) work played a leading role as the beginning of internal growth models linking technological development with market-driven entrepreneurial decisions. According to Romer, economic growth stems from technological developments created by investors seeking to maximize their profits. (Romer, 1990: 71) Technological innovation is the main source of growth. (Yeldan, 2010: 221) In addition, technological advances increase marginal productivity. (Romer, 1986: 1002) Technological innovations enable the firm to increase its market share and increase its profitability on a company basis, while accelerating economic growth from a macro perspective. (Korkmaz, 2010: 3321) In internal growth theory, the definition of capital is not limited to physical capital. The model shows human capital and knowledge as the source of economic growth. (Becsi & Wang, 1997: 51)

According to Romer, technological development in the R&D sector (Research and Development) is driving force of growth. Romer's work is in a sense based on Arrow (1962), which internalizes technological development

in the process of economic growth. Arrow argues that the increase in production will contribute to the whole economy through spillover and learning-by doing is more than the firm's own gains. According to Albelo, learning-by doing business affects human capital as much as formal education. (Albelo, 1999: 360) Romer believes that liberalization of foreign trade and economic integration with countries rich in human capital will positively affect economic growth. (Ercan, 2002: 131-132)

In this model, where international economic integration is taken into consideration,it is stated that the total human capital stock of the countries which enter the integration process will remain. In this case, the quantity of person fund which allocated to search activities will increase and growth ratio will remain. Romer's view emphasizes that international trade is particularly important for countries with large populations such as China and India. Specifically, it is stated that economic integration with countries with relatively high human capital stock is an outstanding element for growth. Maximum striking result of model is that economies with relatively high total human capital stock will have higher growth rates. In this context, free international trade positively affects economic growth. (Romer, 1990: 71-79)

CHAPTER II

R&D BASED ENDOGENOUS GROWTH MODELS

Expenditure on R&D is one of the most common variables used by countries or businesses adapt to technological developments. R&D expenditures has great importance at every stage of technological activities, including the effective use, adaptation or modification of the technology owned or imported by countries. (Cohen & Levintal, 1989: 569)

As in many areas, globalization has led to significant developments in R&D. Globalization and efforts to integrate international goods, services and factor markets have once again emphasized significance of R&D in demonstrating both economic growth performance of countries and the competitiveness of foreign markets. (Saygılı, 2003: 73)

The knowledge and experience produced eventually of R&D activities significantly affect profitability level of company, and also contribute to the production of highly competitive products. R&D is not only about technological development and the associated increase in production; it also performs an outstanding status in growing of new technologies in advanced economies, such as learning-by doing or design. (Guellec & Pottelsberghe, 2001: 105)

In this section, some substantial theoretical approaches clarifying technological improvement based on R&D expenditures are analyzed. It is approved that the literature in this field started with Romer's pioneering essay in 1990.

2.1. R&D MODEL BASED ON HORIZONTAL INNOVATION: ROMER (1990) MODEL

The R&D actions are foundation of Romer Model and the person fund recruited in R&D secture and ingoing product or production techniques produced by the identical sector constitute the general framework of this model. Achieving a

sustained growth ratio in maxi-term depends on amount of qualified workforce such as scientists, researchers and technical staff changed to R&D secture by economy. Upward of inputs of human capital which make up in an economy and the more the economy allocates these resources to the R&D sector, greater growth in this economy will be. In this kind of internal growth theories, ingoing thoughts gained through profitable R&D investments and the resulting knowledge perform a substantial role. (Romer, 1990: 71)

Romer (1990) constructed his model on three foundations. Firstly, technological improvement is at the center of economic growth. Secondly, technological improvement is made by the conscious judgments of the companies which are warned by the market incentives. The third and most substantial foundation is that there are substantial dissimilarities between the use of information in manufacture as a manufacture factor and the use of other manufacture factors. Apart from the one-off cost incurred in producing, information does not result in a remain in production costs, regardless of the extent which they are used in production. This identifies the basic character of technology in this model. The most substantial characteristic of this model is that the remain in market size through the differentiation of goods and trade between countries creates an accretion impact as well as income and wealth impacts. A wider market leads to upward of search and quicker growth. In Romer Model, the measure of market size is not the inhibitants but person fund recruitment.

This model assumed to have four simple inputs works as follows under these hypothesises. The inputs used in pattern are physical fund, workforce, person fund and technological level indices. Technological degree index (A) has ability to grow infinitely and remains along with the newly discovered durable goods. It is also supposed that there are three segments in the economy. The R&D secture uses the existing stock of information and human capital to generate ingoing information. The intermediate goods sector generates durable production inputs that can be promoted in ultimate products secture by using ingoing information and designs produced by the R&D secture. Ultimate products secture generates final goods using durable

production inputs manufactured by intermediate products secture, human capital and labor. The model predicts that the population and labor supply is stable. (Romer, 1990)

In design manufacture, labor, physical capital and the portion of total human capital allocated for this manufacture are used H_A. The manufacture function is in the style of Cobb-Douglas manufacture function and can be demonstrated as follows;

$$Y(H_{Y,} L, x)=H^{a}_{Y} L^{B} \sum^{\infty}_{i=1} x_1^{1-\alpha-\beta} \quad (1)$$

The large A in the research sector has an affirmative impact on the productivity of human capital. Being taken into consideration of the employees in the whole research segment, total design stock is procured as follows;

$$A=\delta H_A A \quad (2)$$

At this place, H_A is commented as total person fund recruited in R & D secture.

Equation (2) contains two substantial hypothesis. Primary, allocating upward of person fund to R&D secture raises ratio of production of ingoing design. Second of all, a large total stock of data and design remains the efficiency of engineers and researchers studying in the R&D segment.

Founder of the R&D essential growth pattern, Romer added different color to economic growth in 1986 with his work “Increasing Returns and Long-Run Growth, which is seen as the beginning of internal growth models. Romer attributes R&D the most important task in his work. The human capital in R&D units and the new products or production methods resulting from the activities of these units form the basis of Romer's work. (Romer, 1986: 1002-1003) Romer introduced R&D essential economic growth pattern for first time in his name of “Endogenous Technological Change” in 1990, which Romer described as the driving force of growth after his study in 1986. (Jones, 1998: 2) In this study by Romer, technological development is at centre of economic growth. In consequence of governments' market incentives, conscious behaviors of individuals bring innovation and

technological development. Romer distinguishes new production techniques gained through R&D and innovations from normal production, which can be used repeatedly without requiring fixed costs. (Romer, 1990: 72)

Romer drew attention to two situations in technological development. The first one is the economic aspect with the feature of increasing productivity and supporting economic growth, and the second is that the technological advancement is achieved through the economic decision-making mechanisms of the state or the unit of production with the resource direction that it is revealed. According to Romer, sustainable growth can be arrived by way of accumulation of person fund in R&D units. According to Romer, technology is a non-competitive and partially restrictable use. Thanks to the power provided by the technologies that they develop, the companies operate from the weak position of the price buyer in perfect competition conditions to the companies that have technological monopoly power in the monopolistic competition market. (Romer, 1990: 1-79)

As a result, economic growth in Romer's model cannot be sustained by capital accumulation alone. Innovation, knowledge and technological change are the elements that will eliminate the differences in development between countries. The R&D sector created by knowledge, technological change and entrepreneurs is the engine of economic growth. Romer, who contributed to the literature in many ways, made significant contributions to the science of economics by remarking that efficiency rate of R&D directly affects the innovation process and that R&D is still an outstanding element for innovation production. (Romer, 1990: 81)

Paul Romer's model emphasizes technological change, which is major weld of growth. Technological change that encourages economic units to maintain their capital accumulation also leads to an increase in productivity. (Türker, 2009: 89) In Romer's model, which includes Scuhumpeterian ideas in his works, technological development is at center of economic growth. Technological development occurs in consequence of market incentives by individuals with conscious activities. Furthermore, since the production cost of the technology input can be considered equal to its initial fixed cost, the

cost of reproducing and using, it is very low. (Yardımcı, 2006: 102) In this model, it is stated that only one-time fixed cost is incurred as a result of the creation of new information, is not that additional cost arises as a result of re-use of the information. In this model, which also takes into account international economic integration, it is stated that the total human capital stock of the countries entering the integration process will increase. In this case, the human capital allocated to research activities will remain and ultimately the growth rate will increase. (Türker, 2009: 89)

In the internal growth theory, it is noteworthy that the definition of capital is not limited to physical capital, but person fund and knowledge are observed as the weld of economic growth. Developments in the R&D sector, which is the source of new information and technologies, have also been seen as dynamic power of growth. (Özer & Çiftçi, 2009: 68)

Contrary to the Neo-classical growth model, which takes data, Romer's model assumes a monopolistic competitive environment; Companies that develop new information and product through R&D activities determine prices over the fixed cost of information. Firms wishing to maximize their profits go to monopolization by protecting their new knowledge and technologies through mechanisms such as patents and property rights. New products and processes resulting from R&D actions will be used by another firms and “Spillover Effect” will emerge. As a result, economic growth will take place. (Taban & Şengür, 2014: 358)

The subscription of remain in the manufacture of information to whole economy by way of the spread effect is more than the gains in the firm. According to this approach, information is a common product that cannot be exempt competition and cannot be excluded from consumption. In the event that rights on new products and processes are protected, the information does not become a public domain and the invention is encouraged. As a result of the protection on intellectual products, the fact that information is partially open to the public encourages rational economic units and individuals for making inventions. (Taban & Şengür, 2014: 358)

Romer's pattern of economic growth leaning against technology hinges on three significat facts. These are as follows: (Romer, 1990: 75)

- Technological developments permit promote of feed stocks to be promoted in the manufacture stage together. Goods constituted in consequence of utilization figure base of economic growth and technology entrench sustained saving of capital edgeways. Also, under favour of technological backing, quantity of thruput is remaining, but what workforce expense goes up fixed.
- But what there are technological growings done by academicians in order to investigate ingoing information outside advantage, firms or contractors who desire to remain their advantages generally engross technological growings. Hence, technology is an endogenous alteration and growing.
- The book value of incurring ingoing knowledge is one time. There is not ingoing book value for repetitive promoting of the generated information. This is debated an identifying property of technology.

In addition to these three factors, the assumptions of the economic growth model developed by Romer with a technology focus are as follows: (Romer, 1990: 75)

- Labor supply and current population will remain stable.
- The recruitment of person fund in inhibitants and part of it that is supplied to the market are fixed.
- Products that are not consumed should be taken from the consumption sector and transferred to the capital sector.
- Only human capital is used in new information and designs created with the support of technology. At this stage, capital or unskilled labor are not involved.
- There is not wear on capital products.

2.2. MODIFICATION OF THE ROMER MODEL: JONES MODEL AS A SEMI-ENDOGENOUS GROWTH MODEL

In Romer Pattern, maxi-run stable growth proportion is proportional with the degree of person fund employed in R&D segment. This impact creates a kind of scale impact. Jones published two studies in 1995 and

proposed a model that eliminates the impacts of scale. Jones discusses that the expected growth impacts from R&D based internal growth models disappear or diminish when the scale impacts are eliminated. (Jones, 1995a; 1995b)

Jones tells that the scale impact is empirically problematic because of the structure of primary generation R&D principal growth models. (Jones, 1995a, p. 777 & Kortum, 1997: 1393) In this Jones study, he tells that there has been a substantial increment in the count of scolars and engineers in total employment throughout period after Second World War. However, national income and Total Factor Productivity (TFP) growth rates remained stable or at least not remained. (Jones, 2005 & Lin, 2001)

Another substantial conclusion that Jones has reached that is related to the findings of policy inefficiency. When the scale impact is excluded from this model, the growth proportion of soever capita income is proportional to labor growth proportion. On the one hand, growth can be told to be internal as growth is a product of conscious R&D decisions as a result of market incentives by private firms. On the other hand, it is external as it is not probable to control the line of stabilized development through public policies. (Jones, 1997: 45-4)

Jones (1995) analyzed impression of R&D essential economic growth patterns on industrialized nations, to some extent improving Romer's current model. The conclusion of pattern is that an imprescriptible remain in R&D doesn’t impress on economic growth.

Jones argues in 1995 that the scale effects in the model established. He suggested that when the effects of scale disappear, the expected growth effects of R&D essential internal growth patterns disappear or decrease. (Jones, 1995: 759-784) He established a semi-intrinsic growth model.

In order to prove validity of R&D based growth models, study examined the growth rates of total count of scholars and engineers of France, Germany, Japan and the United States of America and sum consideration thrift growth rates in time series. In Jones research, when economies were analyzed, scientists and engineers employed in the current economy after the

Second World War, however; there was not increase in national income and total factor productivity growth rates. (Jones, 1995: 759-784)

When the scale effect is excluded from the model, the growth proportion of revenue soever person is proportional to labor force growth proportion. As a result of market incentives of private firms, products of conscious R&D decisions argue that growth is external because control of internal, balanced development is not possible with public policies. (Jones, 1997) As a result, policy points to ineffectiveness.

2.3. GROSSMAN AND HELPMAN'S MODEL BASED ON INCREASE IN PRODUCT RANGES AND KNOWLEDGE AS PUBLIC GOODS

Grossman and Helpman's growth pattern, depending upon technological innovations, links growth with foreign trade and openness. Underdeveloped countries, which cannot allocate sufficient funds to R&D investments, will be able to provide the technologies they require by making technology transfers from developed countries by remaining their openness rates. However, technology transfer will not take place by itself. In order for this to happen, the incentives of the underdeveloped countries for technology transfers and the convenience which they ensure to multinational companies perform a substantial role. (Grossman & Helpman, 1991: 43)

According to Grossman and Helpman, protectionist approaches have an adverse impact on the growth performance of countries, whether for developed countries that allocate sufficient funds to the R&D segment or for underdeveloped countries. If protectionist policies are implemented in developed countries, expenditures will switch from R&D secture to consumer goods and this will prohibit long-term growth rates, as this will prohibit the use of funds in the manufacture of information. In this way, as a result of the implementation of protective policies in the manufacturing industry, qualified labor force in the economy will shift to the manufacturing industry and consequently diminish in technological innovations, the engine of economic growth. (Grossman & Helpman, 1994: 39)

Groosman and Helpman investigate the growth model based on technological innovations under two headings. The first of these is the growth impacts of technological innovations resulting from the remain in product variety and the second is the impacts of public knowledge and growth. In the model based on the remain in product assortment, firms obtain monopolistic rents. (Eaton & Kortum, 2006: 13) As a result of R&D investments, companies that acquire monopolistic rents by developing modern products, as well as non-competitive goods can be used by all companies. The quality of information as public property is largely based on Romer's 1990 Model.

The hypothesises of this model are as follows; the potential for the development of ingoing goods is infinite and the funds necessary for innovation are constant. In the information manufacture sector, there are not diminishing returns to scale. Produced products are priced as a function of wage rates. Wage rates are determined by the free entry condition. How many firms will operate in the market is determined by the profit expectations of the firms. In the case of static equilibrium, prices and source distribution are solved under the hypothesis that the amount of product variety and the value of firms are steady. (Arnold, 2005: 3)

Grossman and Helpman's second model, based on the hypothesis that knowledge is public goods, extended the Romer (1990) Model to involve industrial R&D gains. Accordingly, there are two particular products of R&D activities. Firstly, each R&D project develops design for an ingoing product. This modern design brings a monopoly profit to the designer. Secondly, each R&D project promotes to the existing general capital stock (Kn). This capital stock is depicted with a set of opinions and methods that future generations can use. Growth of technological innovations, the extent of human capital in the economy, the efficiency rate in R&D activities are determined by the willingness to postpone its current consumption to future periods and the assorted product diversity. The breadth of resources in the form of labor leads to an increment in the amount of labor employed in the sector, which leads to an increment in the amount of labor that can be used by

the innovation manufacture sector, thus enabling the production of new technologies.

Gene M. Grossman and Elhanan Helpman published in 1989, 1990 and 1991 are among the models that contributed significantly to the growth approach based on technological innovations and new inventions. In Grossman and Helpman's models, it is stated that technological innovations resulting from the conscious behavior of economic units are internal. They believe that the productivity gains resulting from technological innovations are the source of growth.

In the work and model presented by Grossman and Helpman, they associate different and new products realized by each country with the phenomenon of growth and foreign trade and trade policies. Utilizing the advantages of foreign trade, the R&D sector ensures economic growth by increasing the competitiveness of the economy. According to them, nations that cannot assign adequate welds to their R&D activities and hedges will gain maximum benefit by increasing their volume in the world trade by acquiring the technologies that they need through developed technology transfers through free foreign trade policies. In addition, productivity increases resulting from technological innovations will be the source of economic growth in the long run. (Grossman & Helpman, 1991: 43-46)

According to Grossman and Helpman (1989: 1262), new products obtained or developed through R&D and technological developments will also benefit from the opportunities offered by foreign trade, thus enabling countries to gain comparative advantage. This will pave the way for economic growth of nations that have gained comparative advantage.

