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Rükiye HAKKİTANIR

Responsible Author, Graduated Master Student, Van Yüzüncü Yıl University, Faculty of Economics and Administrative Sciences, Institute of Social Sciences, Department of Economics, rukiye.hkktnr65@hotmail.com, Orcid Id: 0000-0002-1885-6152.

Asst. Prof. Dr. Mustafa TORUSDAĞ

Van Yüzüncü Yıl University, Faculty of Economics and Administrative Sciences, Department of Economics, mustafatorusdag@yyu.edu.tr, Orcid Id: 0000-0002-8839-0562.

R&D EXPENDITURES, FOREIGN TRADE AND GROWTH RELATIONSHIP IN NEW INDUSTRIAL COUNTRIES¹

Abstract

In a world where globalization is accelerating, international competition is increasing, R&D, innovation and technology are at the forefront, it is important to examine the relationship of countries' R&D expenditures with foreign trade and economic growth. Countries coming to the forefront in the global market is only possible with innovation and R&D. R&D is defined as a new service and product development process. Since there is a great variety of products and services, it is possible to make a difference and to reveal innovation with R&D. At this point, the existence of R&D activities is important. As a matter of fact, one of the indicators of the development level of countries is R&D expenditures. Technological advances achieved through R&D reduce production costs and save time. R&D expenditures provide countries and companies with advantages such as competition and productivity increase. However, it reduces the foreign dependency of countries technologically and enables foreign capital to enter the country. In this study, Taylor and Sarno (1998) analyzed the period of 2000-2019 for 10 new industrialized countries, namely Turkey, Brazil, South Africa, South Korea, Greece, Colombia, Mexico, India, Thailand and China, in terms of economic growth and foreign trade relation of R&D expenditures. Econometric analysis was implemented with the MADF unit root test, Emirmahmutoglu and Kose (2011) panel causality test. Emirmahmutoglu and Kose (2011) as a result of the panel causality analysis findings, in line with the findings of the panel-wide analysis, the bidirectional causality relationship between trade and R&D and import and R&D in 10 newly industrialized countries, as well as from R&D to exports, from economic growth to R&D, from exports to economic growth and from imports to economic growth one-way causality relationship, has been found. However, from exports to economic growth and due to the unidirectional causality relationship

¹ This article was carried out by Rükiye Hakkıtanır, Van Yüzüncü Yıl University, Institute of Social Sciences, Department of Economics. (May-2021), derived from the master's thesis (Thesis No: 668413) titled "The Relationship between R&D Expenditures, Foreign Trade and Growth in Newly Industrialized Countries".

from import to economic growth, it has been concluded that the growth hypotheses based on export and import are valid for the economies of 10 newly industrialized countries.

It has become inevitable to investigate rural employment in a period when the unregistered agriculture in the labor market in Turkey continues and the rate of youth unemployment in general employment is high and the labor force participation of women is low. The activity is still continuing with the decrease in the share of agriculture in employment. It is necessary to investigate the structure of the labor force in the countryside and develop policies for solving their problems to reduce the informality and to increase the production. In our research, Emirdağ's labor force structure will be investigated according to at least the last 5 years' data. According to the obtained data, solutions for the place, problems and problems of men and women in employment will be proposed. For this reason, the employment structure in our district needs to be determined and assessed in a healthy way.

Keywords: R&D Expenditures, Economic Growth, Foreign Trade, Panel Data Analysis.

1. INTRODUCTION

With the entry of the information age and the effect of globalization, rapid developments and advances in technology increase the importance of information and cause an increase in Research and Development (R&D) activities. Research and development (R&D), Solow (1956); Köhler et al., (2012); Szarowská (2013), (2016); Halásková and Halásková (2015), Freimane and Băliņa (2016), Marcelino-Jesus et al. (2017), knowledge is stated as the main source of technical change that will lead to the acquisition of new products-processes and technologies (Szarowská, 2017: 90). R&D, a concept that has been used in recent years, refers to the activities and expenditures of countries in order to establish superiority in foreign trade and achieve innovation. According to the general evaluations expressed in the literature, it is seen that R&D activities affect technological development and technological development positively affects R&D activities.

