

The Impacts of Research and Development Expenses on Export and Economic Growth

Serhat Yüksel[✉]

Department of International Trade and Management, Faculty of Social and Human Sciences, Konya Food and Agriculture University, Turkey

Info Articles

History Articles:

Received 1 December 2016

Accepted 15 January 2017

Published 2 February 2017

Keywords:

Research and Development;
Export; Economic Growth;
Dumitrescu Hurlin causality
analysis.

Abstract

The purpose of this study is to identify the effects of research and development expenses on export and economic growth. Within this scope, annual data of 28 European Union member countries for the periods between 1996 and 2014 was taken into the consideration. Additionally, Dumitrescu Hurlin panel causality analysis was used in this study to achieve this objective. First of all, Im, Pesaran and Shin and Levin, Lin & Chu panel unit root tests were used to understand whether the variables are stationary or not. As a result of these tests, it was defined that the variable of economic growth is stationary whereas other two variables (export and R&D) are not. According to the results of Dumitrescu Hurlin causality analysis, it was determined that there is not a significant relationship between economic growth and R&D. On the other hand, it was concluded that there is a causality relationship from export to R&D expenses. This situation shows that EU member countries, which have higher export amount, give more importance to R&D in order to improve themselves.

[✉] Address Correspondence:

Dede Korkut Mah. Beyşehir Cad.

No:9 42080 Meram, Konya, Turkey

E-mail: serhat.yuksel@gmail.com

e-ISSN 2549-0303

INTRODUCTION

Especially after globalization, economic borders between the countries disappeared. In other words, as a result of the globalization, companies had a chance to access new markets. This situation increased the competition in these markets. Therefore, it can be said that companies should improve themselves to have higher profitability. Within this context, companies tried to search new ways in order to increase their competitive power (Drenzer, 2005).

Research and development (R&D) is a way of increasing effectiveness of the companies. Due to this condition, it can be seen that companies give more importance to R&D investment so as to achieve this objective (Mairesse, 2005). The main reason behind this situation is that it is possible to have technological improvement by increasing R&D investment. Hence, this issue brings a competitive advantage to these companies.

In addition to the advantageous of R&D investment for the companies, it also has some important benefits to the countries. First of all, when companies make higher R&D investment in a country, they will have a competitive power in international markets (Lefebvre et. al., 1998). That is to say, owing to the R&D investments of the companies, export amount of this country will increase. This situation will be helpful to decrease current account deficit problem which is accepted as a significant indicator of the financial crisis (Oktar and Yüksel, 2015).

Moreover, R&D investment is also beneficial for the countries so as to increase economic growth. First of all, R&D investment contributes economic growth by rising exports. Because export is the component of GDP, any increase in the export amount causes economic growth to go up. Additionally, it also improves economic growth by increasing investment in the countries (Goel et. al., 2008). The main reason for this aspect is that investment is also another component of GDP similar to the export.

Because of these advantages emphasized above, countries started to pay more attention to R&D activities. Within this scope, they encourage the companies to make R&D investment by providing some conveniences. For example, many countries decrease tax rates for the companies that make R&D investment (Bloom, 2002). Due to these incentives, it will be helpful to increase this investment and attract foreign investors.

According to World Bank report, it was seen that there was an important increase in R&D expenses. While the amount of total R&D expenses all over the world was 622 billion USD in 1996, this amount jumped to 1,621 billion USD in 2013. On the other side, US has the highest R&D expenses in the world. Although this amount was 197 billion USD in 1996, it exceeded 454 billion USD in 2013.

While considering these aspects, it was understood that studies related to R&D expenses of the countries are very important. Therefore, in this study, it was aimed to identify the effects of R&D expenses on the export and economic growth. Within this context, the data of 28 European Union member countries for the period between 1996 and 2014 was taken into the consideration. As a result of this analysis, it will be possible to understand whether R&D expenses have influences on export and economic growth. Hence, this study will make a significant contribution to the literature by helping to solve this problem.