According to Grossman and Helpman, conservative approaches such as tariffs and quotas will prevent growth of nations without discriminating between them. The protectionist policies of countries that allocate sufficient resources to R&D units but they shift their expenditures to consumption goods may negatively affect their long-term growth rates. Protective policies will lead to a halt in growth as a result of the activities that will prepare the ground for adding value by directing expenditures from R&D to consumer

goods. Trade liberalization facilitates access to information through technology transfer in fewer sophisticated nations, while in sophisticated nations it encourages employment of qualified labor in the R&D sector. (Grossman & Helpman, 1994: 39; 1990: 811-814)

G. Grossman and E. Helpman's "Innovation and Growth in the Global Economy" describes "Dynamic Comparative Advantage" model. The number of differentiated product designs in this model is the main factor determining the structure of trade. In other words, the structure of international trade varies depending on the amount of new inventions found in consequence of R&D hedges and R&D studies carried out by countries. In this model in which innovation is internalized, the weld of economic growth is phenomenon of innovation that increases diversity and quality of intermediate goods in consequence of R&D actions. (Türker, 2009: 89)

In Grossman and Helpman's model, internal growth is achieved by improving the quality of R&D goods and increasing product diversity based on the continuous growth of ingoing technologies by R&D secture. Taking advantage of opportunities provided by foreign trade, the R&D sector will be one of foremost elements of growth by giving country's economy a comparative advantage. (Taban & Şengür, 2014: 358) In the Grossman and Helpman model, he associates growth with foreign trade and foreign trade deficit. Countries that do not allocate welds for R&D hedges will provide technologies they stand by transferring technology from developed countries and in this case, they will increase their openness rates. (Özer & Çiftçi, 2009: 223)

In Grossman and Helpman's model of economic growth, accumulation of knowledge capital is identified as an important element of technological development: Accordingly, technology is an instrument of knowledge capital, (Grossman & Helpman, 1990: 4) authors who consider technology as a good have developed two types of good;

1. They saw technology as a non-disruptive commodity,
2. Technology is a product that can be partially prevented (easily intercepted by patent, copyright, etc.) (Gürak, 2006: 144)

A number of assumptions were made in the model; Savings are spent on R&D. R&D has two main objectives:

i. Reduce production cost,

ii. Produce new product. Monopoly profit (excessive profit) is achieved through technological innovation as a result of R&D. (Gürak, 2006: 145)

Therefore, there is a monopoly structure in the market. Although global competition increases, these monopoly profits will decrease and technological innovations will decrease (competition conditions force companies to make new inventions). In this place, profit expectations and rate determine the number of firms entering the market. The products on the market cannot substitute each other fully. Market entry conditions determine wage amounts. The prices of the products emerge as a function of the wage rate. (Grossman & Helpman, 1991: 517-526)

Thanks to technological innovations and foreign trade in a small country can grow very quickly. Large countries allocate more resources to R&D. Both technological innovations and growth will be faster. Therefore, faster growth is seen in countries with more qualified labor.

The structure of foreign trade is shaped in consequence of comparative advantage based on R&D efforts and technological development differences. According to this analysis, countries do not trade, firms do foreign trade. (Gürak, 2006: 143-150) It is possible to bring three important criticisms to the model; Firstly, they talk about the decrease in monopoly profits and the decrease in technological innovations when global competition is lifted, whereas the number of technological innovations increases as the global competition rate increases. Secondly, they have adopted the comparative advantage theory approach among countries, but nowadays companies do not trade. Thirdly, the approach of simultaneously determining prices in product, factor and capital markets is also invalid. (Gürak, 2006: 150)

2.4. AGHION AND HOWITT MODEL

Another R&D based growth pattern is incoming Schumpeterian "creative destruction" model developed by Aghion and Howitt. (Aghion & Howitt, 1992: 323-351) As regards Schumpeter, the engine of the capitalist system and its main driving force is incoming consumer goods, new methods of manufacture or transport and new markets. This process perpetually transforms the economic structure from the inside, constantly destroys the old and consistently creates an ingoing one. The process of creative destruction is the basis truth of capitalism. (Schumpeter, 1970: 83; Alcoufe & Kuhn, 2004: 230)

In the Aghion-Howitt model, the innovations produced as a result of R&D activities and these innovations indicate a successive development in product quality. The main character of quality improvement efforts in the form of vertical innovation is the obsolete innovation or innovation of an ingoing invention. (Aghion & Howitt, 1998: 53) This obsolescence or creative destruction of a new invention leads to two consequences. The first is that it recognizes an adverse relationship between current and future R&D activities. Secondly, although current R&D activities induce affirmative externalities for future R&D activities, they can also have adverse impacts on producers.

In this model, following the Schumpeter, the following hypothesis are made; individual innovation adequately influences the entire economy. The period covered is a period between two accomplished innovations. The length of time between each successful innovation is random because of the indiscriminate disposition of novelty continuum. However, relationship between amounts of R&D activities in both successful innovation periods can be deterministic. The R&D amount in the initial period is in an adverse relationship with the R&D amount expected to be made in the next period due to two impacts. The first is impress of creative destruction. Preliminary R&D activities depend on level of monopolistic rent that is hoped to be achieved in the time to come. These rents continue until a new technological innovation is made. Therefore, the present value of expected rent is

backwards interested in amount of novelty possible in following period. Secondly, the overall equilibrium impact of changes in the wages of skilled labor that can be used by the R&D and manufacturing segments (Diao et al., 1999: 345; Ateş, 1998: 46)

This functional relationship between the two R&D periods leads to a stable and stable state equilibrium of the economy. In this equilibrium, there is not change in the distribution of skilled labor between the manufacturing industry and R&D segments and the GDP is increasing in a random manner.

A withstanding innovation entrepreneur obtains a patent that gives him a monopolistic character in the intermediate goods segment. It is supposed that patents proceed ever more. Although patent rights proceed for ever, the power of monopoly continues until an ingoing technological innovation. The length of the time between the two technological innovations is determined randomly and the model cannot predict when a technologically higher quality and superior innovation will occur. All markets except that he intermediate sector are fully competitive markets. (Aghion et al., 2001: 467-492)

The model has a substantial inter-period spreading impact. A technological innovation enhances efficiency without losing impact for ever. Each innovation incures an imaginative impact aimed at achieving monopoly profit. But it also eliminates that the rents obtained from the previous innovation. Thus, the remain in R&D activities induces a derogation in profits from these activities and a patent competition. (Aghion & Howitt, 2004)

Inspired by Schumpeter's idea of creative destruction, Philippe Aghion and Peter Howitt conducted a "Model of Growth Through Creative Destruction" in 1992 and "Endogenous Growth Theory" in 1998. With these studies, like Schumpeter, they developed an internal growth model by examining the contribution of technological innovations realized through R&D activities to economic growth.

Aghion and Howitt constitute the main source of competition in the model. They established vertical technological innovations. The efficiency of a technological innovation multiplies its effect forever. According to the

authors, there are two sectors in the market. The first of these sectors is research and the other is production. The production sector strives for the production of finished goods and the research sector strives to manufacture the intermediate products used in manufacture of the finished products. Inventions and innovations appear in consequence of activities of the search sector. Every innovation that comes with, as well as the drive to make a profit, eliminates that the rents derived from the previous innovation. This is where the growth is based on the replacement of old products with newly produced fame. Innovations gained in consequence of R&D activities lead to introduction of better quality and new products to the market and paving the way for old products to become obsolete. As a result, R&D activities prepare the ground for the replacement of the old ones with better ones and enable the process of creative destruction. Along with these, the authors suggest that the public sector can use R&D as a tool for economic growth because R&D provides positive externalities. (Aghion & Howitt, 1992: 323-351; 1998: 53-67)

Aghion-Howitt model which accepts technological innovations as an internal phenomenon, is different from other internal models developed by vertical technological innovations. In the Aghion-Howitt model, the innovations produced in consequence of R&D actions and goods quality of these innovations show a successive development. The main feature of the quality improvement efforts in the form of vertical innovation is that the innovation or a new invention created as a result of technological developments in the competitive R&D environment is aging the existing technology or product. (Aghion & Howitt, 1998: 53)

According to Aghion and Howitt, the adaptation process of technological changes resulting from R&D activities cannot be realized easily. New technologies often replace them after entering into competition with older technologies. In short, the process of technological diffusion takes time. (Aghion & Howitt, 1992: 324)

According to the Aghion-Howitt growth model, growth emerges as a random series of quality-enhancing innovations that result from research.

Every innovation that is occurring improves the quality of an existing product, but it is not certain that any research to create new innovation will be successful. Each new innovation overrides and deletes the old technology. More clearly, when new technology emerges, consumers do not consume the old technology. This brings us to Schumpeter's concept of “creative destruction”. This is why Aghion-Howitt's model is called the New Schumpeterian growth model. (Yıldırım, 2009: 263)

According to this model, there are two sectors in the market as research and production. There is a production sector for the production of final goods and a research sector for the manufacture of intermediate outputs promoted in manufacture of ultimate products. Innovations and innovations emerge in consequence of R&D actions. These innovations eliminate obtained rents from the previous innovations of companies acting with the motive of making a profit. In this case, the engine of growth is to replace the old ones of the newly produced products. The reason for this is that the innovations resulting from R&D activities offer better quality and new products to the market. The ancients are replaced by the better ones. In this content, Aghion Howitt (1992, 1998) advises policymakers that using R&D as a tool will lead to positive externalities and increase economic growth. (Erdoğan & Canbay, 2016: 39-40)

When an innovation occurs as a result of research, the owner of the innovation becomes a monopolist in intermediate product secture. Formation of monopolistic intermediate products sector is realized through innovations resulting from competitiveness in the research sector. In this model, when a country innovates, the productivity level of the country becomes the most advanced technology and sets the upper limit. If the country remains at the current level of innovation without innovation, the technology of the innovating countries advances. The technology of the non-innovating country lags behind time. In this context, the distance of the countries that cannot realize innovation to the technology boundary increases compared to the ones that realize it. (Yıldırım, 2009: 263)

Aghion-Howitt regards technological innovation as an internal phenomenon. The difference of this model from other internal growth models is that vertical technological innovations have a quality-enhancing effect on products. According to this model, the innovations resulting from the R&D activities and these innovations show successive development in product quality. More specifically, the main feature of quality improvement efforts in the form of vertical innovation is the existing technology or product of innovation or invention resulting from technological developments in the competitive R&D sector. (Aghion & Howitt, 1992: 53) However, the adaptation of these technological changes resulting from R&D activities is not easily realized. Primarily, new technologies rival via elder ones. They often prevail and juggle elder ones. This is a date-consuming continuum. (Aghion & Howitt, 1992: 324)

With respect to Aghion and Howitt, every technology developed after each R&D activity and consequently the effect of each product continues exponentially. Research will give birth to new products, while new products will facilitate the next research. There is a consecutive situation on top of each other. In this context, R&D activities for innovation can be seen as the key to the economy.

Aghion and Howitt (1992; 1998) developed a two-sector model by introducing a Schumpeterian approach to internal growth theory. In the model consisting of production and research sectors, the production sector includes the manufacture of ultimate product, while research secture focuses on the development of the intermediate product used in manufacture of ultimate goods. (Yıldırım, 2011: 263)

In this model, the standard of outputs is realized by "Vertical Technological Innovations". The difference of this model from other internal growth models is the source of growth, vertical technological innovations in competitive R&D secture. In consequence of innovations resulting from R&D studies, more new products are introduced to the market and old products are becoming obsolete. At the end of this process, while the old ones disappear, better and new products take their place and Schumpeter processes

“creative destruction”. (Taban & Şengür, 2014: 360) According to Schumpeter; the engine of the capitalist system is new consumer goods, new methods of production or transport, and new markets. This process continually renews the economic structure and destroys the old. This creative destruction process is the necessity of capitalism. (Özer & Çiftçi, 2009: 224-225) The model assumes that individual R&D efforts are important in influencing the whole economy, and the amount of large-scale R&D activities determines the growth rate in the economy. (Taban & Şengür, 2014: 360) The most important element in Schumpeterian creative demolition model is technological innovations that provide product quality development and patent system that provides dynamism by preserving these innovations. (Özer & Çiftçi, 2009: 225)

According to Philippe Aghion and Peter Howitt, “Vertical Technological Innovations” in R&D secture are source of growth. (Aghion & Howitt, 1992: 323-351) Old products are destroyed and new ones are replaced. Thus, the process of “creative destruction” works. (Gürak, 2006: 139) The product competitiveness model developed by Aghion-Howitt has an important place in internal growth models. (Ünsal, 2007: 263)

The model of Aghion and Howitt has three basic features. The first is growth in the imperfect competition process. While the technological process is realized in the competitive market-based growth models with the effect of spreading, it is formed through the investments of R&D sector of the companies that are attracted to the monopolistic profits under the imperfect competition market. As the R&D sector, the higher level of increasing, the quality of the intermediate goods of the invention, it is the faster in growth. Under this assumption, the inventor with monopoly power will remain in the market as a monopolistic force for a period of one year (until the patent expires). (Ünsal, 2007: 264) The second is the concept of creative destruction. Accordingly, due to the destructive nature of technological innovations, the products have a life cycle and the products that complete this cycle which are eliminated and replaced by new ones. The monopolistic position of the producer ensures a high rate of profit. This is the main factor

on growth. The third is discontinuity. The technological structure is discontinuous. Special-quality labor triggers technological innovation and growth. (Gürak, 2006: 142-143)

According to the researchers, it is possible to summarize the elements and critics of the economic growth model:

- Technological innovations are both internal and a source of growth. New technologies produce special labor. (However the model does not provide information on how this particular labor is formed and how it develops.)
- Growth rate;
  - ✓ quantity of innovations,
  - ✓ the quantity of qualified workforce,
  - ✓ Associated with R&D efficiency. Therefore, it cannot adequately explain growth differences between countries.
  - The reason for technological innovations arises from the importance that competitive companies attach to " R&D ".
  - GDP growth rate is random.
  - There are 3 sectors in the model;
    - **a.** Research sector,
    - **b.** Search-Invention Sector (Scientific new invention and technological innovation emerge here),
    - **c.** Consumer goods sector. (For example, the services sector is excluded from the model.) Accordingly, since the cost-cutting innovations were ignored and the services sector was eliminated as the most important engine of growth, it turned this growth model into a "partial growth model".
  - In an important case, the marginal utility of consumption has been kept constant. (It is not possible for any goods to remain stable after a certain point.) All society has the same preferences. (In this place, the influence of some classicists is greater.) (Gürak, 2006: 140-144)

2.5. ACEMOĞLU AND ZILIBOTTI MODEL

Acemoğlu-Zilibotti Model, which is one of the models for explaining income dissimilarities between sophisticated and progressive nations, they tell that differences are induced by selection of inappropriate technologies by developing countries. (Acemoglu & Zilibotti, 2001: 563-606) Unprecedented technologies are designed on the main of the needs of developed rich industrial countries and thus they do not produce the identical impacts as developed countries when they are implemeted in developing poor countries.

This model predicts that there are two varieties of economies, North and South. Northern economies have an innovative structure. In the South, there is not activity for the creation of ingoing technologies. However, the Southern economies are adapting the new technologies developed by the North. The legal arrangements for preservation of spiritual ownership rights are not performed in Southern countries. There are three segments in the economy, namely the end product sector, the intermediate goods segment and the machinery segment. (Acemoğlu & Zilibotti, 2001)

Firms in the Machinery Sector are classified in two ways as innovative (North) and copycat (South). Innovative firms that create ingoing technology in the North are gaining a rent as their patents are well protected in the Northern economies.

In the South, intellectual property rights are not protected and thus there is not R&D activity. Machine manufacturers in the South copy designs created in the North at a small fixed cost. (Basu & Weil, 1998: 1041) As a result, companies in the South are working with machines developed by the North. In the South, the skill of the labor force is relatively low. This model is indicated that the output per labor force in Southern economies is lower than the output per labor force in the North. This conclusion remains valid even under the hypothesis that both groups of economies use the identical technology. Southern economies use a combination of technologies developed taking into account the basic characteristics of the Northern economies. However these technologies operate at less than optimal efficiency when they used in the South. The variation in productivity between

North and South is induced by technological incompatibility. These technologies developed by the North are not appropriate for the capabilities of the labor force in the developing and underdeveloped economy.

The variations in economic conditions and constructions of nations create differences in level of development. The need for appropriate innovation and technology to help market conditions and economic growth was recognized. Acemoğlu-Zilibotti Model, which tries to explain the income gap between developing and developed countries, argues that this is due to the fact that developing countries cannot choose the appropriate technology. (Acemoğlu & Zilibotti, 1999) The problem is that developing countries design new products according to the needs of developed countries and that these designed products do not have the same beneficial effect as innovations in developing countries.