Sustainability of economic growth and superiority of countries and companies in international competition and foreign trade are possible with the effective use of R&D activities. As expressed by Brown and Jan (2004), R&D, which is also expressed as a part of innovation, is the expenditure incurred by countries and businesses in order to continue their activities, to become a leader against their competitors and to make a profit. As Samimi and Leadery (2010) stated, R&D expenditures, as a concept that affects the foreign trade and export levels of countries, have a decisive role in terms of positively affecting the production of high technology products, the amount of exports and the growth levels of the countries. It is especially important for developing countries to make R&D expenditures and to develop high-tech products. Chowdhury and Islam (1980) stated that the savings rate level of newly industrialized countries should be 15%, the real GDP per capita should be 1000 dollars, the share of the manufacturing industry in GNP and total employment should be 20%, and the human development index should be 0.75 for these countries. In this context, in this study, for the economies of 10 newly industrializing countries (Turkey, Brazil, South Africa, South Korea, Greece, Colombia, Mexico, India, Thailand and China) for the period 2000-2019, It is aimed to examine the relationship between R&D expenditures, economic growth and foreign trade by making analyzes with Breusch and Pagan (1980) cross-section dependency test, Taylor and Sarno (1998) MADF unit root test and Emirmahmutoglu and Kose (2011) panel causality test.

2. R&D, ECONOMIC GROWTH AND FOREIGN TRADE RELATIONSHIP

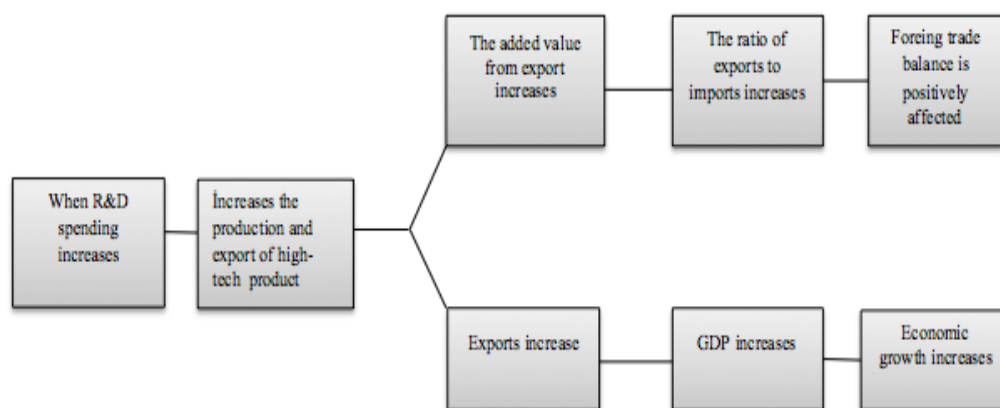
Today, countries are faced with an intense competitive environment. Countries have to be in this competitive environment not only with the effect of globalization, but also as a result of the development in the field of information and technology. This competitive environment increases the importance of R&D. Thanks to R&D, reducing production costs, saving time, efficient use of production factors, etc., by making use of technological development and knowledge. It provides an increase in production level with effects (Miroslav et al., 2011: 71).

Economic theory explains economic growth with R&D and human capital accumulation (Griffith, 2000: 2). However, while the Post Keynesian model states that the necessary tools for growth are savings and investment, the Neo-Classical growth model emphasizes technological development as the locomotive of growth. In the neoclassical growth model, total factor productivity is explained by technological change, while technological change is taken as an exogenous factor. For this reason, physical and human capital come to the fore in the growth differences of countries (Vergil and Sinay, 2013: 60).

The Neo-Classical model began to lose its validity in the 1980s, with studies suggesting that the growth rates of countries would converge over time. The New Growth (Internal Growth) Model, on the other hand, states that factors such as R&D, human capital accumulation and externalities have an impact on technological development in the long run (Kesikoglu and Yildirim, 2012: 166).

International foreign trade can affect the R&D investments of countries and companies through three different channels: "import competition", "export" and "technology import". The effect of import competition on innovation was examined by Klundert (1995) with the endogenous growth model. Accordingly, imports encourage companies to invest in R&D by reducing their profit margins. The large-scale production of the companies ensures that their R&D investments gain increasing returns to scale.

Figure 1. The Effect of R&D Expenditures on Economic Growth and Foreign Trade Balance



Source: Dam, 2016: 347.