This paper consists of four different parts. After the introduction, in the second part, similar studies in the literature will be analyzed. Furthermore, the third part gives information about the methodology and analysis. Finally, in the last section, analysis results and the recommendations will be discussed.

LITERATURE REVIEW

R&D expense is a very popular issue in the literature. Because of this aspect, it can be seen that there are lots of study in which this subject was analyzed. Some of these studies was detailed on table 1.

Table 1. Similar Studies in the Literature

Authors	Scope	Method	Result
Galovic (2015)	OECD	Regression	R&D has a significant influence on export amount.
Bozkurt (2015)	Turkey	Johansen Cointegration Analysis	There is a causal relationship between economic growth and R&D expenditures.
Akçalı and Sismanoğlu (2015)	19 different countries	Regression	R&D expenditure increases economic growth.
Kuo and Su (2015)	US	Regression	There is a positive correlation between R&D investment and export.
Gümüs and Çelikay (2015)	52 different countries	Regression	R&D expenditure has a positive and significant effect on economic growth.
Edquist and Henrekson (2015)	Sweden	Regression	R&D investment plays a very significant role with respect to economic growth.
Guarascio et. al. (2015)	EU	Regression	R&D has a positive impact on economic performance of the countries.
Altıntaş and Mercan (2015)	21 OECD countries	Panel Cointegration Analysis	R&D expenditures play a very significant role in order to increase economic growth.
Inekwe (2015)	66 developing countries	GMM	R&D has a positive contribution on economic growth.
Çetin and Cincera (2015)	EU	Probit	Export and R&D expenditure have strong correlation.
Blanco et. al. (2016)	US	Panel Cointegration	R&D investment has a positive influence on economic growth.
Bilas et. al. (2016)	EU	Granger Causality Analysis	There is a causality relationship between R&D expenditure and economic growth
Türedi (2016)	23 OECD countries	GMM	There is a relationship between R&D expenditures and economic growth.
Vuong et. al. (2016)	Sweden	Regression	R&D investment increases the productivity of the firms that provides a competitive advantage regarding export.
Sungur et. al. (2016)	Turkey	Granger Causality Analysis	R&D is an influencing factor of the export in Turkey.
Altomonte et. al.	4 EU	Probit	There is a strong correlation between

(2016) Coad and Grassano (2016)	countries EU	Descriptive Statistics	export and R&D expenditures. R&D investments play a key role for economic growth.
Hong (2016)	Korea	Granger Causality Analysis	Private R&D has stronger effect on economic growth in comparison with public R&D.

Akçalı and Sismanoğlu (2015), Hadi and Suryanto T et.al (2016) made a study in order to define the relationship between economic growth and R&D expenditures. In order to reach this objective, 19 different countries were analyzed in this study. As a result of the regression analysis, it was determined that R&D expenditure has a positive and significant effect on economic growth. Similar to this study, Edquist and Henrekson (2015), Akçalı and Sismanoğlu (2015) and Guarascio et. al. (2015) also concluded that R&D investment plays a very significant role with respect to economic growth by using the same method.

In addition to those studies, Altıntaş and Mercan (2015) tried to identify the relationship between R&D investment and economic growth. So as to achieve this objective, 21 OECD countries were taken into the consideration. Moreover, panel co-integration analysis was used in this study. They reached a conclusion that R&D expenditures play a very significant role in order to increase economic growth. Similarly, Bozkurt (2015) and Blanco et. al. (2016) also used the same method and concluded that there is a causal relationship between economic growth and R&D expenditures.

Furthermore, Inekwe (2015) evaluated the effect of R&D investment on economic growth. For this purpose, general method of moment approach was used for 66 developing countries. As a result of this analysis, it was identified that R&D has a positive contribution on economic growth. Türedi (2016) also reached similar conclusion by using the same method for 23 OECD countries. Additionally, Bilas et. al. (2016) and Hong (2016) underlined the same conclusion with the help of Granger causality analysis.