In Acemoğlu and Zilibotti's model, two countries, North and South, are defined and represent two different economies. The main difference between these two countries is in the field of technology development. North is a country that produces new products and new technology. South is a non-productive country in the name of innovation and transfers new technologies developed by the North and applies them in its own system. (Acemoğlu & Zilibotti, 2001)

While patent intellectual property rights are protected in the Northern country, not such regulation exists in the south. Three sectors were accepted in the model. These; the final product sector, intermediate goods sector, machinery sector. Firms in the industry due to the protection of patent rights in the Northern country, the proliferation of patents by innovative firms triggers growth by increasing the surplus in the economy. There is not patent protection regulation in the south. In companies, they are not inclined to design, their preference is to imitate machines designed in the North at a fixed cost in their own country. They apply the technology they see exactly. The model advocates; The output per labor force in the South will be less than that of the north. This assumption applies even when the same technology is used. The technologies designed in the northern economy do

not work efficiently in the South because they are in accordance with the conditions of the ratio. This shows the technology mismatch between the two countries. That is why the expected efficiency is not obtained from the technologies they transfer from developing countries to developing countries because their labor force capabilities are different. Economies should find the appropriate technology. (Acemoğlu & Zilibotti, 2001)

2.6. RIVERA-BATIZ AND ROMER MODEL

Another model that investigates connection between strange commerce and growth is the one developed by Rivera-Batiz and Romer. In this model, it is concentrated on the spread of new ideas and trade in goods. (Rivera-Batiz & Romer, 1991: 537)

The basis of the Rivera-Batiz and Romer Model (1991) is the horizontal distinction of inputs. The remain in input diversity has a favourable impact on the productivity of the finished goods segment. Input diversity is generated in consequence of activities in R&D segment. The upward of inputs in the market for the manufacture of any commodity, the more firms will be able to select the appropriate combination of inputs. In this model, technological information is spread in two ways.

The first is through international trends in ideas and knowledge in the Romer (1990) Model. The second is a model called Lab-Equipment, which takes place in trade of goods with new ideas and new technologies. (Savvides & Zachariadis, 2005) In the first model, information is a public property and the spread of information takes place at zero cost. In the laboratory equipment model, it is essential to have input or intermediate trade in order to disseminate information. The trade of goods and inputs, which includes ingoing information and technologies, remains productivity and leads to growt ratios. (Tuncer, 2001: 46)

The Rivera-Batiz and Romer Model (1991) tell that international economic connections have a substantial role in the process of economic improvement. However, the model supposes that economies leading to economic integration are duplicate economies.

By internalizing knowledge and technology, this model aimed to free the neo-classical growth model from the stagnant situation that developed countries have brought into the developed countries and to establish a competitive balance system that fits the real world. The model is based on the monopolistic competition market where there is freedom of entry and exit, externalities and information overflow. According to the model, economic activities continue in two sectors, one of which is manufacturing and the other is R&D. Depletion and investment outputs are manufactured in manufacturing sector and ingoing opinions and techniques are manufactured in R&D secture that ensure continued growth. (Romer, 1986; 1990; Rivera-Batiz & Romer, 1991a; 1991b)

Rivera-Batiz and Romer (1991a) first considered output in the manufacturing and R&D sectors as person fund (H, incapable workforce) (L, physical capital) (K and knowledge level) (A function). C consumption, the output function of the manufacturing sector, K investment (K = I), is as follows;

$Y=C+K=F(H_{y,} L_{y,} K_{y,} A)$.

The output function of the R & D sector is as follows;

$A=R(H_{A,} L_{A,} K_{A,} A)$.

The sub-indices in these functions represent the sector. Inputs other than A may be used in only one sector at a time, while A may be used in both sectors at the same time. When this characteristic of A is combined with information overflows, external supply of raw materials and intermediate goods by firms in the monopoly competition market, increased efficiency is seen in both sectors. This feature is reminiscent of Arrow (1994) saying, " If I give you some of my knowledge, I will not lose anything from the knowledge I already had ".

Rivera-Batiz and Romer (1991b) then formulated output in manufacturing sector where consumption and investment goods were produced as person fund (H), incapable workforce (L and physical capital) employed in this sector as follows (K);

$Y(H, L, x(.))=H^{\alpha}L^{\beta}\int^{A}_{0} x(i)^{1-\alpha-\beta}$.

Here x (i) represents the physical capital inputs used in the manufacturing sector: $K= \int^{A}_{0} x(i)$. α of human capital, β of physical labor and 1−α–β is the product supply flexibility of physical capital. A, representing the most recently discovered information and commodities index, is considered to be i>A for all jobs, as it is used as input for the production of consumer and investment goods, like other inputs.

In the new form of the model, the production in R&D secture is considered to be of two types. One of these, the capital is the production of a new design of the property that is the unskilled labor in manufacturing and physical capital use, production at an efficiency coefficient) (δ human capital) (H and general scientific knowledge) (is carried out by (Rivera-Batiz & Romer, 1991b);

$$A=\delta HA$$

The second manufacture in R&D secture is prototype production of the investment goods whose design is produced and the laboratory tests of the goods currently produced. The inputs of this production, as in the manufacturing sector, are capital goods such as human capital, unskilled labor, computers and measuring instruments. In this case, new design is not produced, prototypes are produced under the laboratory conditions of previously manufactured or patented goods and laboratory tests of the products currently being produced (Rivera-Batiz & Romer, 1991b);

$$A=BH^{\alpha}L^{\beta}\int_{0}^{A}x(i)^{1-\alpha-\beta}.$$

Forward-looking, profit-maximizing entrepreneurs try to produce new designs and technology in the R&D sector and internalize these innovations in their production processes. Adding to this, positive externalities arising from new information and technologies do not result in declining yields and stagnant conditions in developed countries. Unlimited growth is prevented by linking the production of new knowledge and technology to declining yields. (Romer, 1986; 1990)

2.6.1. Schumpeter Model

Joseph Alois Schumpeter (1883-1950) is a prominent thinker with his works in different fields. He expressed the dynamics of the capitalist economic process by developing different approaches. For instance, innovation, economic growth, business cycles, unemployment, savings, income distribution, monopolization, political economy and economic sociology are some of them. He has many works that can be evaluated in the fields of economics, sociology and politics. When we look at Schumpeter's ideas in the social, economic and political fields in general, it can be said that she has an elitist point of view.

These views of Schumpeter on economic analysis show that she acted with a different approach from Neoclassical economics. Instead of balancing and optimizing, he stated that the dynamic imbalance created by the innovative entrepreneur is the norm of a healthy economy and is central to economic theory and practice (Drucker, 1984: 27). Because economic life operates with dynamic processes in a state of constant change. For Schumpeter, the imbalance had a positive meaning and Schumpeter tried to find the balance within the imbalance in his economic analysis. At this point, he stated that the mathematical models of Neo-Classical economics based on extreme rationality are not very sufficient to explain economic analysis.

Schumpeter also opposed neo-Classical economics' understanding of capital and profit. For Schumpeter, capital is not considered as a means of production, but as the purchasing power required for innovation by entrepreneurs. This purchasing power, which is owned by bank money (credit), will provide the entrepreneur with the opportunity to access the means of production. At this point, Schumpeter stated that innovation is an important driving force in the emergence of economic development. While Weber's entrepreneurial profile is static, expressing an ascetic lifestyle, which is extremely distant from worldly goods, Schumpeter's entrepreneurial model has an innovative and dynamic character that constantly pursues the new, thanks to its creativity. Such approaches of Schumpeter to innovation have

offered new opportunities and visions for all countries in terms of economic growth and development.

According to Schumpeter; the firm has a life cycle. This period begins with the production of a new, better or cheaper product and ends with the entry of other competitors. Firms experience their most profitable period when their competitors are new. Profit is a very important place in this model. According to this model, there is not profit without development, no progress without profit.(Schumpeter,1939:154) He describes this process as 'creative destruction'. This process is creative as it encourages technological innovation, however; it is destructive because it weeds out companies that cannot sustain and keep up with technological innovations.

CHAPTER III

LITERATURE REVIEW

Ansal (1985) argues that there is little difference of opinion among economists on the fact that technology is an integral part of industrialization and development. The role of technology in the economy Neo-classical, Keynessian, Marxist, Schumpeter or development economists, all the theories of development are taken into account. She states that she first discussed technology in the light of these different economic perspectives in the economic literature, then she mentioned the debator on the economic effects of technology nowadays and last of all she tries to discuss what we expect the future in terms of technology.

Soyak (1995) states that the purpose of his study is not to introduce emerging evolutionary theory. However with this paradigm shift in economics, he expresses that he tries to clarify and argue some facts, as well. He advocates that technological developments are one of these cases, even the most important. Therefore, he expresses the aim of his work as to critically identify neoclassical and evolutionist perspectives on the phenomenon of technological development.

Li and Mirmirani (1998) state that the analysis of 16 American and European countries during the 1978-1994 period changed the country's overall impact on the growth of arms trade in terms of the Malmquist index. Contrary to the general belief, they argue that the findings of their study do not show that industrial countries use foreign military technology more efficiently than developing countries. They also argue that the total effect difference between countries is mainly due to differences in the efficiency change rather than the technical change.

Laursen (1999) states that 19 nations and 17 producing sectures are involved in era 1965-1988. Additively, the impacts from the structural decomposition (SD)

analysis, a count of variables includes as explicative variables. In this regard, he argues that there is one favourable connection between commerce productivity and singular nation's talent to transfer into technological segments proposing on the top centering technological occasion.

Loo and Soete (1999) state that R&D based models related to technical change and economic growth fail to explain the recent productivity paradox. They describe the various explanations of the paradox with experimental methods. They advocate that the idea of R&D studies are increasingly connected to product differentiation, hence at the same time consumers increase their welfare by showing limited impact on economic growth and it seems promising to explain efficiency.

Tallon and Kraemer (1999) state to embark on a skeleton of IT-led growth to indicate how, in spite of having a feeble native IT segment, Ireland has achieved in built a globe-grade industry in computing device equipment, program and missions via an expedient of "industrialization by papers on appeal". They express to summarize from Ireland's experimentations via IT-led growth to ensure some running subjects for progressive nations.

Pohjola (2000) expresses to examine the effects of knowledge technology hedge on economic growth in one crosscut of 39 nations in term 1980-1995 by implementing an open pattern of economic growth, an increased edition of neo-classical (Solow) growth pattern.

Çelebi (2002) expresses importance of examining the relations between the current technological structure and foreign trade while investigating the causes of foreign trade deficits. First, he stated to approach that technology has a decisive role in international trade. Then, he explained the current technological structure and its impact on imports and exports.

Bayraç (2003), stated that in consequence of innovations in data and transmission technologies, the significant and lasting effects of the economy necessitate the redefinition of many concepts at micro and macro levels. In this study, he evaluated the conceptual framework of the new economic phenomenon, its defining features and the growth of data and transmission technologies, and then changes that these developments have created on societies and economies.

Kim (2003) argues that the goal of his working is to investigate impress of Knowledge Technology an economic growth and thrift in Korea in period 1971-2000. He states that growth additives from normal data considerations. Information Technology fund datas and occupation era impact are numbered on foundation of growth bookkeeping structure. Besides, he argues that weld of thrift growth may have played by promoting expanded growth pattern and arousing interest to status of information technology and information fund.

Yoo (2003) states in this paper that by promoting one nation assay subject to datum from 56 progressive nations between 1970 and 1998, he examines the influences of Information Technology (IT) enterprise on economic growth. According to results, he argues that IT enterprise has contributed considerably to the economic growth in progressive globe.

Ertekin (2005) states that in the application-oriented works are promoted a favourable and powerful connection between R&D and productiveness growth. Nevertheless, she predicates that common R&D has an unfavourable effect on outcome growth due to crowding-out effect, when state expense on R&D substitutes actions that would on the contrary have been assumed by private sector.

Indjikian and Siegel (2005) generally state that working from the enhanced world provide evidence of favourable positive correlation between IT and economic productivity, as well as evidence of IT-related changes in labor composition on the side of excessively capable or trained employees and organizational alterations that permit firms to practice IT further influentially. They express that there are two switch lack in order to maximize social yields to IT investment, policy makers in developing countries. These are; an absence of information of "best implementation" in IT utilization and IT-concerned lacks in the labor force.

Strulik (2015), his model estimated that economic growth was positively linked to human capital accumulation, positively or negatively by population growth, and was so largely helped by empirical evidence than previous models. Especially, long-term growth was consistent with a stable population.

Falvey and Foster (2006) offer while powerful IPR (Intellectual Property Rights) conversation can once for all reap awards with regards to bigger domestic novelty and rised technology diffusion in developing countries with adequate

capacity to make a change. They state that it has little effect on novelty and diffusion in those outside such capacity and may impose additive margin, specifically for the least developed countries to will be hindered from handling imitation as a point to improve progressive capacity. Therefore, they defend that there is a significant encouragement for countries at various parts of growing to handle the elasticities in the TRIPS Aggrement to maximize its net earnings for their growing.

Simurina and Tica (2006) express that the focus on their study is to investigate the changes in technology and its effects on economies since the First Industrial Revolution. They state that changes occurred in the respective economies, industries, companies and individuals. At all these levels, they argue that there have not been seen changes in history before the First Industrial Revolution.

Self and Grabowski (2007) state that status of agricultural technology in economic growth is an experimental cross-country analysis in their article. Definitely, they express that hypothesis examined is whether agricultural technology has an important effect a long-term economic expansion. Consequently, they justify that agricultural modernization has a favourable impact on both economic growth and human development criteria.

Karagöz (2007) states that the primary goal of her working is to search whether growing and propagation of Information and Communication Technologies (ICTs) have an enhancing effect on export in Turkey. She has managed to examine the connection at topic, exports, telecommunication hedges, gross domestic product and foreign exchange changeables. She advocates that the conclusions of time series and regression analyses find out that telecommunication hedges do not have outstanding impress on export productivity, while economic growth and valuation of US dollar have restorative impact on exports.

Güneş (2008), Incentive Programs were one of the significant economical tools for industry specific development. If incentive programs dilated their scope in favor of industrial design and comprehend it, as an innovative and added value of the product, in industry, product design practical would get an effectual and extensive application field for itself. This paper would investigate the place of the industrial design concept in Turkish incentive regulations and the necessary behaved to be done to get included within stimulation systems executed.

Kalça and Atasoy (2008), stated that it is very important for companies, industries and countries that adopt sustainable economic growth as the main target to focus on information dissemination and innovation. They stated that major goal of working was to explain interaction of information dissemination, innovation and growth in close relationship with each other; they stated that Turkey is at what point in this interaction.

Ünlükaplan (2009), in his working, to determine relationships between economic development, competitiveness and innovation, it examined connection between economic growth variables and novelty-competitiveness variables for 27 member states of the European Union through canonical correlation analysis. In consequence of study, it was observed that there was one high connection between economic development, competitiveness and innovation in the member states of the European Union.

Yıldırım (2009) expresses that her work consists of four main sections. She states that she gave general and theoretical information about technology and economic growth in the first two chapters. In addition, she also states to examine the relations between R&D, patent applications, export, production and technology as indicators of technology and technology in Turkish economy. Finally, she has explained the issue of accrument and closure of the development deficit in Turkish economy.

Zalewski and Skawinska (2009) argue that the purpose of study is to look over present accomplishments related to reformer action and novelty theory, comprising the theme of "triple helix" and the expansion by supplementation the client. They argue that the theme of flat and upright products relates to variation and arrival to information resources, output class and creative action. They defend that arrival to information contingents upon kind of Research and Development (R&D) action and net management between companies.

Çalışır and Gülmez (2010) have expressed although South Korea and Turkey initiated the development move at nearly the same time, Turkey is ranked for quite behind South Korea just their economic developments are contrasted. They argue that South Korea has implemented stable and effective technology policies at the core of this success in development.

Doğan (2010) states that the ICT sector, which has increased its share in the economy and spread to large circles, has created new employment areas scientific to the sector as well as increasing productivity and giving a new perspective to the business community. He argues that in the economic literature, ICT sector measures economic growth with different methods. In his study, the Cobb-Douglas production function, adopting to the model which he founded, has investigated additive of ICT investment to economic growth in Turkey. He has stated to establish the model between the years of 1990-2006 by using data from Turkey Statistics Institute (TSI) in his analysis.

Martinez, Rodriguez and Torres (2010) stated that they use a production function with six varied capital inputs, three of them relative to ICT assets and the others to non-ICT assets. They found that the technological change buried in hardware equipment had a non-neutral power, which corresponds to about one quarter of total growth in the 1980-2004 period in the US productivity growth. In general, they argued that the technological change specific to ICT constitutes approximately 35 % of the total growth in labor productiveness.

Yapraklı and Sağlam (2010) indicate that economic growth is affirmatively influenced by ICT in mini and maxi term in keeping with the conclusions. Nevertheless, they state to be sighted that additive of ICT to economic growth is fewer than that of alternative good elements in Turkey. According to the Error Correction-Augmented Granger Causality Test, they defend that there is couple-path causality between ICT and economic growth.

Mercan, Göktaş and Gömleksiz (2011), Purpose of their working is to find out relationship between patent acceptances, which can be considered as indicators of innovation, and Research and Development activities, which have recently tended to increase, and the number of researchers and entrepreneur rates. R&D actions, entrepreneur ratios and count of surveyors, which are interested in the number of patent acceptances and innovation processes, which are considered as indicators of innovation, are the variables that constitute the econometric part of the working. Coefficients of these changeables are numbered by using “Panel Data Analysis” method. The providings of the pattern were commented at degree of proteuses and promoted by proposals at the end of the study.