As seen in Figure 1, depending on the increase in R&D expenditures, the production of high-tech products and product exports increase, the added value obtained by exporting increases and exports increase. The ratio of exports to imports rises and GDP growth is achieved. Therefore, the foreign trade balance is affected positively and provides an increase in economic growth. In order to close the income and growth differences between the newly industrialized countries and the developed countries, they had to cooperate with the industrialized countries, along with studies such as increasing their R&D investments and allocating more funds for education. It encourages foreign direct entry by realizing the technology transfer of newly industrialized countries. The public and private sectors also resort to the method of providing support to R&D investments (Cetin, 2019: 32).

The economic growth of developed countries is based on the development of technology and foreign trade on a large scale. Information targeted in technological developments has become the main creator of the competitive advantage of companies and countries in the world market (Lucas, 1988, 1993). This development in technology will have a positive effect on foreign trade and will have a positive effect on economic growth (Sokolov et al., 2006: 1005).

In an open economy, the causal relationship between exports and growth is explained by three hypotheses (Dereli, 2018: 280): First hypothesis; It has been expressed as the “one-way causality from exports to growth - export-pull growth” hypothesis. The second hypothesis is the one that states that there is a causal relationship from growth to exports: Exports with growth pulls. The third hypothesis is that “a two-way causality relationship between exports and growth: Export Driven Growth and Growth Driven Exports are seen together. It is argued that in the long run, the increase in exports will lead to economic growth and that exports will increase due to the increase in productivity. The increase in exports will cause a decrease in costs. Decreased costs will increase profits from production. In addition, increasing foreign trade will increase the income level and increase the foreign trade volume (Bilgin and Sahbaz, 2009: 180).

The relationship between imports and growth in an open economy is explained by 3 hypotheses: First hypothesis: “One-way causality from growth to imports; Growth Driven Imports emerges in two ways. First, the increase in income with growth increases purchasing power and consumption for foreign goods. The second is in the form of importing more intermediate and capital goods due to the increase in input requirement in an economy that grows as a result of the increase in production capacity (Korkmaz and Aydin, 2015: 52). Second hypothesis; According to the “One-way causality relationship from imports to growth – “Import-Driven Growth” hypothesis, acquiring the technology to be used in production provides intermediate and capital goods that cannot be obtained from the local market and is used as a tool in economic growth. Esfahani (1991) stated that imports and exports contribute significantly to growth for newly industrializing countries, and that the problems in imports hinder growth (Dereli, 2018: 281).

Third hypothesis: “A bidirectional causality relationship between imports and growth: Import-Driven Growth and “Growth Driven Imports” occur together. According to this relationship, increasing trade (imports) in an open country allows advanced technologies to enter the country. This hypothesis prepares the necessary facilities and infrastructure to enable the gains from learning by doing and the entry of better management practices into the country. In this process, economic growth causes an increase in income. The increase in income, on the other hand, leads to an increase in trade (imports) through the proliferating mechanism, with the effect of the marginal import tendency. In addition, in the context of causality from growth to imports, the need for input imports increases due to the increase in production resulting from growth (Korkmaz and Aydin, 2015: 52; Bilgin and Sahbaz, 2009: 18).

LITERATURE REVIEW

One of the factors affecting economic growth is R&D expenditures. The effect of R&D expenditures on growth has been the subject of many studies in the literature. When the studies in the literature are examined comprehensively, it is seen that many national and international econometric analyzes are used to examine the relationship between R&D expenditures, foreign trade and growth.

Sylwestwr (2001) analyzed the relationship between R&D expenditures and economic growth for 20 OECD countries, including the G7 countries, using the Variable Regression Analysis method. As a result of the study, while R&D expenditures for G7 countries have a positive effect on economic growth, the same result could not be reached for 20 OECD countries.

Samimi and Alerasoul (2009), using the data of 30 developing countries between 2000 and 2006, the relationship between R&D expenditures and economic growth was analyzed by panel data method. As a result of the study; It has been stated that if developing countries, including Turkey, give more importance to R&D activities, an increase in their growth rates will be achieved.

Ozer and Ciftci (2009) analyzed the relationship between R&D expenditures and exports for OECD countries by using panel data technique. As a result of the analysis applied, it was revealed that there is a high rate and significant relationship between R&D and exports.

In the study of Eid (2012), the effect of R&D expenditures on growth for 17 OECD countries was examined using Dynamic Panel Data Analysis method between 1981 and 2006. As a result of the analysis, it was concluded that R&D expenditures had a positive effect on growth in the years it was appropriate.