On the other side, it was also seen that there are also some studies in which the relationship between R&D investment and export was analyzed. Vuong et. al. (2016) and Suryanto T(2016), made a study in order to analyze this relationship in Sweden. According to the results of the regression analysis, it was identified that R&D investment provides a competitive advantage regarding export. Moreover, Galovic (2015) and Kuo and Su (2015) reached the similar conclusion by using the same method.

Additionally, Altomonte et. al. (2016) tried to determine whether R&D investment has an influence on export or not. Within this scope, 4 EU countries were taken into the consideration. As a result of the probit analysis, it was concluded that there is a strong correlation between export and R&D expenditures. Parallel to this study, Çetin and Cincera (2015) also emphasized this conclusion with the help of the same method. In addition to them, Sungur et. al. (2016) identified that R&D is an influencing factor of the export in Turkey by using Granger causality analysis.

As it can be seen from table 1, there are lots of studies in which the effects of R&D investments on economic growth and export amount were evaluated. It can also be understood that different methods were taken into the consideration in order to achieve this objective, such as regression, Granger causality analysis, Johansen co-integration analysis, general methods of moment and probit approaches. Therefore, it can be said that there is a need for a study that analyzes this relationship by using a new and original method.

RESEARCH AND APPLICATION

Data and Scope

The aim of this study is to define whether R&D has influence on export and economic growth. For this purpose, the data of these three variables for the periods between 1996 and 2014 was provided from the website of World Bank. In addition to this situation, all 28 member countries of European Union were analyzed in this study. Additionally, Eviews 8.0 program was used in all analysis.

Dumitrescu Hurlin Causality Analysis

Dumitrescu Hurlin causality analysis is the advanced form of Granger causality analysis. The main benefit of this method is that it is appropriate for panel data. The main prerequisite of this method is that variables, which will be used in the analysis, should be stationary (Dumitrescu and Hurlin, 2012). The details of this test were explained on the following equation.

$$Y_{i,t} = a_i + \sum_{k=1}^K Y_i^k Y_{i,t-k} + \sum_{k=1}^K B_i^k X_{i,t-k} + \varepsilon_{i,t} \quad (1)$$

In this equation, the causality relationship between the variables Y and X is analyzed. In addition to this situation, “i” represents the number of panel. Moreover, “K” demonstrates optimum lag interval and “ε” shows the error term.

Analysis Results

Before starting causality analysis, first of all, panel unit root test results were performed in order to understand whether the variables are stationary or not. Within this scope, Im, Pesaran and Shin and Levin, Lin & Chu panel unit root tests were used so as to reach this objective. The results of these tests were given on table 2.

Table 2. Panel Unit Root Test Results

Variables	Im, Pesaran and Shin W-stat (p Value)	Levin, Lin & Chu Test (p Value)
Export	0.9954	0.4204
Economic Growth	0.0000	0.0000
R&D Expense	0.9998	0.2995

As it can be seen from table 2, it was identified that the probability values of economic growth are less than 0.05 in both two different tests. Thus, it can be said that this variable is stationary on its level value. On the other side, it was also determined that probability values of export and R&D expense are higher than 0.05. This situation shows that they have unit roots. Because they are not stationary, the first differences of these variables were used in the analysis. In order to understand the effects of R&D expenses on export and economic growth, Dumitrescu Hurlin causality analysis was used. The details of this analysis were given on table 3.