Yousefi (2011) expresses the conventional growth pattern as a structure for estimating additive of labor, Information-Communication Technology (ICT) and non-ICT fund to economic growth in sophisticated and progressive nations. Guesses of growth pattern by promoting data serials transverse-nation datum of 62 nations in era of 2000-2006 indicate that the economic growth impress of ICT varies between particular revenue classes of nations. As a result of the study, he argues that ICT performs an important status in growth of higher and high-medium-revenue classes, nevertheless; it does not promote to growth of subordinate-medium-revenue nations.

Qin and Hong-li (2011) with the rapid development of electronic technology and the Internet, they state that information technology has become an important factor in economic activities and has a great impress on economic growth. In paper, they argue that they have created a spatial model of econometric model and economic growth to explore quantitative connection between IT and econometric growth in China.

Farhadi, Ismail and Fooladi (2012) state that investigating the effect of Information and Communication Technology (ICT) handle on economic growth managing Generalized Method of Moments (GMM) predicator including structure of driving panel datum touch and practices it to 159 nations above era 2000 to 2009. They argue that there is an affirmative connection between the actual GDP soever capita growth rate and the ICT usage indices. In addition, they indicate that impact of ICT put to promote on economic growth is upper in superior revenue class in preference to another classes.

Garces and Daim (2012) examined the two effects on multi-factor productivity: the impact of R&D hedge and impact of R&D hedge on restorable power technologies. They argue that the results indicate that technological novelty favourablely influences US economy in maxi range. They also state that R&D hedge in restorable power technology affects economy in mini and maxi range.

Iscan (2012), the author of working, impressions on bits of Information and Communication Technologies in sensitive sectors affecting economic growth address to economic growth and would provide a better understanding of Turkey. He argues that the hypothesis is tested whether is Information and Communication Technology supports economic growth, especially through ICT sensitive sectors. In this context,

it is stated that the results obtained from date serials assay evaluate importance of analyzing connection between Information and Communication Technology and economic growth.

Steenhuis and De Bruijin (2012) state that the goal of working is to make a survey of connection between technology and economy. They express that each of the four literature flows giving an idea about this relationship are discussed. They argue that the study contributes to the management of the technology field by summarizing different views on technology and economy.

Türedi (2013) from the annual data for the period 1995-2008 in his analysis, he stated that fixed and incidental effects use panel data method. Although the results were higher in developed countries in the period examined, he argues that Information and Communication Technologies have an affirmative impress on economic growth in both sophisticated and progressive nations.

Artan, Hayaloğlu and Baltacı (2014) state that the goal of their working is to investigate connection between Information and Communication Technologies and economic growth for passing economies. They express that in the working including 1994-2011 period, fixed panel datum assay style was promoted. In comparison with conclusions of the analysis, they defend that the development of Information and Communication Technologies positively affects the economic growth in transition economies.

Demir and Geyik (2014), explained the concept of innovation, which had become increasingly important in recent years; science, technology and innovation activities with East Asian countries had achieved and assess the achievements and significant achievements in the development process were intended review of these actions in Turkey. Another objective of working is to address current circumstance which is the natural outcome of R&D and innovation investments in Turkey patent application and number of patenting. The findings showed that R&D and innovation spending in Turkey was not sufficient, the number of patent applications and agree was at very low levels.

Özer and Kılınç (2014) argue that technological development happening in parallel with the development of human knowledge; via new production techniques, inventions and innovations move a significant role by ensuring more efficient use of

production factors (both labor and capital and also technology). They indicate that in their study, the relationship between technological development and economic growth was analyzed by Panel Datum models for era 1991-2011 based on OECD nations. In reference to conclusions of assay, they explain that technological development in OECD counties positively affected economic growth in accordance with expectations.

Aytaç (2015), in this study, the output of the relations between Turkey and innovation in the venture capital and patents were examined using regression analysis in the period covering the years 2000-2012. In the empirical study, it was eventuated that there is not statistically unstanding connection between patent and venture fund.

Bayar (2015) states that his study examines the relationship between technological process and some switch macroeconomic indicators economic growth, financial development, inflation, fdi inflows, savings, high technology exports and R&D expenditures in major Eurozone countries through the period 1999-2012 by applying panel Poisson regression and negative binomial regression. He defends that the findings from the both model are showed that economic growth, financial development, savings, R&D expenditures and superior technology exports have positive effect on technological process.

Çalışkan (2015) points out that the aim of letters and technology is to permit attempts and particulars to promote technologies upward of thriftily because it means that it reduces costs and increases efficiency. She argues that the promote of ingoing technologies leads up to the manufacture of ingoing cheap products and for the growth of capital and for this, the individual international competitiveness of the individual countries. She expresses that it contributes to the cultural and politic evolvement of communities as well as advanced quality for scientific research institutions. She also states that the standard of growth ratios is as outstanding as their gauge.

Biber (2016), the main objective of his study concordantly was to analyze how the preservation intellectual property rights in Turkey was relevant to technology achievements, high tech exports and economic growth via basic economic indicators equate them to countries where they are rivals.

Erumban and Das (2016) state that the ICT investment shows an increasing role in directing total economic growth in India, by way of substantially restricted to ministration secture. They remark that the economy also does not have been accomplished in spreading the ICT spillover impact across the board, therefore restricting the productivity gain from ICT using. Though they see a developing productivity growth in ICT applying market services and their additive to aggregate productivity growth, the manufacturing sectors falls quite behind.

Hofman, Aravena and Aliağa (2016) argue that increasing ICP investments have explained a significant portion of haste of economic growth in US since 1995. They explained that the US-based gap in soever capita GDP soever capita factors assisted to diminish openness in GDP soever capita by improvement in the work force factor and conversely labor productivity was adversely affected.

Jargenson, Ho and Samuels (2016) express that procure circumstantial knowledge about critical status of knowledge technology in post-war growth of US economy, from evolvement of correspondences jobs and correspondences apparatus industries by way of victorious commercialisation of semiconductor technology to continued transition to cloud-based IT jobs. They state to find that the slowdown in the significant growth rate over. Great Recession was adverse due to total thrift growth modestly, but only one small fraction of decline in growth ratio stemmed from IT-manufacturing sectors.

Malatyalı (2016), in consequence of technological developments in his study has expressed to give an acceleration to economic growth. He stated that technological development and economic growth in time, technological development is not thought independent of each other on the notion of economic growth which brought with it.

Pala (2016) states that the outcomes of panel Granger Causality is symbolized that the effect of gross capital generation and internet utilizers on economic growth is favourable and statistically important in short-run and there is not Granger causality connection between changeables in long-run. She argues that remaining internet utilization policies applied in EU-28 countries should be encouraged economic growth.

Özkul and Örün (2016) state that the effect of the entrepreneurship and novelty on the economic growth has been implemented by applying the GEM data between 2002 and 2013 of the 9 OECD countries via hail data by panel data analysis in their article. They argue that technological novelty density has been favourable and outstanding effect on economic growth in 5 models and intrapreneurship which has been debated qua a new firm generation has been favourable and outstanding impress on the economic growth in mere 2 model in which has been constructed qua a vitalism-driven intrapreneurship action and nascent intrapreneurship ratio.

Telatar, Değer and Doğanay (2016) specify that the relationships between variables were examined by Engle-Granger (1987) co-integration and Granger causality tests. According to obtainment attained from co-integration testing outcomes, they indicate that low and medium technology intense outputs have important and favourable impacts on Turkey's economic growth. Otherwise, in comparison with Granger causality test, they defend that there is not a road causality towards economic growth from both medium and high technology product exports.

Algan, Manga and Tekeoğlu (2017) state that their study is researched the connection between the percent of R&D expense in GDP, the count of patent implementations and GDP per person evaluating Granger causality test for the term of 1996-2015. They express that Granger causality test analysis is finalized short-run unidirectional causality from high-technology good exports and R&D expense to GDP per person and unidirectional causality connection from GDP per person to patent implementation counts. Additively, they argue that long-run R&D spendings and patent implementations have finalized in a favourable GDP per person while high-technology exports, in opposition to waiting, adversely influenced.

Altıner and Toktaş (2017), in their study the impact of innovation on economic growth was analyzed by panel data technique using data from 1992 to 2015 for 21 emerging market economies. They used real GDP soever capita to present economic growth within scope of the analysis. In addition to patent applications representing the innovation changeable, gross constant fund constitution rate and accession ratio variables were used as explanatory variables. According to the estimation results, long-term innovation, gross constant fund constitution and employment ratio had affirmative and statistically substantial effects on economic

growth in majority of the countries discussed. Finally, Dumitrescu-Hurlin (2012) applied the panel causality test to determine the causal connections between changeables. As a result, it determined couple-road causality connection between economic growth and innovation.

Kızılkaya, Sofuoğlu and Ay (2017), in their study, effects of external frontal enterprise and clarity on elevated technology goods exports in 12 developing countries in 2000-2012 period were investigated by panel data analysis method. By virtue of application, it was seen that external frontal enterprises and openness of foreign direct investment had an affirmative effect on elevated technology goods exports. In structure of the tentative obtainments, expedient exhortations for progressive nations were presented.

Qu, Simer and O'Mahony (2017), in this article, they estimate the long-term economic effects of digital technologies by using infiltration of mobile phones and the use of the Internet as broad indicators. They express that the tentative conclusion after that between 2004 and 2014, propagation of digital technologies considerably enhanced economic thruput in Australia and outland, promoting to stable state gdp soever capita accretion of nearly 5.8 soever cent on mean. In addition, they argue that these obtainments may administer as an initiating spot for estimations of possible impacts of following technologies.

Alper (2018) states that FGLS panel data analysis procedure is implemented applying sessional datum for the term 1996-2016. She argues that the achieved conclusions find out that knowledge and conversation technologies have promoted declaratively to economic growth and debased unemployment in chosen EU countries as well as Turkey through the term beneath review.

Baykul (2018), in her study, she investigated impressions of R&D expenditures and R&D employment on regional economic growth which was one of arbiters of regional economic growth by Panel Data Analysis. Inspection Level II statistical regions in Turkey were done based on 2010-2014 data. The impact of R&D expenditures and R&D employment on regional economic growth was positive and statistically significant.

Çakmak and Yıldız (2018) express that in their study, the impact of technological innovation on export is examined. They state that in their study

involved the period of 1998-2013, technological innovation index values were calculated to be referred TIE and AR-GE indices at first. They remark that Turkey's total exports to the EU countries has been separated into components as widespread and intensive exports. According to the results of the analysis, there is not strong evidence that technological innovation affects widespread exports. On the other hand, it was determined that technological innovation affects intensive exports statistically significant and positive.

Niebel (2018) argues that the positive relationship between various panel data regressions and the growth of ICT capital and GDP is correct. He states that for united instance of all 59 nations forecasted thruput elasticity of ICT is greater than ICT element redress subsidy offering surplus restorations to ICT fund. He indicates that declines for subsamples of emerging progressive and sophisticated nations do not occur statistically important discrepancies in thruput elasticity of ICT between these 3 parts of nations. Therefore, he states that progressive and sophisticated nations are not winning further from enterprises in ICT than sophisticated countries.

Özkan and Çelik (2018) indicate that the additive of Information and Communication Technology (ICT) to accretion in Turkish economy for term 1998-2015 will be analyzed. They state that the agent stem test and Granger causality test are practiced for economic growth as addicted variance, constant as uncommitted variance, internet utilization by mobile phone utilization and internet utilization. In compliance with, the conclusions achieved, the utilization of ICT favourable impress on economic growth.

Yıldız (2018) implies that the goal of her working is in order to evaluate impress of technological novelty performance on economic growth through 1998-2013 for Turkey and the EU-15 countries. According to the obtainment achieved, she expresses that TIE (Technological Innovation Index)) performance of the countries across the panel has a statistically important and affirmative impact on the economic growth degree. Nonetheless, when valuation countries with regards to Turkey on the basis of the obtainment, she argues that there is a correction between variables statistically powerful argument could not be achieved.

Bahrini and Qaffars (2019), their study explained the impress of Information and Communication Technology (ICT) on economic growth of choosed nations in

Middle East by using the Panel and using the Panel (North America (MENA)) area and Sub-Saharan Africa (SSA) area in the period 2007-2016 with the method of Moment (GMM) growth model. According to the results of the policy perspectives; they in the MENA and SSA countries advocate for their investment in ICT infrastructure.

Erdil Sahin (2019), examined the effects of causality analysis on the economic growth of high technology exports in Turkey, in her study. The effect-response and variance decomposition results were evaluated together. She concluded that high technology exports have an impact on GDP and are consistent with the Granger Causality Test results. Thus, she stated that high technology exports affect economic growth. As a result of her work, she emphasized that Turkey should give more importance to increasing the share of high technology in its exports and to encouraging high technology production.

Hafeez, Shah Syed and Qureshi (2019), besides, their working sustains both maxi and mini term connection of economic growth and expenses on R&D apart from that mini-term parameter seems trivial in circumstance of progressive nations. Their working means that economies via greater R&D expenses are in tendency to have greater economic growth. Their working has recollective expedient inclusions for operation and expedient-builders who could build significant efforts at public degree concordantly.

Mayda (2019), in her study, the count of surveyors in two nations between years 1984-2016, patent applications, growth rate of investments and economic growth rates were handled as data sets. First of all, the author performed unit root tests of variables; provided stability. Then she examined the relationship between the Granger Causality Test and explicit implementations and count of staff for both countries. Lastly, she analyzed connection between growth rates and other variables by using regression analyzes, in which growth rates were taken as dependent variables. She made the Granger Causality Test results while causing an increase in patent applications increase in the number of staff in Turkey, did not find such a relationship in Finland. According to the results of regression analysis, where growth rates are taken as dependent variables; Increased growth rates while increasing investments in Turkey, it does not lead to increases in headcount and growth in

patent application. In Finland, the increase in all variables considered means an increase in growth rates.

Omar (2019), in this report, was used the panel recovered normal fault procedure to explain the heterocedacity and probable simultaneous correl between the panels and initial layout autocorrelation inside of the panel for unstable data sets. This working was concluded that R&D expenditures were affirmative and statistically outstanding in the GDP explanation, however; connection was powerless. Particularly, 10 percent rise in R&D spending increases GDP by 4 percent. Especially, person fund, work force and constant fund saving were affirmative and statistically important. Inventions highlighted matter of novelty and training in promoting economic growth and urged MENA states to fund more in the R&D and novelty secture.

Sikder, İnekwe and Bhattacharya (2019), their paper investigates the long-term impacts of power mixture, commerce deficit and search and evolvement on economic thruput of G20 nations. Their inventions show that G20 should proceed to support search and evolvement investments in the power secture, as well as commerce completion for tolerable evolvement. Status of the variable power mixture is got to be particular across class.

3.1. STUDIES CONDUCTED WITH RELATED TO R&D

Pinstrup-Andersen (1982) explores the role of agricultural research and modern technology in the fight against poverty, hunger and malnutrition. He states to discuss tack and husbandry in progressive nations; improving husbandry search, economic growth and normals of life; husbandry search in for progressive nations; delivery of economic advantages and economic profits to husbandry search and technology; act of manures; peripheral impacts of contemporary technology; gauges to increase search additive; and requisition for exterior aid.

Park (1995), this article measured the cross-public diffuse impacts of state and special enterprise in Research and Development (R&D), promoting a panel datum constitute of ten OECD nations. Conclusions indicated that local special search was an important arbiter of both local and external thrift growth and that external state search encourages local special search. Obtainments were substantial in

providing experimental backing for discussions on behalf of transnational economic expedient organization, especially in field of transnational learning and technology.

Stokey (1995), the total R&D ratio in an agonistic economy was contrasted via optimum ratio. It had been shown that the optimum R&D ratio was the identical for entire choices in a large folk, competition ratio was susceptible to substitutability between outputs and therefore may diversify significantly inside of the folk. Second topflight degree of R&D had been indicated to be familiar in the folk and equivalent to appropriate ratio. Quantitative instances indicated that declining provisions in novelty technology were foremost latent resource for extreme R&D in an agonistic economy.

Davidson and Segerstrom (1998), offered an interior growth pattern in which some companies allocated sources to develop better standard outputs (progressive R&D) and others allocated sources to copy (imitate R&D). While users advantage from information generated by both kinds of R&D actions, merely progressive R&D backings led to quicker economic growth; imitating R&D backings indeed led to gentle economic growth. Fundamental hypothesis that pushes results was that R&D actions were depending upon diminishing yields. When R&D actions were generally accepted as continuous returns, the only balance that was both innovation and imitation was unsteady.

Bilbao-Osorio and Rodriguez-Pose (2004) state that R&D enterprise, in the aggregate, and advanced education R&D enterprise in environmental areas of the EU especially, are assertively associated with novelty according to the consequences. They express that there are the existence and strength of this union, nonetheless; contingent upon area-obvious socio-economic features, which influence the capacity of every area to convert R&D enterprise into novelty and, consequently novelty into economic growth.

