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The Effect of Innovation and Foreign Trade on Economic Growth in Selected Countries: Panel Causality Test

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Abstract

Countries competing with each other in the Globalizing World are using innovative activities to expand their economies. Innovations emerging in the markets stimulate competition and increase the total output level. The next aim of the countries that achieve the targeted economic growth will be to increase the welfare of the society. For this purpose, they developed foreign trade relations to increase income. With the impact of globalization, the transfer of information and technology from one country to another is easy, economic integrations are gaining momentum, and the conveniences experienced in logistics and payment transactions increase the foreign trade volume of the countries. The important thing here is that the innovation process does not negatively affect the marginal technical substitution rate in the economy. If the technological development increasing as a result of innovation activities affects the production process positively, leaving people unemployed due to machining, this will lead to a loss of welfare through the economy. Therefore, the effects of innovation and foreign trade on economic growth need to be investigated well. For this purpose the study year of 2000-2017 annual data with Turkey, Brazil, Russia and India on Emirmahmutoğlu and Kose (2011) developed by the panel causality test was applied. As a result of the analysis, while a one-way causality relationship from innovation to economic growth at 1% significance level in Brazil and India is determined; In Turkey and Russia, a one-way causality from economic growth to foreign trade is determined. The findings show that innovation is an important factor in the sustainability of economic growth. Taking policy decisions by taking into account this situation will increase the level of welfare of the economy.

Key Words: Innovation, Foreign Trade, Economic Growth, Panel Causality

Introduction

In general, innovation can be expressed as the activities of a business that provide more gains. According to the OSLO Guide, a joint publication of OECD and Eurostat, innovation, new or significantly modified product (goods or services) or process; a new marketing method; or the application of a new organizational method in business practices, workplace organization or foreign affairs (OECD and EUROSTAT, 2005). Innovation takes a very important position in terms of competition in the markets. Countries need to develop innovation and turn new ideas into technical and commercial success so that they can continue their economic growth and compete. As stated in the Oslo guide, innovation types are examined under 4 headings. The first is product innovation. Product innovation involves significant improvements in the components or materials of the good or service, their technical features, software, ease of use, or other functional features. New products must contain significant differences from the products that were previously produced in terms of their use and properties (Alegre and Chiva, 2005). The second is process innovation. Process innovation is the delivery of a new or significantly improved delivery or production method using new technology and knowledge. The main goal in this innovation is to increase quality and reduce production or delivery costs. Apart from this, ensuring the emergence of a new or significantly improved product may also be a part of process innovation (Güleş and Bülbül, 2004). In process innovation, it is necessary to control and supervise by management in order not to fail the processes (Altunışık et al., 2016: 349). Another type of innovation is Marketing innovation. Marketing innovation includes important differences such as

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product design and packaging, positioning, marketing communication or payment methods. Marketing innovation is the fact that the new product can respond to customer tastes and preferences better than before and is a method that has not been used before. The aim is to provide a higher-than-ever service to customers in the target audience and to gain competitive advantage against other businesses that do the same job (Altunışık et al., 2016: 344). The fourth and last one is organizational innovation. This type of innovation includes innovations or improvements in the workplace organization or the relationships that the firm has established with companies and institutions abroad. The organization deals with issues such as coordination, project management and optimization (Altunışık et al., 2016: 347). The purpose of this type of innovation is to increase the productivity of the workers with workplace satisfaction, to reduce the costs of tools, equipment and equipment used in the process, administrative and firm and thus to access new information from external sources (Kurt, 2010: 69). Innovation plays an important role in internal growth models. The most well-known works are the works of Romer, Grossman-Helpman and Aghion-Howitt. Romer model stated the importance of innovation and technological developments for economic growth (Romer, 1986: 1002). In addition, Romer's work in 1990 has been described as the first innovation-based economic model (Jones, 1998: 2). According to the Grossman - Helpman Model, it will be easier for a country to achieve economic growth with the incentives for innovation. Grossman-Helpman especially examined the relationship between foreign trade and technology and emphasized that there is an important relationship between new and different products in the countries and the foreign trade policies of that country (Grossman and Helpman, 1991: 43). In their study, Aghion and Howitt (1992), although technology is an internal phenomenon, has a purpose to increase the quality of the product. With the increase in quality, better and new products will be released due to innovation support and will replace the old ones as time goes on.

In the study, population, geographical area, market size and the range of applications because they have similar characteristics in terms of economic growth rates, Brazil, India, China, Turkey countries have preferred. The data for the years 2000-2017, which were not a problem in terms of obtaining data, were used. In the study, the impact of innovation and foreign trade on economic growth was applied to the panel causality test developed by Emirmahmutoğlu and Köse (2011).