Table 3. Dumitrescu Hurlin Panel Causality Test Results

Null Hypothesis	Prob Values (lag=1)	Prob Values (lag=2)	Prob Values (lag=3)
“R&D” does not cause “Export”	0.7525	0.9937	0.6562
“Export” does not cause “ R&D”	0.0217	0.2008	0.0105
“R&D” does not cause “Economic Growth”	0.1124	0.8567	0.9754
“Economic Growth” does not cause “R&D”	0.8023	0.5067	0.1974

Table 3 gives detailed information about causality relationship between these variables. In this analysis, when probability values are less than 0.05, the null hypothesis can be rejected and alternative hypothesis can be accepted. As it can be seen from table 3, the null hypothesis of ““R&D does not cause export” could not be rejected since the probability values for each lag is more than 0.05. This situation explains that there is not a significant conclusion that R&D influences export amounts.

In addition this situation, it can also be understood from table 3 that the null hypothesis of “R&D does not cause economic growth” could not be rejected. The main reason behind this condition is that probability values of this hypothesis for each lag is higher than 0.05. Similar to this aspect, it was also defined that the probability values of the null hypothesis “Economic growth does not cause R&D” are more than 0.05, so this hypothesis also had to be accepted. These results refer that the significant causality relationship between economic growth and R&D could not be found.

Moreover, it was also determined that the probability values of the null hypothesis “Export does not cause R&D” are less than 0.05 for the lags 1 and 3 although this value is higher than 0.05 for lag 2. While considering these numbers, it can be understood that this hypothesis can be rejected for these lags. These results mean that export is the main cause of R&D expenses. In other words, it was identified that EU member countries, which have higher export amount, give more importance to R&D in order to improve themselves. Neves and others (2016), Aw and others (2008) and Çetin and Cincera (2005) reached also similar results in their studies.

CONCLUSION

In this study, it was aimed to determine the effects of R&D investment on export amount and economic growth. Within this context, annual data of 28 European Union member countries for the periods between 1996 and 2014 was taken into the consideration. In addition to this issue, Dumitrescu Hurlin panel causality analysis was used in this study so as to achieve this objective.

In the first stage of the analysis, unit root test was performed in order to understand whether the variables are stationary or not. Within this scope, Im, Pesaran and Shin and Levin, Lin & Chu panel unit root tests were used. As a result of these tests, it was identified that the variable of economic growth is stationary whereas other two variables (export and R&D) have unit roots. Because of this situation, the first differences of these variables were used in the causality analysis.

After that, Dumitrescu Hurlin causality analysis was used to understand the relationship between these variables. According to the results of this analysis, it was determined that there is not a significant relationship between economic growth and R&D. On the other side, it was identified that export is the main cause of R&D expenses. In other words, it was identified that EU member countries, which have higher export amount, give more importance to R&D in order to improve themselves.

Especially in the last years, companies started to give more importance to R&D in order to increase the efficiency. Also, most of the countries encourage the companies for this situation by

decreasing tax rate and increasing subsidies. Thus, it is obvious that studies that analyze R&D are very important. Similar to this issue, the results of this study explain the relationship between R&D with export and economic growth. Because of this aspect, it can be said that this study made an important contribution to the literature by helping to explain this condition.