Şimşek and Behdioğlu (2006), in their study, moral of the GDP allocated to R&D spending, researchers per thousand people employed and count of total R&D personnel from the point of place among the other OECD countries, Turkey has tried to be examined through cluster analysis. According to the cluster analysis results, R&D expenditure in GDP ratio in OECD Countries, OECD countries are employed per thousand researchers and total R&D workers from the point of number of

Turkey is not on the same level with other OECD countries. Turkey's R&D activities with other OECD countries at the same level in terms of the reason for Turkey to indicators of R&D activities is to have a low value compared to other countries. When they contrast from the point of R&D expenditure in GDP ratio, Turkey has a poorer performance than the OECD average. When they contrast in terms of R&D expense in GDP ratio, Turkey has a poorer performance than the OECD average.

Tiryakioğlu (2006), in his study, he examined the connection between R & D expenses and economic growth in selected OECD nations since 1970s in the context of Causality Analysis. He analyzed technology, unit of dynamics of economic growth, on the basis of ingoing internal growth models that considered the engine of economic growth. In his study, which analyzes whether economic development depends on R&D outgoings in both long and short period for OECD countries, he emphasized the importance of technology in economic development. The findings of his study prove that there is one causative connection between R&D expenses and economic growth.

Zerenler, Türker and Şahin (2007), stated to be able to operate successfully in the world economies and in the economies of their own countries and to gain superiority to their competitors, they should constantly renew and develop their existing production factors and products. In today's competitive environment, rapidly developing and growing businesses often innovative businesses that attach importance to development; They emphasize that there are various reasons related to the importance of Research and Development related to the market, business and social benefits and personnel and that Research and Development has gained global importance. The authors stated that the rapid and radical changes in our age do not leave choice to be innovative; in this case, they stated that enterprises should attach importance to research and development activities in strategic dimension.

Goel, Payne and Ram (2008), subject to 48-year US data from 1953 to 2000, working contributed to the R&D growth relationship across five dimensions. First of all, they drew attention to some descriptive patterns that reveal facts stylized by US R&D spending for half a century. These are: (a) one effectual remain in moral of united R&D spending, (b) an opposing decrease in moral of officially unified R&D expenditures, and (c) a further striking decrease in moral of plea R&D expenditures.

Secondly, while leaving most of the relevant literature, they examined the R&D growth bond at separated degree, taking into account status of united, non-united and plea R&D spending. Thirdly, they used the relatively new boundary tests and ARDL (otoregressive broadcast delay) methods of Pesaran et al. Fourthly, almost contrary to universal belief, their estimators showed that federal R&D plays a larger role than non-united R&D in growth and besides had one superior defense R&D than non-plea (united) R&D. Finally, in so far as that their predictions were advisable, on the top-mentioned transitional evolvements in share of united, non-united and plea R&D expenditures represent social dispositions as part of economic growth and prosperity and to significantly improve united plea R&D and non-plea R&D expenditures. Appropriate policy interventions were needed.

Altın and Kaya (2009), in this study, R&D spending to growth Turkey relations were analyzed in the context of causality. VEC (Vector Error Correction) pattern was chosen as procedure for this. By virtue of study, the connection between R&D expenses and economic growth was not found in any direction in short term, but it was concluded that R&D expenses were cause of economic growth in long term.

Güzel (2009), stated that new competition requires more attention to Research and Development (R&D) actions. She stated that the information and technological inventions obtained from R&D activities, such as non-exclusion and lack of competition in their consumption, lead them to be included in the public goods group. She therefore argued that their production required public intervention. She stated that this intervention took place in two ways. The first was that R&D actions are presented by state. The second advocated that private sector R&D activities should be supported by various incentive policies. In recent years, she stated that many OECD and EU countries prefer tax incentives instead of direct subsidies in their R&D policies. She also stated that they are trying to increase their effectiveness by revising their incentive policies. She stated that some arrangements were made for a long time neglected promote R&D area in Turkey, as well. She examined the adequacy of these regulations in this study.

Özer and Çiftçi (2009), in their study, impress of R&D expenses, count of searchers and number of patents on GDP was investigated. In the analyzes conducted

producing panel datum technique for OECD nations, it was provided that R&D expenses, count of searchers and count of patents had a positive and high impact on GDP.

Genç and Atasoy (2010) predicate that their studying is researched connection between R&D and economic growth for 34 nations. They advocate that implementation panel causality method via sessional data from 1997 to 2008 finds out that there is one-way causal connection running from R&D to economic growth.

İleri and Horasan (2010), in our time's management globe where rivalry is remaining by degrees, with the great importance given to technology and R&D, enterprises provide sustainable and profitable growth. R&D and technology management stand out as an important factor in achieving sustainable competitive advantage for companies. In this intense competitive environment, enterprises that produce, develop, dominate and concentrate on technology can shape the world as they wish. In their study, the concepts of globalization, technology, R&D and competition are examined within the framework of sugar factories and their importance is explained.

Korkmaz (2010), stated that remain in R&D expenses will enable enterprises to grow and become more competitive with the outside world. In today's competitive environment, businesses need to be constantly searching for innovation in order to survive. She stated that innovation will increase prosperity and productivity in the long run and this will contribute to economic growth. In working, connection between R&D spending and economic growth for Turkey and Johansen cointegration method has looked at promoting sessional datum for term between 1990-2008.

Yaylalı, Akan and Işık (2010), in their work, R&D and economic growth in 1990 & ndash; ADF, cointegration and causality tests were used in theanalyzes covering 2009 period. As a result of the analysis of the data set compiled from R&D and economic growth figures, single-track connection between R&D investment expenses and economic growth was determined in maxi run. Destination of this relationship has been observed from R&D investment expenses to economic growth.

Türkoğlu and Çelikkaya (2011), in working, the authors aimed to address the R & D subsidies for SMEs in Turkey. Accordingly, SMEs, which had a large share in the economy, should attach importance to Research and Development (R&D)

actions. R&D dispositions in world and Turkey and R&D subsidies for SMEs were handled.

Gülmez and Yardımcıoğlu (2012), For this purpose, they used Pedroni and Kao cointegration tests, Pedroni DOLS and FMOLS tests and Canning; Pedroni panel causality analysis. In pursuant of Lamda-Pearson statistic, panel causality results show a long run bivium causality connection between R&D expenditures and economic growth, while group's average statistical values show one single-track causality connection from economic growth to R&D expenses. Finally, it can be expressed that there is a vice versa outstanding connection between R&D expenses and economic growth instabilities in the long run.

Yıldırım and Kesikoğlu (2012), in these studies, they investigated the causality connection between R&D expenses and exports by promoting panel datum set covering 1996-2008 term and 25 sub-sectors. According to the findings obtained as a result of causality analyzes based on GMM-system estimation and Wald test, they stated that there is a single-track causality connection from R&D expenses to exports. They stated that this finding means that R&D policies can be an important tool in increasing exports. However, they stated that exports do not cause R&D expenditures.

Göçer (2013) state that stability of the series are examined by tool of Hadri-Kuruzomi panel unit root test, causality connection are examined through Dumitrescu-Hurlin (2012) test, the occurrence of cointegration connection are examined by means of Eberhardt-Bond (2009) Panel AMG method. In consequence of studying, he expresses to be identified that an increment as %1 in R&D expenses remained elevated technology export as 6.5 % Information and Communication Technology exports as 0.6 % and economic growth as 0.43 %.

Kaya and Uğurlu (2013), stated that the outward and export-oriented growth policies followed in the post-1980 period led to a rapid increase in exports and a change in the quality of the exported products. In this context, they stated that in recent years, especially since the mid-1990s, labor-intensive export structure has become a relatively technology-intensive structure. They stated that this structural transformation will inevitably impact amount of R&D needed in export sectors.

Subaşı and Eren (2013), aimed to reveal the connection between agricultural R&D expenses and agricultural growth in study. In 1990–2010 period, the average annual growth in technical efficiency and technological change was 0.14% and 0.38%, respectively in agriculture of Turkey. As a result, total factor productivity increased by 0.51% during the period. In the research, it was seen that the main determinant factor in total factor productivity is technological change. As a result, it is revealed that there is a 5-year delay between the emergence of resources transferred eventually of investment decision on agricultural R&D activities. The entity of maxi-run connection between agricultural R&D expenditures and agricultural growth was determined by Johansen cointegration test. A one-way causality relationship was determined between sum element thrift and agricultural R&D expenses used as a basic indicator in the evaluation of growth efforts of countries from agrarian R&D expenditures to agrarian growth.

Teke (2013), in the first part of his study, he examined green energy R&D investments of other countries. In the following section, he examined the Turkey's green energy R&D investments and capacity, compared with the situation existing in other countries. He also examined the inadequacies of R&D departments of public institutions working on energy and presented some solutions in the results section.

Ünal and Seçilmiş (2013), stated that in the new economic understanding based on science and technology; R&D has become a necessary condition for companies to continue their activities profitably by providing competitive advantage. Obtaining the science and technology in question or producing new materials, products and tools with the existing knowledge; They stated that it is possible to create new systems, processes and services to cover software production or to improve existing ones through regular R&D activities. The authors stated that when the group of companies carried out these activities in a holistic sense, an economy constitutes the wheels of growth. They stated that weight of R&D actions should be noticeable in order for national economy to compete with other national economies. In terms of Turkey's R&D activities in these studies, they aimed at determining the location of the world compared to developed economies.

Akbel (2014), firstly has dealt with the relationship between science-technology-innovation by putting it in historical perspective. Then, he analyzed

Marx's analysis of capitalism, Schumpeter's imaginative expression of destruction, Solow's assay of fund-work force proportion, Romer's assessment of the remaining incremental rate of return, Lucas's point on person fund, Grossman and Helpman's North-South divide, Aghion and Howitt's expectations assay between the couple novelty terms and finally Jones's inhibitants-oriented approximation. Then he summarized other original contributions, involving Harvey's conditions about the depreciation of dated technology and inability of the workforce.

Akıncı, Akıncı and Yılmaz (2014), the aim of their studies is to investigate impressions of financial development on R&D expenses in OECD member nations by promoting panel datum assay. Panel data analysis results showed that financial depth does not have an outstanding impress on payments made for person fund use and number of articles published in scientific and technology-based academic journals. In addition, the author's findings suggest that the financial development process accelerates high-tech product exports, R&D spending, employment in R&D industries and patent applications. When the analysis results are evaluated as a whole, it can be said that the Schumpeterian hypothesis that financial growth has an affirmative impress on technology is valid.

Çetin and Işık (2014), stated that innovation and R&D activities have become one of topflight effective elements in development, leveragable economic growth and social welfare. They stated that many countries are trying to create a system that supports R&D and innovation through incentive policies and various legal changes. In their study, they indicated that the various indicators and the financial supports that were decisive for the development of innovation and R&D activities were indicated in EU countries and Turkey.

Doruk and Söylemezoğlu (2014), in study, connection between R&D expenses and GDP per capita for 22 developing countries between 2000 and 2007 is investigated with Prais-Winsten Panel Standard Errors Corrected Regression Model and ArellanoBover / Blundell and Bond System GMM method. The World Bank (2013) data was selected between 2000 and 2007 in order to keep the count of nations in the assay high and was not prefered balanced panel datum assay. According to conclusions, impress of R&D expenses on economic growth is affirmative.

Kılıç, Bayar and Özekicioğlu (2014), in their study, by using panel data analysis, connection between search and growth expenses and superior technology product exports in G-8 nations between 1996 and 2011 was analyzed. By virtue of working, it was designated that R&D expenses and actual cash switch proportion had an affirmative impress on high technology product exports. In addition, it had been determined that there is a couple-road causality between R&D expenses and superior-tech output exports and R&D expenses and actual impressive switch proportion, and a single-track causality from superior-tech output exports to actual impressive switch proportion.

Kocamış and Güngör (2014), stated that R&D expenses in our country have increased over the years although they are behind OECD countries. They analyzed the impact of R&D expenditures, which have an important role in providing competitive advantage, especially for the enterprises operating in the technology sector, using the financial performance data of 16 firms traded in the Istanbul Exchange technology sector between 2009-2013. In consequence of working, they were found that there was positive connection between profitability values consisting of profitable R&D expenditures and operating profit, profit before tax and net profit of the period.

Meçik (2014) indicates that handle Cobb-Douglas manufacture function model and panel data set of OECD countries for goal of analyzing impacts of the R & D expenses on economic growth. According to Meçik, the discoveries show that the variables of labour force, fund and R&D spending have favourable and important impacts on economic growth. About this subject, he states that it is probable to form an estimate of the R&D expenses are follower consideration on the continuum of the econometric growth.

Şahbaz, Yanar and Adıgüzel (2014), aimed to test data with the relationship between R&D expenses superior-tech exports for Turkey and 17 EU countries with panels and panel cointegration causation analysis covering the years 1996-2011. According to the results, they found that there is a couple-road Granger causality between R&D expenses and superior-tech exports. In other words, while the R&D expenses increase exports of superior-tech goods, the exports of high-tech goods increase the R&D expenditures.

Özcan, Ağırman and Yılmaz (2014), panel datum assay method was promoted in the study. In compliance with conclusions of the analysis, there was not causality from R&D expenses to stock returns, while there was a causality to R&D expenses from stock returns. The conclusions of fault rectification pattern demonstrated that short-term imbalances were resolved in the maxi run.

Özcan and Arı (2014) express that the connection between R&D and economic growth are investigated for the chosen 15 OECD countries from 1990 to 2011 in this context of panel data model in their study. They defend that R&D influences economic growth assertively. As a politics inference, they defend that countries purposing to expedite the living standard and economic growth must be made a mention of R&D enterprises.

Özkaya (2014), The developments in endogenous growth theory have focused on competitive conditions of industries, R&D efforts thereof, innovations succeed and their overall impact on economic growth. The present study purposed to fill this gap and to respond the question given in the title of the study via third generation endogenous growth theories and empirical approach for the period of 2003-2014.

Yaylalı and Karaca (2014), in their study, the effect of Research and Development (R&D) expenses on Foreign Direct Investment (FDI) inflow was investigated by using border test approach using data from 1990-2013. As a result, an outstanding connection was found between R&D expenses and FDI inflows in maxi run. In short-term analysis, it was provided that R&D expenses decreased the inflow of foreign direct investment in the current period, but decreased after one period.

Çakın and Özdemir (2015), in their study, considering the main R&D and innovation indicators, Classification of Statistical Region Units in Turkey (SRE) in the first level of the region 12 in the year 2010, 2011 and 2012 innovation performance were utilized. In this context, regression assay, DEMATEL based Analytical Network Process (DANP) and TOPSIS methods were used. Regression coefficients obtained through the instrument of regression assay were used in DEMATEL method and criteria were weighted and then the performance ranking of the regions was made by TOPSIS method.

Fikirli and Çetin (2015), in their study between the years 1990-2013 R & D capital accumulation in Turkey and Total Factor Productivity (TFP) have

investigated the relationship between co-integration with the ARDL bounds testing methods. They examined connection between TFP and R&D capital accumulation by separating them into components of R&D fund recruitment. Effect of R&D fund accumulation on TFP is examined directly and indirectly, and in this study they preferred “Direct R&D Effect”. According to the findings, none of the R&D capital accumulation components had a statistically outstanding impress on TFP during assessment term.

Gümüş and Çelikay (2015), this paper provided a tentative assay of connection between Research and Development (R&D) expenditure and economic growth, and specifies whether connection varied via level of growth. Concordantly, research promoted one driving panel datum pattern using data from 52 countries from 1996 to 2010. The research revealed that R&D expenditures had an affirmative and outstanding impact on economic growth for sum nations in maxi term, in line via concerned litterateur. For progressive nations, this impress is thin in mini term and spirited as expected in maxi term. Working added ingoing tentative proof to litterateur.

Karakaş and Adak (2015), long-term relationship between the total patent applications have been tested and economic growth after the R&D structure in Turkey in the last 10-year period analyzed in this study. In consequence of assay, it was found that there was a remain in national total R&D expenses and count of R&D worker recruited. In consequence of Engel-Granger Cointegration test between annual patent applications and annual production figures, it is concluded that couple changeables have a maxi-term balance connection.

Mercan and Altıntaş (2015), in their studies, they used fixed capital formation and labor growth rate variables in addition to R&D expenditures. They used a new generation of panel data methods that took into account the cross-sectional dependence, i.e. the assumption that a recruitment occurring in any of nations studied would impress others. In consequence of assay; they found that remain in R&D expenses had a strong impact on economic growth, impress was greater than rate of constant fund contitution and labor growth, and that a one-agent remain in R&D expenses increased economic growth by 3.4 agents. They found that constant fund constitution and labor power growth rate changeables besides positively

impressed economic growth and that 1 agent remain in changeables remained growth by 0.21 and 0.20 units, respectively.