Gulmez and Yardimcioglu (2012) used panel unit root analysis of the bidirectional relationship between R&D expenditures and economic growth. The analysis showed that the relationship between R&D, GDP per capita and economic growth of 21 OECD countries between 1990 and 2010 is positive and significant in the long run.

Gul and Kamaci (2012) tested the relationship between foreign trade and growth by using panel data analysis for developed countries (1980-2010) and developing countries (1993-2010). As a result of the findings; In developed countries, there is a unidirectional relationship from imports to growth, imports affect growth, but growth does not affect imports. For developing countries, it is concluded that there is a one-way relationship from foreign trade (import-export) to growth, foreign trade affects growth, but growth does not affect foreign trade.

Inekwe (2015) study examined the relationship between R&D expenditures and economic growth for 66 developing countries. Data between 2000 and 2009 were analyzed with the GMM method. As a result of the analysis, the effect of R&D expenditures on growth has a low effect on growth in low-income countries. It has a high effect in upper and middle income countries.

3. ECONOMETRIC ANALYSIS AND FINDINGS

Newly industrialized countries are Turkey, South Africa, South Korea, Argentina, Mexico, Brazil, China, Indonesia, Philippines, India, Malaysia, Thailand, Chile, Colombia, Uruguay, Yugoslavia, Greece and Portugal etc. It consists of 22 countries. The economies of these countries cannot reach the economies of developed countries. However, it differs from other developing country economy groups in terms of "fast economy" and "social development" in terms of macroeconomics. For this reason, newly industrialized countries are defined as a subgroup of developing countries.

3.1. Data Set and Empirical Application

In this study, the effect of R&D expenditures on economic growth and foreign trade for 10 newly industrialized countries (Turkey, Colombia, Brazil, Mexico, South Africa, India, China, Greece, South Korea, Thailand) between 2000-2019 is examined. Economic growth (% change), R&D expenditure (% GDP), import (% GDP), export (% GDP) rates and trade (Trade % GDP - Trade, with goods and services measured as a share of gross domestic product) represents the sum of exports and imports) data were obtained from the World Bank (data.worldbank.org). Econometric analysis, Stata 12.0 and Gauss 10.0 programs were used. First of all, the cross-sectional dependence of the variables Breusch and Pagan (1980), Pesaran (2004) CDIm, Pesaran (2004) CD was analyzed with the Swamy test. Then, the data were analyzed using Taylor and Sarno (1998) MADF unit root test, and Emirmahmutoglu and Kose (2011) panel causality tests.

3.1.1. Cross-Section Dependency for Variables and Models

Analyzes without considering the cross-sectional dependence between the series will significantly affect the results (Breusch and Pagan, 1980; Pesaran, 2004). In order to eliminate this deficiency, the dependency between cross-section units should be taken into account. In addition, second generation unit root tests should be used to perform the stationarity analysis (Gocer, Mercan, and Hotunluoğlu, 2012: 457). Second generation unit root tests include MADF (Taylor and Sarno, 1998), SURADF (Breuer, Mcknown and Wallace, 2002), Bai and Ng (2004), CADF (Pesaran, 2006) and PANKPSS tests. Cross-section dependency test is important in determining econometric analysis techniques. These techniques in the literature, it is known as second generation econometric analysis. (Gul and Inal, 2017: 75).

Table 1. Cross-Section Dependency in Variables

Variables	R&D		Export	
Tests	Stat	prob	Stat	Prob
Cd Lm1 (Breusch,Pagan 1980)	322.510**	0.000	170.814**	0.000
cd LM2 (Pesaran 2004 CDIm)	29.252**	0.000	13.262**	0.000
cd LM (Pesaran 2004 CD)	-1.107**	0.013	-2.473**	0.007
Bias-adjusted CD test	14.200**	0.000	9.213**	0.000
Variables	Import		Growth	
Tests	Stat	prob	Stat	Prob
Cd Lm1 (Breusch,Pagan 1980)	192.706**	0.000	123.256**	0.000
cd LM2 (Pesaran 2004 CDIm)	15.570**	0.000	8.249**	0.000
cd LM (Pesaran 2004 CD)	-2.720**	0.003	-2.123**	0.017
Bias-adjusted CD test	8.861**	0.000	3.067**	0.001
Variables	Trade			
Tests	Stat	prob		
Cd Lm1 (Breusch,Pagan 1980)	175.220**	0.000		
cd LM2 (Pesaran 2004 CDIm)	13.726**	0.000		
cd LM (Pesaran 2004 CD)	-2.563**	0.005		
Bias-adjusted CD test	8.798**	0.000		

In Table 1, various cross-section dependency tests such as Breusch and Pagan (1980) LM, Pesaran (2004) LM and CD, and Baltagi, Feng and Kao (2012) LM were applied to the variables. The coefficients of the variables used in the analyses, probe for each country. Since the probability values (p value) of the variables used in the analysis are less than 0.05, there is a cross-section dependency in the variables.