Literature

When the literature is examined, there are many studies examining the relationship between innovation and economic growth. The literature will be briefly reviewed here. Lichtenberg (1993) examined the relationship between public and private sector-funded R&D spending for 74 countries and economic growth and productivity between 1964 and 1989. As a result of the study, it was stated that R&D expenditures financed by the public sector had no effect on economic growth, but there was a positive relationship between Research and Development expenditures and economic growth and efficiency. Goel and Ram (1994) studied the relationship between R&D spending and economic growth for 52 countries between 1960 and 1980. As a result of the study, they stated that there is a long-term relationship between economic growth and R&D expenditures, but the direction of causality in this relationship is not clear. Freire-Serén (1999) examined the relationship between R&D investments and economic growth for 21 OECD countries between 1965 and 1990. As a result of the study, it was concluded that there is a strong positive relationship between R&D and economic growth, and that 1% increase in R&D expenditures will provide an increase of 0.08% in real gross domestic product. Guellec and Potterie (2001) stated that there was a positive correlation between R&D expenditures and growth efficiency in the panel data analysis using the data of 16 OECD countries. Ülkü (2004) examined the relationship between economic growth and innovation for 20 non-OECD and 10 non-OECD countries between 1981 and 1997. As a result of the study, there is a positive relationship between innovation and economic growth in both OECD and non-OECD countries. However, innovation investments do not cause a continuous increase in economic growth. Nasab and Aghaei (2009) conducted Panel Data Analysis for OPEC Countries from 1990 to 2007. As a result of the study, they stated that there is a one-way causality relationship from R&D to economic growth. Korkmaz (2010), 1990 - Turkey between the years 2008 to Johansen Cointegration test done. As a result of the study, it has identified a one-way causality relationship from R&D to economic growth. Petals and Scott (2010), 1980 - applied Granger causality

test for Turkey from 2008 years. As a result of the study, they detected a bidirectional causality relationship between R&D and economic growth. Bozkurt (2015), 1998 - Johansen has applied for Turkey between 2013 Cointegration test. As a result of the study, it has identified a one-way causality relationship from economic growth to R&D. Szarowska (2017) conducted Panel Data Analysis for 20 EU member countries between 1995 and 2013. As a result of the study, it has identified a one-way causality relationship from R&D to economic growth. Yazgan and Yalçınkaya (2018) conducted Panel Data Analysis for 29 OECD countries between 1996 and 2015. As a result of the study, they identified a one-way causality relationship from R&D to economic growth. Özkan and Bayar (2019) conducted Panel Data Analysis for 16 countries between 2000 and 2015. As a result of the study, they identified a one-way causality relationship from economic growth to R&D. Chawla (2020) conducted Panel Data Analysis for 18 OECD countries between 1981 and 2012. As a result of the study, they identified a one-way causality relationship from R&D to economic growth. Young and Tandon (2020), between 1990 - 2017 fourier the impact on economic growth for Turkey's R & D-based stains were examined by cointegration test approach. As a result of the study, they determined that there is a bidirectional causality between R&D and economic growth. Canbay (2020), 2004 - Between 2017 and examined the effects on exports of R & D expenditure for Turkey. As a result of the study, it was found that R&D expenditures increased exports in the short and long term.

Methodology

In the study, population, geographical area, market size and the range of applications because they have similar characteristics in terms of economic growth rates, Brazil, India, China, Turkey countries have preferred. The data for the years 2000-2017, which were not a problem in terms of obtaining data, were used. In the study, the impact of innovation and foreign trade on economic growth was applied to the panel causality test developed by Emirmahmutoğlu and Köse (2011).The variables and data sources used in this study are shown in Table 1.

Table 1. Variables Used in Analysis and Data Sources

Variables	Data Period	Data Sources
Real GDP (GDP)	2000-2017	World Bank Development Indicators Database
R&D Expenditures (% of GDP) (INO)	2000-2017	World Bank Development Indicators Database
Share of Exported Goods and Services in GDP (FT)	2000-2017	World Bank Development Indicators Database

The econometric model used in the analysis is included in Equation 1.

$$GDP_{i,t}=\alpha i+\mu t+\beta 0+\beta 1INO_{it}+\beta 2FT_{it}+\varepsilon it \qquad (1)$$

While the αi parameter in Equation 1 shows the country-specific effect, the μt parameter refers to the time-specific effect. Choosing the appropriate method in the analysis is closely related to these two parameters. The shortage of data in the study experienced smoking Brazil, Russia, India and Turkey, covering the period between 2000-2017 samples were made with an annual panel data analysis. In order to obtain reliable results in the analysis, it is necessary to investigate the dependence of the horizontal cross-section and first or second generation unit root tests are applied accordingly (Şimşek & Destebaşı, 2020: 815). In Table 2 shown below, the horizontal cross-section dependency is shown.

Table 2. Horizontal Cross Section Dependency Test Results

	GDP		FT		INO	
Test	**Statistic**	**Prob**	**Statistic**	**Prob**	**Statistic**	**Prob**
Breusch-Pagan LM	97.291	0.000	101.60	0.000	26.291	0.002
Pesaran scaled LM	26.353	0.000	27.595	0.000	5.857	0.000
Bias-corrected scaled LM	26.235	0.000	27.477	0.000	5.740	0.000
Pesaran CD	9.8608	0.000	10.077	0.000	-1.232	0.217

When Table 2 is examined, it is seen that GDP, FT and R&D variables have horizontal cross-section dependence. For this reason, Pesaran (2003), which is the second generation unit root test, was applied to variables. Unit root test results are shown in Table 3.