Yücel and Ahmetoğulları (2015), stated that he goal of their working was to analyze impact of R&D expenses of companies registered in BIST technology, software and IT sector on net profit change and profit per share values. For this purpose, the data obtained from financial expressions of 135 nations in technology, software and informatics sectors traded in BIST for the years 2000-2014 were analyzed in the SPSS program using gradual regression analyzes. In their results of working; provided that there was an outstanding increase in R&D expenses of firms in 14-year period, the existence of a positive co-term connection between change in R&D expenses and net profit change of the same period and the impact of R&D expenditures on the profit per share were delayed for three periods.

Akgün and Akgün (2016), the goal of working was to measure impact of R&D expenditures on profitability, which was the starting point of technological activities in enterprises. In this context, Aselsan sample which was active in technology sector, which was one of the most intensive R&D researches was examined.

Çetenek and Oransay (2016), their study purposed to examine whether the R&D pattern estimates were effectual for the economies of 76 nations. Economic methodology promoted in working was panel VAR assay. Worthies for GDP soever capita alteration that was evaluated the situation to present economic growth and R&D soever capita alteration that was debated to present R&D actions had been acquired from World Bank Database. Assay of sessional datum between 1996 and 2014 suggested that economic growth Granger-causes R&D expense, however; there was not proof to commit that R&D expense had effect on economic growth.

Çetin (2016), in this study, the effect of R&D expenses on superior-tech exports was analyzed by applying Granger causality and fixed and random effects estimation methods to the data of 1996-2013 period of 7 new industrialized countries. In this study, data of 5 sectors considered high technology was used by World Bank. According to the Granger causality test, R&D expenses lead to superior-tech exports, while random effects estimate results showed that R&D expenses had an affirmative and outstanding effect on high-tech exports.

Demir and Alpaslan (2016), in their study to see impacts of R&D spending, world's top 20 R&D spender firms and the world's top 20 reformer firms' data investigated for the period covering the years of 2008-2012. The study also did not provide outstanding connection between R&D expenditure increase and productivity and employment. The conclusions that were acquired raised questions about the achievement of the current Turkish encouragement programs of R&D, as well.

Demirgüneş and Üçler (2016), In these studies, they aimed to designated possible impacts of R&D investments on sectoral growth. In their study, to designate stability of the series and the cointegration connection between serials, Carrioni-i-Silvestre et al. (2009) agent stem test and Maki (2012) cointegration test were used. Long-term cointegration coefficients were determined by Dynamic Ordinary Least Squares (DOLS) procedure sophisticated by Stock and Watson (1993).

Doğan and Yıldız (2016), the aim of their study was to research effect of "Research and Development" (R&D) expenditures on company profitability. In this study, data of 136 companies listed on Istanbul Stock (BIST) for the years 2008-2014 were used. Accounting-based performance indicator "Return on Assets" (ROA) and "Return on Equity" (ROE) were used as dependent variable in research. Descriptive statistics and multiple regression and t-test methods were used in the empirical analysis. In consequence of assay, it was found that remain in R&D expenses had an affirmative impact on profitability of companies.

Erdoğan and Canbay (2016), in working, they investigated connection between R&D activities and economic growth at theoretical level. They classified the relationship between variables as pre-endogenous growth patterns and period of internal growth models. In the conclusion part; they concerned with the tasks of political power to remain contribution of R&D expenses and investments to economic growth.

Işık, Engeloğlu and Kılınç (2016), in their working, connection between R&D expenses and sales and profitability was analyzed by promoting Panel Datum models for term 2008: Q1-2014: Q4 based on Istanbul Stock firms. In consequence of assay, it was provided that R&D expenditures had an affirmative and significant impact on the profitability and sales of firms.

İnal, Altıntaş and Çalışkan (2016), ultimately they state that the importance given to R&D units and expenditures will contribute to the level of competition and economic growth. They indicate that implement Toda-Yamamoto causality test for the term of 1990-2013 with sessional datum for this goal. Consequently, they indicate to find causality from GDP soever capita to R&D expenditure, nevertheless; there is not causality from R&D expenditure to GDP for Turkey.

Karanfil (2016), aimed to evaluate the role of MIT in R & D for the European Union and Turkey in his study. In study impacted of R&D on MIT was researched for EU-28 (Luxembourg, Denmark, Swedish, Netherlands, Austria, Finland, Germany, Belgium, Ireland, France, England, Italy, Spain, Cyprus, Slovenia, Greece, Portugal, Malta, Czech Republic, Estonia, Slovak Republic, Lithuania, Latvia, Poland, Croatia, Hungary, Romania, Bulgaria) and Turkey. Relationship between soever capita revenue, R&D and accumulations were researched by using Westerlund Bootstrap Westerlund Durbin-Hausman cointegration and Hacker and Hatemi-J bootstrap causality in panel datum assay. Conclusion of paper was the result of a maxi-run connection between changeables. One-way causality was determined from soever capita revenue to R&D. However, causal impact was not provided between R&D and soever capita revenue.

Polat and Elmas (2016), for this purpose, the effects of BIST Metal Goods, Machinery and Equipment Construction companies' R&D investments on financial performance were investigated with panel data analysis. In the study, which used quarterly data for 2007Q1-2015Q2 period, four models were created to represent firm performance. In regard to conclusions of assay, impact of R&D investments on firm performance was determined as negative. When the unit effects of firms are examined, it is found that some firms are positively affected by R&D investments and some firms are affected negatively. From these results, it was concluded that some of the firms used their R&D investments efficiently and the others used inefficient ones.

Sungur, Aydın and Eren (2016), They estimated two separate models in their study. First of all, they used ADF and PP agent stem tests to determine degree of stasis of series, and also Zivot-Andrews test was applied. In the collateral part, existence of cointegration relationship between series was investigated by Engle-

Granger cointegration test. In the third step, Hatemi-J asymmetric causality test was used with Granger. In regard to Granger Causality test conclusions, they found unit-road causality connection from Model Number to growth for Model 1. For Model 2, there is unidirectional unit-road causality connection from share of exports to R&D expenses to public revenue, from number of patents to exports, and from count of R&D workforce to exports. Finally, according to the more advanced Hatemi-J asymmetric causality analysis, Model 1 found a unidirectional relationship between patent-to-growth positive components, growth-to-patent negative components, and R&D to growth-negative components. In Model 2, it is concluded that there is a connection between R&D workforce and positive components of export variables, and between negative components from R&D workforce to exports and from export to R&D.

Alper (2017), in this study, first of all, Fourier KPSS agent stem test, which permits constructural gaps, was applied to determine the fixed of serials. Collateral stage, existence of long-term relationship between the series was determined by Bayer-Hanck cointegration test. In the last stage, Hatemi-J used irregular causality test. Bayer-Hanck cointegration test showed maxi-term connection between changeables. According to the conclusions of Khatemi-J asymmetric causality test, high technology product exports are determined from adverse and affirmative constituents of patent count and R&D expenses to adverse and affirmative constituents of economic growth, while from economic growth to superior technology product exports and R&D expenses. The causality is correctly determined only in the positive components. From economic growth to the number of patents, causality could not be detected in negative and positive components.

Bayraktutan and Kethudaoğlu (2017), following their basic conceptual and theoretical introduction, they interpret R&D data in the world and in OECD members; summarize the relevant literature and present evaluations based on models and findings. The results of the analysis, they indicate that the R&D expenses and the count of researchers studying full-time in the R&D field positively affected economic growth.

Çıtak and İltaş (2017), in working, the efficiency of search and evolvement enterprises of companies listed in Istanbul Stock Technology Index (XUTEK) was

analyzed. Relative activities of firms with respect to each other in terms of Research and Development investments were analyzed on three types of activities using data from 2013, 2014 and 2015. Two variables of R&D intensity and R&D / Assets data envelopment patterns CCR (Charnes, Cooper and Rhodes (1978)) and BCC (Banker, Charnes and Cooper (1984)), where input, asset profitability proportion and staple value / carrying amount proportion variables were couple products were used. Obtainments of working showed that pristine tuberculous competence degrees of firms were comparetively superior and that in 2015 five companies had complete pristine tuberculous competence. Thus, it could be told that in order to remain the total technical actions of the firms, they should increase the scale activities in general.

Duman (2017), in this study, whether the R&D expenses are result of real economic growth and causal aspect of the effect that real economic growth will produce on economic outputs (patents, brands, utility models and design numbers) are analyzed. Turkey between the years of 2000-2015 six-month period of real economic growth, R&D spending and improvements in time-series relationship between economic output will be analyzed taking into consideration. By virtue of assay, direction of causality will be determined under favour of Johansen cointegration and Granger causality tests.

İltaş and Bulut (2017), the aim of their working was to investigate connection between R&D expenses and net sales revenue promoting datum for the period 1996-2013 to five sectors in Turkey (food, beverages and tobacco products industry, basic metal and fabricated metal products sector, textile and textile products industry, chemical industry and wholesale and retail trade sector). To the end, the bootstrap panel causality assay developed by Konya (2006) had been used in the study following horizontal cross-section dependence and heterogeneity tests. In regard to conclusions of panel causality analysis, there was one-road causality from R&D expenses to net sales revenue in textile and textile products industry. In addition, there was a unit-road causality from net sales revenue to R&D expenditures in the food, beverage and tobacco products industry, the main metal industry and processed metal products sector and the wholesale-retail trade sector. Based on empirical findings, some conclusions had been drawn in the conclusion of the study.

Kesikoğlu and Saraç (2017) express that assay effect of R&D on growth in Turkey at territorial degree. They defend when the conclusions of the territorial relative test applying the R&D expenses and growth datum of the 12 areas in the NUTS (Statistical Region Units Classification) Level 1 2010-2014 term are made allowance for, it has been got that there is favourable connection between R&D expenses and GDP in all areas. They determine that the greatest degree of effect is in Northeast Anatolia.

Köse and Şentürk (2017) state that R&D and patent expenses for the Turkish economy and effect of technological continuum on economic growth in 1989-2012 term are researched. In compliance with the discovery achieved from the analyzes, they express that there is bilateral favourable connection between R&D expenses and economic growth. They imply that there is also an important connection between technological advancement and economic growth. Nevertheless, they defend that important connection is not provided between economic growth and patent expense. Virtually, they advocate that it is of life-sustaining significant to rise enterprise in R&D actions and technological improvement to expedite economic growth in Turkey.

Kutbay and Öz (2017), in these studies, they analysed impacts of tax incentives on R&D expenditures on R&D investments and R&D investments on economic growth by means of three different models. In Model 1, when R&D tax incentives for SMEs increased by 1% throughout the panel, firms' R&D while increasing investment in R&D investment of 0.15% of the firms in Turkey has increased by 0.94%. In Model 2, in general the panel large companies tax incentives for R&D increased by 1% when the R&D investment increases by 0.17%, while the companies R&D investment by companies in Turkey increased by 1.18%. In Model 3, in general the panel while the 1% remain in R&D enterprises increased national income by 0.95%; national income 1% remain in R&D investment in Turkey has increased the rate of 1.08%.

Sağlam, Egeli and Egeli (2017), the aim of their studies is to analyze the causality connection between economic growth and R&D expenses for 26 different developed and developing countries. In this context, Romer's (1990) set out the internal growth model, which states that changes in technology increase the

efficiency of economic growth in maxi term. They viewed 1996-2014 period in the context of the annual data obtained from Eurostat and dynamic panel data analysis. In the empirical part, they first looked at heterogeneity with the Delta test improved by Pesaran and Yamagata (2008) and examined transerve-partial addiction for the variables. They applied CADF and Hadri Kurozumi unit root tests considering heterogeneousness and cross-sectional dependence. They found entity of the cointegrated connection between variables by using Westerlund Error Correction Mechanism (ECM) test and conducted panel causality tests with Dumetriscu-Hurlin (2012) and Emirmahmutoğlu-Köse (2011). They stated that the findings indicate unit-road causality connection from R & D expenditures to economic growth in long term.

Sezgin (2017), in her study, was aimed to test whether predictions of R&D panel are binding for developing and developed countries by using 2010-2016 annual data. The results reached for the whole panel showed that R&D expenses had an affirmative impact on growth.

Sökmen and Açcı (2017), this study 1999-2015 period BRICS-T nations (Brazil, Russia, India, China, South Africa, Turkey) were examined by the panel data methods that the gross domestic product ratio of Research and Development expenditure had an impact on the growth rate. Panel Cointegration tests showed that there is maxi-run connection between research and development expenditures and economic growth.

Özkan and Alancıoğlu (2017), in their study, Information Technology (Knowledge Economy) in Turkey, the transformation, Knowledge Economy Index, as well as R&D expenditure, science and human resources that the technology would be analyzed the impact in terms of scientific publications and patents factors.

Özkan and Yılmaz (2017) state when the interior growth models are investigated, it is visited that R&D expenses have favourable impacts on the rise of per capita income along with economic growth by making exteriority. According to the conclusions for the whole panel, the express that R&D expenses declaratively influence high-technology exports and GDP. As a result, they advocate to be told that countries stand to concentrate on R&D hedges in an attempt to enhance their degrees of GDP and exportation.

Tarı and Alabaş (2017), the goal of their working consisted of four sections. Initial section ‘’entrance’’ chapter is formed. Collateral section, workings in litterateur and abstract institutions of connection between R&D and economic growth were argued. ‘’Methodology and Terminology’’ in next part, regarded to section of work methods and datum implementations were established; the final part tendered conclusions of experience tests were given. By virtue of conclusions acquired, it was resulted that expensing on R&D impacted affirmatively economic growth in mini and maxi run. It was significant for Turkish Economy to rise expense of R&D sistematically in maxi run to procure ongoingness.

Taş, Taşar and Açcı (2017), in working, they investigated help to growth of R&D investment expenses in Turkey in 2005-2015 period ended Industrial Production Index and R&D gross domestic spending have used share of the variables in revenue. As a result of empirical analysis of the study, they were able to identify causality economic growth of R&D investments in Turkey.

Ülger (2017) states that Augmented Dickey Fuller and Phillips Perron agent stem tests are done to designate fixity before her study. In reference to agent stem test conclusions, entire the serials are found out to be constant at the rating. The conclusions of the variance sortation and action and reaction function are indicated that any alteration in R&D does not possess an important impact on the GDP equilibrium, nonetheless; GDP has an important impact on R&D. Otherwise, she figures that Panel Data Analysis is applied for 38 OECD countries applying 1996-2015 data and GDP rised by 11,484 units while R&D 1 unit remained. In other word, she states that there is a favourable connection between them. She expresses that the connection between R&D encouragements and growth for the years 2006-2015 in Turkey is proved to be investigated by Granger causality analysis, however the conclusions are not important because of inadequate datum.

Ülger and Durgun (2017), in their study, Augmented Dickey Fuller (ADF) and Philliphs Perron (PP) agent stem tests were executed to determine stability. According to results of the agent stem test, all series were found to be stationary at the level stage. The conclusions of the alteration diffuse and effect-provision functions indicate that any change in R&D does not have an outstanding impact on balance of GDP, nevertheless; the GDP has significant impact on R&D.

Ünverdi (2017), connection between RD and economic growth in theoretical literature had been evaluated within the framework of first and second generation internal growth theories. In addition, empirical studies and findings related to this relationship were investigated. In litterateur, it was sighted that the empirical workings on subject for the case of Turkey had generally adopted less elaborated techniques based on causality and cointegration tests. It is significant to carry out more comprehensive empirical studies especially focusing on Turkish economy that took into account second generation theoretical approaches.

Ayar and Erdil (2018), their study data was collected with 313 exporting enterprises operating in Turkey from the CATI method. Eventually of data analysis, significant and strong connection was provided between innovation and R&D activities. Eventually of their working, it is another finding that innovation and R&D activities have an effect on perception of export performance. In addition, it has been found that two situations in which the enterprises devote the most importance in terms of novelty and R&D actions are budget allocated to R&D expenditures and support of learning culture in order to gain competitive advantage.

Çapik and Kaygısız (2018), the goal of their working was to analyze impact on the growth of R&D expense and exports high-tech products in Turkey. Therefore, variables representing GDP, R&D, and advanced technology exports for the period 1993-2016 were used. Cointegration analysis and error correction models had been applied. As regards conclusions, maxi-run connection was provided between changeables. In addition, it was determined that the deviations will reach equilibrium after 8.3 periods.

Cenger, Gülcü and Karaca (2018), for this purpose, they investigated the connection between R&D density of relative efficiency levels of companies operating in Metal Goods, Machinery and Equipment Manufacturing sector with the Data Envelopment Analysis Method. They stated that only data variable of research, which uses data for 2013-2016 periods, is R&D expenditures and outputs are: “sales, gross profit, main business income, pre-duty income and pure income for term”. In their study, they compared the DEA scores and R&D intensity rankings of companies, and they found that R&D intensities and super-activity levels were positively correlated by performing the super efficiency analysis of the active firms.

Duman and Aydın (2018), in their study, the existence of connection between R&D expenses and GDP was tried to be proved to be linear. Concordantly, R&D expenses and GDP data generated between 1998 and 2015 were discussed. In the results of working; committed R&D spending in Turkey was determined to be linear and one-way relationship between GDP. By virtue of causality test, R&D expenditures were cause of GDP. In other words, while the remain in R&D expenses led to positive increases in GDP, decreases led to a decrease in GDP.