Table 2. Cross-Section Dependency in Models

Variables	Trade - R&D		Import - R&D	
Tests	Stat	prob	Stat	Prob
Cd Lm1 (Breusch,Pagan 1980)	723.784**	0.000	683.896**	0.000
cd LM2 (Pesaran 2004 CDIm)	71.550**	0.000	67.346**	0.000
cd LM (Pesaran 2004 CD)	26.861**	0.013	26.080**	0.007
Bias-adjusted CD test	27.563**	0.000	25.961**	0.000
Variables	Export -R&D		Growth - R&D	
Tests	Stat	prob	Stat	Prob
Cd Lm1 (Breusch,Pagan 1980)	743.826**	0.000	301.797**	0.000
cd LM2 (Pesaran 2004 CDIm)	73.663**	0.000	27.069**	0.000
cd LM (Pesaran 2004 CD)	27.242**	0.003	16.422**	0.017
Bias-adjusted CD test	26.352**	0.000	1.844**	0.033

In Table 2, there is a cross-section dependency in the variables and models. As a result, the MADF unit root test developed by Taylor and Sarno (1998), which is the second generation panel unit root test, was applied.

3.1.2 Taylor and Sarno (1998) MADF Unit Root Test

After applying the cross-sectional dependency test for models and variables, II. generation unit root test should be selected. The MADF (Multivariate ADF) unit root test, one of the second generation tests developed by Taylor and Sarno (1998), was applied ($T > N$) that is MADF unit root test is used when the panel data is larger than the time dimension (N) and the cross section dimension (T) (Brooks, 2014: 547):

Table 3. Taylor ve Sarno (1998) MADF Unit Root Test

Series	MADF	Lag	Critical Value (%5)
Trade	64.814	1	41.700
Growth	330.478	1	41.700
Import	76.677	1	41.700
Export	89.016	1	41.700
R&D	44.364	1	41.700

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

The values in the parenthesis in the critical values column in Table 3 means the lag length. In the MADF test, Akaike and Bayesian information criteria are taken into account in order to find the appropriate lag length. It is seen that the economic growth, export, import and trade MADF test statistics values of each variable used in the model are greater than the critical value (5%), and when the first difference of the series is taken, the series do not contain unit roots and are stationary.

3.1.3 Emirmahmutoglu and Kose (2011) Panel Causality Test

Emirmahmutoglu and Kose are second generation causality tests that adapt causality tests to panel data. The similarities and differences of this approach with other alternative approaches are as follows (Emirmahmutoglu, 2011: 99-106): In Emirmahmutoglu and Kose (2010) causality test, it is the adaptation of the Toda–Yamamoto approach to heterogeneous panel data, which is used in time series to handle causality relationships between variables. An important advantage of the Toda and Yamamoto (1995) method is that there is no need for preliminary tests to determine the unit root tests of the series before the Granger causality test is performed.

Table 4. Emirmahmutoglu and Kose (2011) Panel Causes Test Results

Causality Direction	Panel Fisher	P-val	Causality
Import → R&D	34.681**	0.022**	Yes
R&D → Import	56.644**	0.000**	Yes
Ar-Ge → Export	39.961**	0.005**	Yes
Export → R&D	26.036	0.165	No
R&D → Growth	28.168	0.105	No
Growth → R&D	147.157**	0.000**	Yes
Trade → R&D	30.212	0.066*	Yes
R&D → Trade	47.602	0.000**	Yes
Growth → Import	28.335	0.102	No
Import → Growth	60.564	0.000**	Yes
Import → Export	26.760	0.142	No
Export → Growth	49.919	0.000**	Yes

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 4, Emirmahmutoglu and Kose (2011) panel causality test results are given for the panel as a whole. When the panel-wide analysis findings are evaluated, it has been found that there is a bidirectional causality relationship between trade and R&D and imports and R&D for 10 newly

industrializing countries. In addition, it was concluded that there is a one-way causality relationship from R&D to exports and from growth to R&D.