Table 3. Pesaran (2003) Panel Unit Root Test Results

		Variables	***CADF***		***Variables***	***CADF***
Level	*Constant*	GDP	6.072 (0.639)	*First Differences*	GDP	20.1168 (0.009)
		FT	4,168 (0.383)		FT	24.4589 (0.002)
		INO	4.964 (0.762)		INO	19.9954 (0.011)
	Constant + Trend	GDP	8.013 (0.434)		GDP	16.512 (0.035)
		FT	4,040 (0.328)		FT	29.9055 (0.002)
		INO	10.785 (0.214)		INO	42.520 (0.000)

According to the Pesaran Unit Root Test results in Table 3, the variables included in the analysis are not stable at level, both in fixed and constant and trending situations. When the first degree difference of the variables is taken, it is seen that the variables become stationary in constant and constant-trend situations. After examining whether the model is stationary or not, there is a cointegration test to determine whether there is a long term relationship between the series. For this purpose, Kao Cointegration test analysis was done. The Table 4 below shows the results of the Kao Cointegration test.

Table 4. Kao Cointegration Test Results

Null Hypothesis: No cointegration
Trend assumption: No deterministic trend
User-specified lag length: 1

	t-Statistic	Prob.
ADF	-0.855029	0.1963
Residual variance	0.000233	
HAC variance	7.66E-05	

As can be seen in Table 4, considering the p values resulting from the analysis, since it is greater than 0.05, the zero hypothesis that there is no cointegration is accepted. In other words, for Brazil, Russia, India and Turkey included in the analysis, no co-integrated vector could be detected in the long run between innovation, foreign trade and economic growth. Emirmahmutoğlu and Kose (2011) panel causality test, which takes into account the

cross-sectional dependency, was applied to determine the possible short-term causality relationship between them. Test Results are shown in Table 5.

Table 5. Emirmahmutoğlu and Kose Panel Causality Test Results

Country-specific (individual) results					
Country	Lag	INO=>GDP	p-value	GDP=>INO	p-value
Turkey	2.000000	4.278987	0.117714	0.753996	0.685917
Brazil	3.000000	31.43059	6.90E-07	7.466471	0.058426
Russia	3.000000	5.411466	0.144031	1.896770	0.594106
India	3.000000	15.84562	0.001220	0.265944	0.966301
Panel results	Fisher stat.	p-value			
RD=>GDP	49.94631	4.18E-08			
GDP=>RD	7.543931	0.479237			
Country-specific (individual) results					
Country	Lag	FT=>GDP	p-value	GDP=>FT	p-value
Turkey	1.000000	0.046403	0.829445	8.587791	0.003384
Brazil	1.000000	0.158818	0.690247	0.240019	0.624193
Russia	1.000000	3.007741	0.082868	6.178555	0.012931
India	2.000000	0.446612	0.799870	4.199399	0.122493
Panel results	Fisher stat.	p-value			
FT=>GDP	6.543040	0.586638			
GDP=>FT	25.21553	0.001429			

When Table 5 is analyzed in general, a one-way causality relationship has been found at the 1% significance level from innovation to economic growth. In terms of countries, Brazil and India for 1% level of significance when determining the true innovation from a unidirectional causal relationship to economic growth, Turkey and Russia it was not detected any causal relationship. Again, when looking at table 5, a one-way causality relationship was determined from economic growth to foreign trade in general. When it looks at Turkey and some countries in detecting the unidirectional causality from economic growth to foreign trade for Russia, Brazil and India could not find any causal relationship.

Conclusion

Today, with the rapid development of technology, economic competition and foreign trade are increasing among companies and countries and innovative activities are gaining importance. Work on innovation and foreign trade to economic growth over Turkey, Brazil, Russia and India, countries in 2000 - 2017 years using annual data from causality were examined. For this purpose, the horizontal cross-section dependency of the countries that were handled first was examined. After determining the cross-sectional dependency between countries, Pesaran CADF unit root test, which is the second generation panel unit root test, was applied. Since the long memory is also taken into account, the first degree difference of the variables included in the analysis was taken and the procedure was performed. As a result of the Kao Cointegration test conducted to determine the existence of long term relationship, no cointegrated vector was found. As a result of Emirmahmutoğlu and Köse (2011) Panel Causality Test, which constitutes the last stage of the analysis and takes into account the heterogeneity and a horizontal cross-section dependency, a one-way causality relationship from innovation to economic growth has been determined. In terms of countries, Brazil and India for 1% level of significance when determining the true innovation from a unidirectional causal relationship to economic growth, Turkey and Russia it was not detected any causal relationship. In addition, a one-way causality relationship has been determined from economic growth to foreign trade in general. In some countries, while Turkey and the detection of a unidirectional causality from economic growth in foreign trade for Russia, could not find any causal relationship with Brazil and India. As a result, in order to ensure that economic growth can be sustained, policy makers should carry out activities that encourage foreign trade and innovative activities.

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