Durgun and Çapik (2018), the goal of their working was to assay effect on growth of R&D spending and exports superior-tech goods in Turkey. For this reason, co-integration assay and fault rectification models were applied by using variables representing the GDP, R&D, and advanced technology exports of the period 1993-2016. As regards conclusions, maxi-run connection was provided between changeables. In addition, it was determined that the deviations will reach equilibrium after 8.3 periods.

Efeoğlu and Topçuoğlu (2018), in their study, GDP per capita for economic growth, R&D expenses for R&D and patent applications for patents were used. With the annual data of 1996-2014 period, time series analysis was performed for each country and unit root, cointegration and causality tests were performed and countries were compared.

Evcim (2018), the model was estimated using spatial panel econometrics methods. Then, it was tested qualitatively and quantitatively. As a result, spatial effects and coefficients involved in pattern were provided to be appropriate and outstanding.

Futagami and Konishi (2018), their study provided a generational model that coincides via internal thrift, mortality and R&D actions. They showed that pattern explained sighted thrift dynamical of sophisticated nations. When degree of soever capita earnings revenue was mini or maxi, a remain in revenue increased thrift proportion. When soever capita earnings revenue was evident, a remain in this revenue reduced thrift proportion. Besides, pattern predicted sighted connection between inhibitants growth and novelty efficiency. Initially, both inhibitants growth rate and technological continuum rates increased so there was an affirmative

connection. After that, population growth ratio decreased, nevertheless; proportion of technological continuum increased, which was an adverse connection.

Günay, Ağır and Türkmen (2018), in their study, 20 OECD countries were analyzed for the period 1991-2016 with new econometric methods developed within the framework of the connection between R&D expenditures and economic growth. Obtained results showed that R&D expenditure affected positively on economic growth.

İlarslan and Bıyıklı (2018), goal of this working was to investigate effect of R&D expenses on profitability of the pharmaceutical sector. About this subject, one of Turkey's largest drug company had used the 1994-2016 period of annual data. Gross profit margin was evaluated as addicted changeable and R&D expenses as uncommitted changeable. In the econometric methodology stage, Almon Model, one of the delayed distributed models was used and as a result of the analyzes, it was determined that the gross profit margin was positively affected by the density of R&D expenses in recent 6 years. Moreover, the impact of R&D expenditures on gross profit was higher in current year compared to previous years.

İskenderoğlu and Çakmak (2018), the goal of working is to specify whether economic growth, R&D expenditures, exports and net foreign capital inflows are effective on this index. Concordantly, connection between GDP, R&D expenses, exports, net foreign capital inflows and economic fitness index data in the annual frequency of 20 countries between 1996 and 2015 was tested with panel causality, panel cointegration, FMOLS and DOLS analyzes. The relationship between cointegration and causality was determined among the variables and it was found that R&D expenses had an affirmative impact on the economic fitness index.

Külünk (2018), the author of this study in Turkey to 1996 R&D spending between 2016, the relationship between export and GDP series were analyzed by multiple linear regression analysis. As a result, it was provided that R&D expenditures had an affirmative impact on exports and exports had an affirmative impact on growth. Direct connection was not provided between R&D expenses and GDP.

Özcan and Özer (2018), working purposed to test impact of R&D expenses and patent applications on economic growth by promoting panel datum assay using

annual data of 1995 - 2013 for 23 selected OECD nations (Economic Cooperation and Development Organization). In study, long-term relationships between the variables were investigated with Westerlund Panel Cointegration tests and long and short-term coefficients between the variables on the panel basis were estimated by the Mean Group Estimator (MGE) and Pooled Average Group Estimator (PMGE) methods. By virtue of econometric analysis, the maxi-run effect of R&D expenses and patent applications on economic growth was statistically significant and positive. However, short-term coefficients were positive but they were not statistically significant.

Türedi (2018), in this study, the causal relationships between R&D expenses and patent applications and economic growth were investigated by using datum from 23 OECD member nations for term 1996-2011. For this purpose, Wald test was used with GMM (Generalized Moments Method) approach developed by Arellano-Bond (1991). Panel causality estimation conclusions indicated that there is one bi-directional and affirmative connection between R&D expenses and economic growth and one unit-road and affirmative causality relationship from patent implementations to economic growth. Therefore, it can be stated that it is important to assign upward of sources to R&D actions and establish an effective patent system for the countries aiming for sustainable and high rate growth.

Uçak, Kuvat and Aytekin (2018), the goal of their working was to assay relationship between real GDP and the total R&D expenditures in Turkey (R&D / GDP) period 1990-2016. Since the series were stationary at different levels, the cointegration analysis was performed with the ARDL boundary test. When the long-term coefficients of the ARDL Model were analyzed, maxi-run impact of the R&D variable on the GDP variable was positive and significant. The GDP function was consistently explained by the R&D variable, and in maxi term, a 1% change in R&D would increase the real GDP by 5.92%. The coefficient obtained as a result of the error correction model established; was negative and statistically significant. In addition, the absolute value was greater than 1. This situation showed that the fluctuations in the short term would reach a balance point in the long term. The remain in R&D expenses in Turkey were making a positive contribution to superior-

tech product exports in maxi term had an affirmative effect on growth and current account balance.

Yıldırım, Akkılıç and Dikici (2018), the main goal of working was to investigate effect of R&D expenses on export and economic growth in G-20 nations. For this purpose, impact of R&D expenses of G-20 countries on these two macro criteria was investigated by panel datum analysis. As regards conclusions of research, the increase in R&D expenditures has an affirmative and outstanding impact on economic growth and exports.

Yıldırım and Kantarcı (2018) state that the aim of their working is to research effects of R&D on economic growth in progressive nations. In their study, they analyze the effects of R&D expenses on economic growth by using panel datum assay for 15 developing nations by using the annual data of 1998-2013 period. According to the results, they argued that R&D expenses did not have a statistically impact on economic growth.

Acaravcı, Akalin and Erdoğan (2019), in their study, Turkey's economy in Research and Development (R&D) effects of spending on real exports per capita have been investigated by promoting sessional datum covering term of 1990-2014. They state that the delayed autoregressive (ARDL) boundary test approach for cointegration is used to detect short and long-term relationships in the presence of structural breaks. Average trading per capita real income and real exchange rate is added to the model as control variables. Long-term coefficient results indicate a remain in R&D expenses and average soever capita real income of trading partners, Turkey per capita actual exports is positive; The actual switch proportion (in national currency) increase in the value of the 1999 Marmara earthquake in Turkey shows that per capita real exports its negative effects.

Ayaydın, Pala and Barut (2019), the aim of the study; they state that the leverage and ownership structure of the firms operating in Istanbul Stock Exchange (ISE) and operating in the manufacturing sector is to investigate moderator effect on R&D expenses and firm performance. For this purpose, they examine 125 manufacturing companies operating in BIST between 2008-2016. They test the effect of foreign ownership and leverage on firm performance using the system GMM, developed by Arellana and Bover (1995), one of the dynamic panel models. As

regards conclusions of working, they provide that although foreign ownership positively affect the connection between R&D intensity and company productivity, leverage negatively affect connection between R&D density and firm productivity.

Belgin and Avşar (2019), in their study, they are intended to measure the level of regions and provinces of Turkey's R&D and novelty productivity. For this purpose, they use Gray Relational Analysis Method, which is one of multiple criteria judgement doing procedures, and make evaluations regarding performance levels obtained.

Boz, Gültekin and Bayramoğlu (2019), in their study, Research and Development expenditures and high quality product export relations between 2000 and 2015 on behalf of BRICS and MIST [1] country groups were investigated with panel data method. According to the results obtained in China, Turkey and the high-tech product export in Brazil R&D emerged as spending it is a unidirectional causal relationship, while in South Korea it was observed that this is a two-way relationship. In countries such as China and Brazil, direct foreign capital inflows increased technology transfer and technology transfer increased qualified product exports.

Börü and Çelik (2019), in their study, the effect on economic growth of this innovative investment movement in Turkey, 2004 - 2016 was researched by econometric methods. To test connection between changeables, unit root test was conducted, and in the second step, the causality relationship was tested with Granger test. Turkey in specially, R&D based production as a consequence of investment, employment providing innovative products and high value-added in terms of qualitative diversity, the creation of a model of economic growth with economic policy to decrease dependence on foreign as well as Turkey's long-term R&D and innovation progress made by the private sector. It was understood that it had a supportive effect on its GDP. Data Turkey Statistical Institute (TSI) and were acquired from the World Bank.

Coad and Grassano (2019), they implemented a style latterly indicated from Machine Learning Community (Structural Vector Autoregressions (SVARs) defined promoting Independent Components Analysis (ICA)) to a datum-serious of globe's greatest R&D financiers. Their assay emphasizes switch status of company accretion in fields of workers and sellings, in preference to accretion of earnings or staple

capitalisation, in inspiring R&D growth. R&D growth seemed against heel of causative ordination of growth continuum. Their conclusions offered that expedients to rise special R&D would do preferable to objective growth of sellings and worker in place of staple capitalisation or earnings.

Eberle and Boeing (2019), research the effect of Research and Development (R&D) allowances on R&D datas of great and middle-measured companies and the effect on adjunt novelty and economic actions in Chinese countries. They get that the increase in R&D allowances outstandingly reduced special R&D enterprises, but had an outstanding affirmative impact on R&D staff worked in companies. They comment these obtainments as an unfair imposition impact, as community stocks are replacing some special stocks, while sum R&D datas continue to remain. As a complement, they detect a secondary positive impact on provincial patent activity, which is beyond measure of technological progress. In addition, they see the potentially unwanted impacts of R&D allowances on remais in enterprise proportion in physical capital and residential constructions. Even though, R&D allowances cannot stimulate special R&D spending, companies remain sum R&D datas, and reverse economies advantage from subordinate impacts on technological continuum and fund deepening.

Güneş (2019), in his study, for 32 OECD countries, the connection between R&D expenses and economic growth is tested with panel datum assay. In order to test stability of the data, Levin-Lin and Chu (LLC) conducted the Panel Agent Stem Test. Later, he performs the Panel Granger Causality Test. In his analyzes, unit-road causal connection from economic growth to R&D expenses is determined. On the other hand, it can not identify any causal connection from R&D expenses to economic growth.

İspiroğlu and Kılıç (2019), in working, they tested the connection between R&D and economic growth in 15 nations that IMF represented as a remaining staple economy, promoting panel datum assay for the years 1996-2015. Eventually of assay, they found an affirmative connection between R&D expenditures and economic growth in 15 progressive staple economies, and besides found that there was a reciprocal two-way causality between couple changeables.

Kaneva and Untura (2019), their study purposed to analyze the effects of information generation and information software on territorial growth in Russia including the structure of internal growth patterns. They examined the supposal of R&D relevance and expense on technological novelties (H1) and supposals of information leakage (H2) on growth proportions of GDP soever capita. Supposal 2 was restructured while supposal 1 was confirmed; this showed that the absorbing capacity of the innovative delayed zones was not high enough to effectively adapt the ingoing technologies from the technologically novelty zones. The involvement of charts was based on additive information dissemination channels in the regressions concluded in interest of foreign direct investment and imports of outputs and services for regional growth. The conclusions of working may serve as base for the development of novelty expedients for Russian areas.

Özkan and Bayar (2019), using Panel Data Analysis method, they conducted Pedroni Cointegration, Kao Cointegration test and Dumitrescu-Hurlin causality analyzes. They examined the 2000-2015 term data for developing economies. By virtue of assay, they looked over that the R&D expenses, the Information and Communication Technology products exported and increases in the count of patents had a maxi-run cointegration connection via economic growth and changeables had an affirmative impact on economic growth.

CHAPTER IV

THE IMPACT OF TECHNOLOGY ON ECONOMIC GROWTH IN TURKEY: A VECM APPROACHMENT

4.1. MATERIALS AND METHODS

The aim of this study is to investigate the effect of technology on economic growth in Turkey. For this reason, this effect has been analyzed with the help of an econometric model established using annual data for the period 1980-2019. The reason for using annual data in the study is that data to be used for technology cannot be obtained on a monthly or quarterly basis. All of the data used in econometric evaluations were obtained from the websites of the Turkish Statistical Institute (TURKSTAT) and the World Bank (WB). GDP data were obtained from the World Bank website in US dollars (constant 2010 US dollars) and converted to TL using the annual average dollar rate. This series was used in analysis. In this study, econometric analysis was performed using EViews 9 package program.

According to Sylwester, research and development (R&D) is an important variable that explains growth for technology-leading countries (Sylwester, 2001). According to OECD, R&D is related to many other activities with scientific and technological basis (OECD, 2002). Therefore, in this study, representing the technology, total R&D expenditures are used. The change in GDP is one of the macroeconomic data that clearly shows the growth or contraction of the national economy. Therefore, GDP was used to represent economic growth. In the study, logarithm of the variables was included in the analysis. L indicates that the logarithm of the variable is taken.

Variable definitions used in the study are:

LRD: Total R&D Expenditures (TL)

LGDP: Gross Domestic Product (TL)

The empirical model established in the study is:

LGDP = f (LRD)

Firstly, Augmented Dickey-Fuller (ADF) (1981), Phillips-Perron (PP) (1988), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (1992), Ng-Perron (2001) and ERS point optimal (1996) traditional unit root tests are applied to check whether the series are stationary or not. In order to determine the lag length during the unit root tests Schwarz Information Criterion (SIC) was used. The ADF and PP unit root test results for the variables used in this study are provided in Table 1 where the values in parentheses indicate the lag length.

Table 1: ADF and PP Unit Root Test Results

ADF Test Statistics					
Variable	constant	P-values	constant and trend	P-values	Result
LRD	-0.772975(1)	P = 0.8153	-1.584769(1)	P = 0.7803	not stationary
LGDP	0.071600(0)	P = 0.9594	-2.421518(0)	P = 0.3634	not stationary
DLRD	-2.782872(0)	P = 0.0432	-2.439889(1)	P = 0.0441	Stationary
DLGDP	-7.364944(0)	P = 0.0000	-7.626557(0)	P = 0.0000	Stationary
PP Statistics					
Variable	constant	P-values	constant and trend	P-values	Result
LRD	-0.353172(4)	P = 0.9073	-1.687131(5)	P = 0.7380	not stationary
LGDP	0.626486(3)	P = 0.9887	-2.421518(0)	P = 0.3634	not stationary
DLRD	-2.824505(5)	P = 0.0412	-2.796132(5)	P = 0.0434	Stationary
DLGDP	-7.364944(0)	P = 0.0000	-7.625055(1)	P = 0.0000	Stationary

Note: A p-value > 0.05 indicates unit root is detected (not stationary); otherwise, it means there is no unit root (stationary). The "D" used in front of the variables indicates the first difference.

The results of the ADF and the PP unit root tests applied on the levels of the variables show that the variables are not stationary while their first degree differences are, indicating that the difference of the variables is stationary. Next, KPSS test is performed to provide support that the difference of series is stationary. KPSS test results are presented in Table 2.

Table 2: KPSS Test Results

Variable	LM-Stat Constant	Asymptotik Critical Value (5%)	LM-Stat Constant and Trend	Asymptotik Critical Value (5%)	Result
LRD	0.741763	0.463000	0.150965	0.146000	not stationary

LGDP	0.765713	0.463000	0.359532	0.146000	not stationary
DLRD	0.144076	0.463000	0.134163	0.146000	Stationary
DLGDP	0.201628	0.463000	0.097374	0.146000	Stationary

According to Table 2, the LM test statistics for the levels of the variables are not stationary as they are absolutely greater than the KPSS test critical values at 5% significance level, leading to the conclusion they contain unit root while the results obtained by applying the same test to the first order difference of the variables show that the difference of the variables is stationary. Thus the results obtained from the KPSS test support the results obtained from the ADF and PP tests.

The Ng-Perron (2001) unit root test was performed after ADF, PP and KPSS unit root tests. Table 3 shows the Ng-Perron unit root test results.

Table 3: Ng-Perron Test Results

	Constant				Constant+Trend			
Variable	MZ_a	MZ_t	MSB	MPT	MZ_a	MZ_t	MSB	MPT
LRD(2)	-6.77025	-1.67477	0.24737	4.16837	-7.05090	-1.83199	0.25982	12.9821
LGDP(0)	1.67283	0.63366	0.37879	17.1320	-11.7757	-2.13571	0.18137	9.18019
DLRD(0)	-9.52178	-2.18187	0.22915	2.57335	-18.1472	-3.00309	0.16549	5.07666
DLGDP(0)	-17.8738	-2.89840	0.16216	2.64000	-39.9892	-4.40909	0.11026	2.60739
Asymptotic critical value 5%	-8.10000	-1.98000	0.23300	3.17000	-17.3000	-2.91000	0.16800	5.48000

Note: ( ) indicates lag length.

The null hypotheses of MSB and MPT tests indicate that the series is stationary, whereas the null hypotheses of MZ_a and MZ_t tests show that the unit root is in the series. The Ng-Perron test was analyzed by Spectral OLS-Detrented AR. Optimal lag lengths were found with SIC. In Table 3, series I (1) is the first aware station, since the MZ_a and MZ_t values in the first differences of the series are greater than the table value and the MSB and MPT values are smaller than the table value.