Table 5. Import to R&D and R&D to Import Relationship Panel Causality Test Results

i	Import and R&D			R&D and Import		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	1	2.994	0.084***	1	4.983	0.026**
2 China	1	0.674	0.412	1	4.126	0.042**
3 India	1	1.451	0.228	1	3.476	0.062***
4 Mexico	1	1.422	0.233	1	2.719	0.099***
5 Thailand	1	1.134	0.287	1	1.338	0.247
6 Turkey	2	3.153	0.207	2	1.699	0.428
7 South Africa	2	4.063	0.131	2	3.667	0.160
8 Greece	1	2.964	0.085***	1	4.647	0.031**
9 Colombia	1	2.779	0.095***	1	6.719	0.010**
10 Korea	1	1.298	0.255	1	4.189	0.041**
Panel Fisher	: 34.681			Panel Fisher : 54.644		
p-value	: 0.022**			p-value : 0.000**		

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 5, Emirmahmutoglu and Kose (2011) panel causality test results, causality relationship analysis findings from imports to R&D and from R&D to imports, respectively, are examined on the basis of countries. Since the causality relationship from imports to R&D is significant for the panel in general (p-value: 0.022<0.05), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from imports to R&D for Brazil, Greece and Colombia. Since the causality relationship from R&D to imports is significant for the panel in general (p-value: 0.000<0.05), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from imports to R&D for Brazil, China, India, Mexico, Greece, Colombia and Korea.

Table 6. R&D to Export and Export to R&D Relationship Panel Causality Test Results.

i	R&D to Export			Export to R&D		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	1	2.914	0.088***	1	1.539	0.215
2 China	1	3.540	0.060***	1	1.278	0.258
3 India	1	2.411	0.121	2	2.754	0.252
4 Mexico	1	1.430	0.232	2	1.723	0.423
5 Thailand	1	0.799	0.372	2	1.629	0.443
6 Turkey	1	0.363	0.547	2	1.872	0.392
7 South Africa	2	2.346	0.309	2	2.885	0.236

8 Greece	1	2.889	0.089***	2	7.267	0.026**
9 Colombia	1	5.011	0.025**	3	0.000	1.000
10 Korea	1	2.685	0.101	1	0.888	0.346
Panel Fisher : 39.961				Panel Fisher : 26.036		
p-value : 0.005***				p-value : 0.165		

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 6, Emirmahmutoglu and Kose (2011) panel causality test results, causality relationship analysis findings from export to R&D and from R&D to export, respectively, are analyzed on the basis of countries. Since the causality relationship from R&D to exports is significant for the panel in general (p-value: 0.005<0.01), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from R&D to exports for Brazil, China, Greece and Colombia. Since the causality relationship from exports to R&D is meaningless for the panel in general (p-value: 0.165>0.05), there is no causality relationship in newly industrialized countries. However, when analyzed on the basis of countries, there is a causal relationship from exports to R&D only for Greece.

Table 7. R&D to Growth and Growth to R&D Relationship Panel Causality Test Results

i	R&D to Growth			Growth to R&D		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	2	0.955	0.620	2	22.526	0.000**
2 China	1	0.429	0.513	1	19.548	0.000**
3 India	1	0.903	0.342	1	10.088	0.001**
4 Mexico	1	0.394	0.530	1	1.661	0.197
5 Thailand	2	1.228	0.541	2	13.547	0.001**
6 Turkey	2	8.902	0.012**	2	24.800	0.000**
7 South Africa	2	1.066	0.587	2	10.968	0.004**
8 Greece	1	1.094	0.296	1	17.843	0.000**
9 Colombia	1	3.024	0.082**	1	8.894	0.003**
10 Korea	1	2.097	0.148	1	1.486	0.223
Panel Fisher : 28.168				Panel Fisher : 147.157		
p-value : 0.105				p-value : 0.000**		

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 7, Emirmahmutoglu and Kose (2011) panel causality test results, from R&D to growth and from growth to R&D and true causality analysis findings are examined on the basis of countries. Since the causality relationship from R&D to growth is meaningless for the panel in general (p-value: 0.105>0.05), there is no causality relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from R&D to growth for Turkey and Colombia. Since the causality relationship from growth to R&D is significant for the overall panel (p-value: 0.000<0.05), there is a causal relationship in newly industrialized countries. When analyzed on

the basis of countries, there is a causal relationship from growth to R&D for Brazil, China, India, Thailand, Turkey, South Africa, Greece and Colombia.

Table 8. Trade to R&D and R&D to Trade Relationship Panel Causality Test Results

i	Trade to R&D			R&D to Trade		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	1	0.116	0.083***	1	3.726	0.054***
2 China	1	1.011	0.061***	1	3.799	0.051***
3 India	1	3.193	0.048**	1	2.928	0.087***
4 Mexico	1	5.799	0.965	1	1.983	0.159
5 Thailand	1	7.908	0.347	1	1.024	0.312
6 Turkey	2	2.083	0.055**	2	1.407	0.495
7 South Africa	2	2.608	0.240	2	3.397	0.183
8 Greece	1	2.212	0.908	1	3.720	0.054***
9 Colombia	1	0.045	0.751	1	6.527	0.011**
10 Korea	1	5.739	0.008**	1	3.168	0.075***
Panel Fisher : 30.212			Panel Fisher : 47.602			
p-value : 0.066*			p-value : 0.000**			

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 8, Emirmahmutoglu and Kose (2011) panel causality test results, causality relationship analysis findings from trade to R&D and from R&D to trade, respectively, are analyzed on the basis of countries. Since the causality relationship from trade to R&D is significant for the overall panel (p-value: 0.066<0.10), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from trade to R&D for Brazil, China, India, Turkey and Korea. Since the causality relationship from R&D to trade is significant for the panel in general (p-value: 0.000<0.05), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from growth to R&D for Brazil, China, India, Greece, Colombia and Korea.

Table 9. Growth to Imports and Imports to Growth Relationships Panel Causality Test Results

i	Growth to Import			Import to Growth		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	1	0.279	0.597	1	0.369	0.544
2 China	1	0.103	0.748	1	8.993	0.003
3 India	1	0.583	0.445	1	0.121	0.728
4 Mexico	1	1.421	0.233	1	3.445	0.063*
5 Thailand	1	5.471	0.019**	1	5.197	0.023**
6 Turkey	1	1.007	0.316	1	4.768	0.029**
7 South Africa	2	4.289	0.117	2	7.899	0.019**

8 Greece	1	1.078	0.299	1	1.611	0.204
9 Colombia	1	0.119	0.730	1	8.919	0.003**
10 Korea	1	2.753	0.097*	1	2.152	0.142
Panel Fisher : 28.335				Panel Fisher : 60.564		
p-value : 0.102				p-value : 0.000**		

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 9, Emirmahmutoglu and Kose (2011) panel causality test results and causality analysis findings from growth to imports and from imports to growth, respectively, are examined on the basis of countries. Since the causality relationship from growth to import is insignificant for the panel as a whole (p-value: 0.102 > 0.05), there is no causality relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from growth to imports for Korea and Thailand. Since the causality relationship from imports to growth is significant for the overall panel (p-value: 0.000<0.05), there is a causal relationship in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from imports to growth in Mexico, Thailand, Turkey, South Africa and Colombia.

Table 10. Growth to Export and Export to Growth Relationship Panel Causality Test Results

i	Growth to Export			Export to Growth		
	Lag	Wald	p-val	Lag	Wald	p-val
1 Brazil	1	0.285	0.593	1	0.289	0.591
2 China	1	0.365	0.546	1	3.393	0.065
3 India	1	1.152	0.283	1	0.386	0.534
4 Mexico	1	1.408	0.235	1	2.955	0.086*
5 Thailand	1	3.822	0.051**	1	5.571	0.018**
6 Turkey	1	1.270	0.260	1	5.215	0.022**
7 South Africa	1	0.997	0.318	1	2.027	0.155
8 Greece	1	0.513	0.474	1	5.586	0.018**
9 Colombia	1	0.418	0.518	1	4.847	0.028**
10 Korea	1	3.286	0.070*	1	1.279	0.258
Panel Fisher : 26.760				Panel Fisher : 49.919		
p-value : 0.142				p-value : 0.000**		

Note: ***, **, * indicate %10, %5 and %1 significance levels, respectively.