Finally, ERS point optimal unit root test developed by Elliott, Rothenberg and Stock (1996) was performed. The basic hypothesis in the ERS test is that the series contains unit root. If the P_t statistic calculated for the ERS test is less than the critical value, the unit root base hypothesis is rejected (Ertuğrul ve Soytaş, 2013). ERS unit root test results are shown in Table 4.

Table *4*: ERS Point Optimal Unit Root Test Results

Variable	P_t	Constant+Trend Critical Value (%5)	Result
LRD(1)	13.84945	5.720000	Unit root available
LGDP(0)	9.274241	5.720000	Unit root available
DLRD(2)	0.823804	5.720000	Unit root does not exist
DLGDP(0)	5.643835	5.720000	Unit root does not exist
Variable	P_t	Constant Critical Value (%5)	Result
LRD(3)	76.86586	2.970000	Unit root available
LGDP(0)	22.89861	2.970000	Unit root available
DLRD(0)	2.963930	2.970000	Unit root does not exist
DLGDP(1)	1.586530	2.970000	Unit root does not exist

Note: The values in parentheses are determined by the SIC, refers to lag lengths.

ERS point optimal unit root test results show that the series are not stationary and the difference is stationary. The ERS test result is consistent with other traditional unit root test results.

As all the variables included in the model are observed to be stationary at first degree, cointegration analysis can be performed together with Vector Autoregressive (VAR) analysis. In VAR analyses, the most important condition is the accurate estimation of the VAR lag length as determined by the information criteria. Table 5 shows the determination of the VAR lag length.

Table 5: Determination of VAR Lag Length

Lag	LR	FPE	AIC	SC	HQ
0	NA	81.87833	10.08096	10.16804	10.11166
1	200.6802	0.277976	4.394820	4.656050	4.486916
2	**27.69062***	**0.145625***	**3.745704***	**4.181087***	**3.899197***
3	1.457935	0.173218	3.913323	4.522859	4.128213

* shows lag order chose by 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

As seen from Table 5, LR, FPE, AIC, SIC and HQ information criteria indicate 2 lag lengths. First of all, the identification test of a two-year lag VAR model was performed. The specified number of lags is expected to have passed the identification tests. The LM test was used to test for the presence of an autocorrelation problem at a specified number of lags. When the probability values in Table 6 are considered, the null hypothesis that there is no autocorrelation problem in the second lag is accepted.

Table 6: Autocorrelation LM Test Results

Lags	LM-Stat	Prob
1	1.677641	0.7948
2	3.923965	0.4164
3	0.658358	0.9564

After the autocorrelation test, white heteroscedasticity test was applied to test the variance problem. The test result is shown in Table 7.

Table 7: White Heteroscedasticity Test Results

Lags	Test Statistics	Prob.
2	12.84713	0.1172

Note: The H_0 hypothesis in the variance test is "there is no variance".

According to this result, it is accepted that there is no variance problem between error terms at 5% significance level. As a result, it was concluded that there were no autocorrelation and variance problems in VAR analysis which was made considering 2 lags.

The next step in the study is to investigate whether the 2-lag VAR model is stable or not. The position of the reverse roots of the autoregressive characteristic polynomial of the model within the unit circle gives information about the stability of the model.

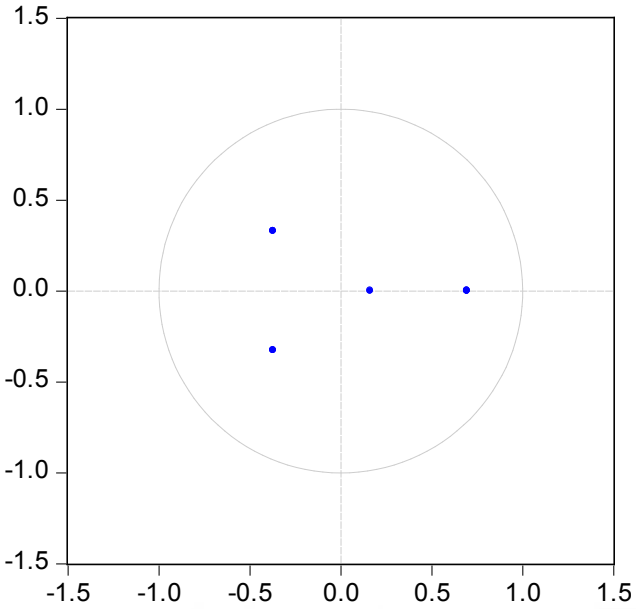

Figure 1: Inverse Roots of AR Characteristic Polynomial

As can be seen from Figure 1, none of the opposite roots of the AR characteristic polynomial are located outside the unit circle, indicating that the established VAR model is stable.

After the completion of the analysis related to the structural consistency of the VAR analysis, Johansen-Juselius (JJ) (1990) test is used for co-integration analysis and the results are given in Table 8.

Table 8: Johansen-Juselius Test Results

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.449778	27.94646	25.87211	0.0272
At most 1	0.146044	5.841397	12.51798	0.4807

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.449778	22.10507	19.38704	0.0197
At most 1	0.146044	5.841397	12.51798	0.4807

Table 8: (continued)

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Normalized cointegrating coefficients (standard error in parentheses)	
LRD	LGDP
1.000000	-0.755982
	(0.05272)
Normalized cointegrating coefficients (standard error in parentheses)	
LGDP	LRD
	-1.322783
1.000000	(0.08013)

According to Table 8, the null hypothesis, which claims the absence of no co-integration, is rejected by trace and maximum eigenvalue test statistics and one co-integration relation is found in the model. In other words, it can be said that there exist a long run relationship between total R&D expenditures (represents technology) and GDP (represents economic growth) in this study. In order to see the directions of these long run relationships, normalized equations according to LRD and LGDP are examined, respectively. Normalized equations are interpreted according to 5% significance level.

Normalized equation according to LRD:

$$LRD = 0.755982\ LGDP \quad (1)$$

(t-value= 14.3396)

Normalized equation according to LGDP:

$$LGDP = 1.322783\ LRD \quad (2)$$

(t-value= 16.5080)

When normalized equations are analyzed, it is seen that there is a positive two-way relationship between total R&D expenditures and GDP in the long run (*t-value= 14.3396* in equation (1), *t-value= 16.5080* in equation (2)) In other words, as long as total R&D expenditures increase, GDP increases, and as GDP increases, total R&D expenditures increase. In the study, since total R&D expenditures are used to represent technology and GDP is used to represent economic growth, the following conclusion can be drawn for the long run: In Turkey, the technology affects economic growth, economic growth also affects technology. Therefore, in the long run, it can be stated that technological developments are an important factor of sustainable growth in Turkey.

The long run relation among the variables enables the establishment of a vector error correction model (VECM) that obviously includes the error correction term obtained though co-integration regressions and thus, is aimed to find the source of the causality.

The VECM equations established in the study are:

$$D(LRD)t = c1 + a1\,ECTt-1 + b1\,D(LRD)t-1 + d1\,D(LRD)t-2 + e1\,D(LGDP)t-1 + f1\,D(L$$

$$D(LGDP)t = c2 + a2\,ECTt-1 + b2\,D(LRD)t-1 + d2\,D(LRD)t-2 + e2\,D(LGDP)t-1 + f2\,D($$

The test results of the VECM are provided in Table 9.

Table 9: VECM Test Results

	(1)	(2)
	D(LRD)	D(LGDP)
ECT(-1)	1.206868	**-0.226178**
	[1.16590]	**[-2.51444]**
D(LRD(-1))	0.341164	0.429607
	[2.13355]	[0.23347]
D(LRD(-2))	0.165122	-0.032546
	[1.04045]	[-0.01782]
D(LGDP(-1))	-0.226739	0.944260
	[-2.53827]	[0.91858]
D(LGDP(-2))	0.047264	1.152404
	[0.29031]	[0.61510]
C	0.265403	-0.451977
	[2.96682]	[-0.43905]
R-squared	0.092737	0.750120
Adj. R-squared	-0.053595	0.635623
F-statistic	0.633744	10.304655

t-statistics in [ ], 5% significance level

ECT (-1), the long run co-integration-related error correction term, shows the size of the past imbalance. In practice, the error correction coefficient is expected to be negative and statistically significant. According to the test results of the VECM,

the error correction coefficients are negative and statistically significant at the 5% significance level for the equation (2). As the error correction coefficient of the equation (1) is positive and also statistically insignificant so it is excluded from the analyses. According to the equation (2), there exists long run causal relationship from total R&D expenditures to economic growth (DLGDP). R^2 = 0.750120 for equation (2) so, it can be said that the interpretation is consistent. This result supports the result obtained from the JJ cointegration test. The causality from total R&D expenditure to economic growth supports the results obtained from the normalized equation (2).

In the next stage, the short run relationships among the variables are investigated. For that purpose, VECM Granger Causality/Block Exogeneity Wald test is performed and the results are shown in Table 10.

Table 10: VECM Wald Test Results

Dependent variable: D(LRD)		
	Chi-sq	Prob.
D(LGDP)	0.064517	0.9683
Dependent variable: D(LGDP)		
	Chi-sq	Prob.
D(LRD)	9.697166	0.0078

5% significance level

According to Wald test results; there is a causality relationship from total R&D expenditure to economic growth in the short run. It is seen that this finding obtained for the short run overlap with the long run finding (Table 11).

Table 11: Causality

	In the short run	
Rising total R&D expenditures (Technological improvements)	→	*Rising GDP (Economic Growth)*
	In the long run	
Rising total R&D expenditures (Technological improvements)	↔	*Rising GDP (Economic Growth)*

After the causality test, impulse-response analyzes are given. The impulse-response functions reflect the effect of a standard error shock on one of the random

error terms on the present and future values of internal variables. The impulse-response analysis results are shown in Figure 2.

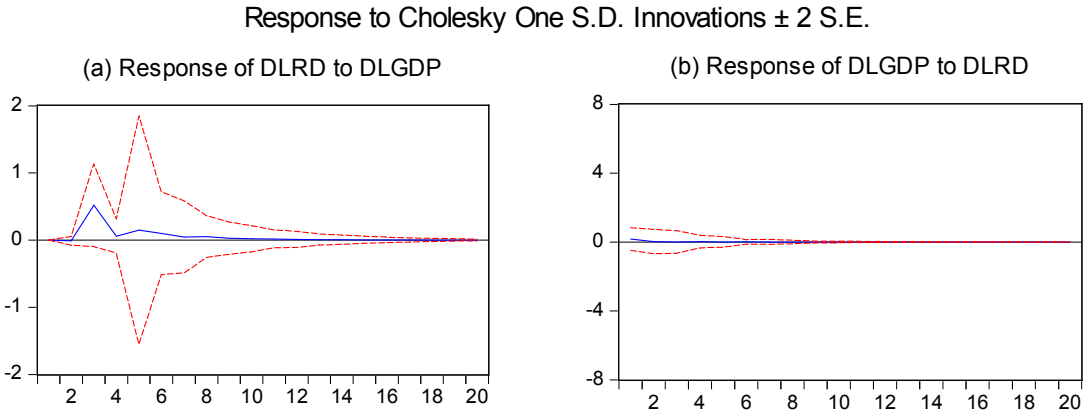

Figure 2: Impulse-Response Functions

Note: Broken drawings in diagrams represent "one" standard reliance bound, and the straight lines represent the point estimates. Response of DLGDP to DLGDP, Provision of DLRD to DLRD are exempted assay.

Figure 2a shows how the 1 standard error shock in DLGDP (change in GDP ≈ economic growth) affects DLRD (change in total R&D expenditures ≈ technological improvements). As can be seen from the graph, the effect is positive but it is gradually falling after the third period. Figure 2b shows how the 1 standard error shock in DLRD impacts the DLGDP. As can be seen from the graph, the effect is consistently positive and it is gradually decreasing. When Figure 2a and 2b are evaluated together, it can be said that there is a bidirectional positive causality relationship between economic growth and technology. This result supports the JJ co-integration test in the long run but partially supports the VECM test result. As a result of the VECM, a causal relationship between economic growth and technology was achieved in one direction, from technology to economic growth.

Another method used in the residue analysis in VAR model, is the variance decomposition. Numerical effects of statistical shocks on variables are tested through this method. Variance decomposition analysis not only decomposes the portions of a change in a variable originating from itself and from the other variables, but also gives information about the degree of causality relationships between variables (Sims, 1980). The variance decomposition test results are given in Table 12. The

results of the variance decomposition obtained from the two-lag-VAR model estimated by the information obtained from the causality test are shown in Table 10.

Table 12: Variance Decomposition Test Results

Variance Decomposition of DLRD			
Period	**S.E.**	**DLRD**	**DLGDP**
1	0.172315	100.0000	0.000000
2	0.266933	99.90658	0.093421
3	0.676374	31.16226	68.83774
4	1.300626	16.36472	83.63528
5	1.748291	14.95860	85.04140
6	2.051355	15.32907	84.67093
7	2.348400	15.24303	84.75697
8	2.694131	14.67132	85.32868
9	3.043340	14.27464	85.72536
10	3.358906	14.17938	85.82062
Variance Decomposition of DLGDP			
Period	**S.E.**	**DLRD**	**DLGDP**
1	1.938612	3.493667	96.50633
2	2.425906	6.478091	93.52191
3	2.487393	8.718163	91.28184
4	2.582255	9.869019	90.13098
5	2.946223	9.714312	90.28569
6	3.352388	9.880234	90.11977
7	3.601745	10.64676	89.35324
8	3.804358	11.27472	88.72528
9	4.068658	11.50506	88.49494
10	4.383473	11.58933	88.41067
Cholesky Ordering: LRD LGDP			

According to the results of the variance decomposition, all of the changes in the total R&D expenditures in the first period are explained by the variable itself. In the last period, 14 percentage of the change is explained by the variable itself and 86 percentage of the change is explained by the change in GDP (economic growth). In the first period, 97 percentage of the economic growth is explained by the variable itself and 3 percentage of the change is explained by technology. This situation is also seen when the last turn has not changed much (88 percentage by the variable itself, 12 percentages by the technology). According to these results, it can be said that the technology had an effect on the economic growth and the economic growth had an effect on the technology. This result supports the other VAR analyzes performed in this study.

CONCLUSIONS

Technology performs a dynamical status in leveragable economic growth in nowadays. That is to say, nowadays, it is impressed on that economic growth is interesed in degree of technology that nations have. Purpose of working is to evaluate appendage of technology to economic growth in Turkey. Therefore, working investigates for causative connection between technology and economic growth by promoting econometric assays via sessional date serials data by way of concentrating on Turkey for term 1980-2019. In working, presenting technology, sum Research and Development (R&D) expenses in Turkey are promoted. In order to designate connection between technology and economic growth, Johansen Juselius (JJ) co-integration test, vector error correction model (VECM), VECM-Wald test, impulse-response and variance decomposition analysis are promoted. Conclusions of co-integration and VECM tests demonstrate that there is a maxi term causative connection between technology and economic growth. As regards, normalised balances achieved from co-integration test, there is an affirmative two-way causal connection between economic growth and technology in maxi term. Otherwise, a road causal connection is provided from technology to economic growth in mini term. Conclusions of impulse-response and VAR decomposition implemented to promote causal tests are stable via co-integration and VECM test conclusions. As regards conclusions, it can be expressed that remaining sum R&D expenses and so growing of technology is a very significant element for leveragable economic growth in Turkey. It can be fond out from this that by imputing more significance to R&D, technology can be promoted more effectually and adequately. Therefore, a remain in manufacture and export of superior-tech outputs in Turkey can be incurred. Via export of superior-tech outputs, Turkey's addiction on exterior resources can be diminished. Diminishing addiction on exterior sources permits for a bigger part of GDP to R&D. This entails to occurrence of ingoing fields of worker and penetrating and influential promoting of sources of economy. All of this remains performance of

Turkey's economic growth and comforts a superior degree of leveragable growth strategies.

Nowadays, technology is a significant factor in ensuring stability in economic growth. When this is the case, it becomes evident that the decision-making units in the economy will focus more on concepts such as technology, Research and Development (R&D) and novelty. With the technological innovations resulting from R&D activities, more efficient and productive economic resources will be used and remains in production may occur. This will perform an outstanding status in remaining welfare level that will accelerate the growth of the national economies.

Finally, the globalization process around the world is causing the commercial relations to deepen day by day. The contributions of open development strategies to this process have also increased the competitiveness of countries. The innovation of any entrepreneur in the production process creates the opportunity for this entrepreneur to earn more profit compared to other entrepreneurs. Therefore, entrepreneurs pursue innovation to increase their profits. Innovation also reveals R&D activities today. Because of all these, it also enables states to contribute to R&D activities. Today, both the increasing emphasis on technology with the transition to knowledge economies and the association of achieving sustainable high growth rates with the production of high-tech products increase the importance of the Schumpeterian concept of creative destruction. As a consequence of this study, we can say that more R&D investments by countries will have a positive impact on economic growth.

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