In Table 10, Emirmahmutoglu and Kose (2011) panel causality test results and causality analysis findings from growth to exports and from exports to growth, respectively, are examined on the basis of countries. Since the causality relationship from growth to exports is meaningless for the panel as a whole (p-value: 0.142 > 0.05), causality relationship is not available in newly industrialized countries. In addition, when analyzed on the basis of countries, there is a causal relationship from growth to exports for Thailand and Korea. Since the causality relationship from exports to growth is significant for the panel in general (p-value: 0.000<0.05), there is a causal relationship in newly industrialized

countries. In addition, when analyzed on the basis of countries, there is a causal relationship from exports to growth in Mexico, Thailand, Turkey, Greece and Colombia.

RESULTS

With the effect of accelerating financial globalization, the connection between countries has also increased. Globalization also refers to the opening up of countries. As integration increases in world economies, the countries included in the definition of "Economies of New Industrializing Countries" and the economies of these countries come to the fore.

It is known that R&D expenditures play a role in minimizing growth differences between countries. Newly industrialized countries attach importance to technology transfer and R&D activities in order to eliminate the growth differences between them and developed countries. It is important to increase the export share of high technology products on the basis of economic growth in the world (including newly industrialized countries).

In this study, Breusch and Pagan (1980) analyzed cross-section dependence, and Taylor and Sarno (1998) MADF unit root test. In addition, Emirmahmutoglu and Kose (2011) analyzed the variables with the panel causality test. According to the MADF unit root test findings, when the first-order differences of economic growth, exports, imports and trade variables are taken, the series are found to be stationary.

When Emirmahmutoglu and Kose (2011) panel causality test results were evaluated for the panel as a whole, it was found that there was a bidirectional causality relationship between trade and R&D and imports and R&D in 10 newly industrialized countries. In addition, it was concluded that there is a one-way causality relationship from R&D to exports, from economic growth to R&D, from exports to economic growth and from imports to economic growth. According to the findings of Emirmahmutoglu and Kose (2011) panel causality analysis, it was concluded that the growth hypotheses based on exports and imports are valid for the economies of 10 newly industrializing countries, since there is a one-way causality relationship from exports to economic growth and from imports to economic growth.

When analyzed on the basis of countries, it is seen that there is a causal relationship from imports to R&D for Brazil, Greece and Colombia. In other words, it can be interpreted that Brazil, Greece and Colombia attach more importance to R&D as they import. There is a causal relationship from R&D to imports for Brazil, China, India, Mexico, Greece, Colombia and S. Korea. In other words, the R&D expenditures of Brazil, China, India, Mexico, Greece, Colombia and S. Korea will determine their import levels. In addition to all these, it can be said that there is a bidirectional causality relationship between R&D expenditures and imports for Brazil, Greece and Colombia.

There is a causal relationship from trade to R&D for Brazil, China, India, Turkey and S. Korea. This means that as Brazil, China, India, Turkey and S. Korea do business, they need to give more importance to R&D. There is a causal relationship from R&D to trade for Brazil, China, India, Greece, Colombia and S. Korea. The fact that Brazil, China, India, Greece, Colombia and S. Korea allocate resources to R&D expenditures shows that these countries attach importance to foreign trade. It is seen that there is a bidirectional causality relationship between R&D and economic growth for Brazil, China, India, Greece, Colombia and S. Korea.

There is a causal relationship from growth to imports for S. Korea and Thailand. There is a causal relationship from imports to growth in Mexico, Thailand, Turkey, South Africa and Colombia. It can be said that the import-led growth hypothesis is valid in Mexico, Thailand, Turkey, South Africa and Colombia. However, it is seen that there is a bidirectional causality relationship between imports and economic growth in Thailand.

There is a causal relationship from growth to exports for Thailand and S. Korea. There is a causal relationship from exports to growth in Mexico, Thailand, Turkey, Greece and Colombia. It can be said that Mexico, Thailand, Turkey, Greece and Colombia have grown based on exports. It is seen that

there is a bidirectional causality relationship between exports and economic growth in Thailand. In addition, it can be said that both the export-led growth hypothesis and the import-led growth hypothesis are valid for Thailand.

As a policy proposal, in order to provide countries with a competitive advantage in foreign trade and to ensure that these advantages are sustainable, R & D, together with various factors (high foreign trade volume, education, health, infrastructure investments, direct public services, etc.) spending has a huge impact. R&D activities should be supported by providing tax deductions and low-interest loans. Government expenditures should have a positive effect on growth, and should maximize the benefit and welfare level of households without making profit, and implement policies accordingly.

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