REFERENCES

- Akcali, Burcay Yasar and Elcin Sismanoglu. 2015. *Innovation and the effect of research and development (R&D) expenditure on growth in some developing and developed countries*. Procedia-Social and Behavioral Sciences 195: 768-775.
- Altıntaş, Halil and Mehmet Mercan. 2015. *AR-GE Harcamaları ve Ekonomik Büyüme İlişkisi: OECD Ülkeleri Üzerine Yatay Kesit Bağımlılığı Altında Panel Eşbütünlük Analizi*. Ankara Üniversitesi SBF Dergisi 70.2.
- Altomonte, Carlo, Simona Gamba, Maria Luisa Mancusi and Andrea Vezzulli. 2016. *R&D investments, financing constraints, exporting and productivity*. Economics of Innovation and New Technology, 25.3: 283-303.
- Aw, Bee Yan, Mark J. Roberts, and Daniel Yi Xu. 2008. *R&D investments, exporting, and the evolution of firm productivity*. The American Economic Review 98.2 (): 451-456.
- Bilas, Vlatka, Mile Bosnjak, and Tomislav Cizmic. 2016. *Relationship between Research and Development and Economic Growth in the EU Countries*. Economic and Social Development: Book of Proceedings: 223.
- Blanco, Luisa R., Ji Gu, and James E. Priege. 2016. *The Impact of Research and Development on Economic Growth and Productivity in the US States*. Southern Economic Journal 82.3: 914-934.
- Bloom, Nicholas, et al. 2002. *How has tax affected the changing cost of R&D? Evidence from eight countries*. The Regulation of Science and Technology. Palgrave Macmillan UK. 136-160.
- Bozkurt, Cuma. 2015. *R&D expenditures and economic growth relationship in Turkey*. International Journal of Economics and Financial Issues 5.1 (2015): 188.
- Çetin, Dilek and Michele Cincera. 2015. *Circular Causality of R&D and Export in EU countries*. World Journal of Applied Economics (WJAE) 1.1: 82-105.
- Coad, Alexander and Nicola Grassano. 2016. *Disentangling the processes of firm growth and R&D investment*. No. JRC103175. Joint Research Centre (Seville site).
- Drezner, Daniel W. 2005. *Globalization, harmonization, and competition: the different pathways to policy convergence*. Journal of European Public Policy 12.5: 841-859.
- Dumitrescu, Elena-Ivona, and Christophe Hurlin. 2012. *Testing for Granger non-causality in heterogeneous panels*. Economic Modelling 29.4: 1450-1460.
- Edquist, Harald Olof and Magnus Henrekson. 2015. *Swedish Lessons: How Important are ICT and R&D to Economic Growth?*
- Galović, Tomislav. 2015. *Impact of R&D on Export Competitiveness of Chemical Industry in Selected OECD Countries*. Poslovna izvrsnost 9.1: 91-107.
- Goel, Rajeev K., James E. Payne, and Rati Ram. 2008. *R&D expenditures and US economic growth: A disaggregated approach*. Journal of policy modeling 30.2: 237-250.
- Guarascio, Dario, Mario Pianta and Francesco Bogliacino. 2015. *Export, R&D and new products. A model and a test on European industries*. Journal of Evolutionary Economics: 1-37.
- Gumus, Erdal and Ferdi Celikay. 2015. *R&D Expenditure and Economic Growth: New Empirical Evidence*. Margin: The Journal of Applied Economic Research 9.3: 205-217.
- Hadi, Abdul Razak Abdul, Shadi Ali Hamad, and Tulus Suryanto. "Capital Structure Determinants: Evidence From Palestine and Egypt Stock Exchanges." *IKONOMIKA* 1.2 (2016): 118-130.
- Hong, Jae-pyo. 2016. *Causal relationship between ICT R&D investment and economic growth in Korea*. Technological Forecasting and Social Change.
- Inekwe, John Nkwoma. 2015. *The contribution of R&D expenditure to economic growth in developing economies*. Social indicators research 124.3: 727-745.
- Kuo, Chuan-Wei and Hsin-Ning Su. 2015. *Exploring influence of R&D investment, import and export performances to patent value*. 2015 Portland International Conference on Management of Engineering and Technology (PICMET). IEEE.

- Lefebvre, Elisabeth, Louis A. Lefebvre, and Mario Bourgault. 1998. *R&D-related capabilities as determinants of export performance*. Small Business Economics 10.4: 365-377.
- Mairesse, Jacques, et al. 2005. *The importance of R&D and innovation for productivity: A reexamination in light of the French innovation survey*. Annales d'Economie et de Statistique: 487-527.
- Neves, Alexandre, Aurora AC Teixeira, and Sandra T. Silva. 2016. *Exports-R&D investment complementarity and economic performance of firms located in Portugal*. Investigación económica 75.295: 125-156.
- Oktar, Suat, and Serhat Yüksel. 2015. *Bankacılık krizlerinin erken uyarı sinyalleri: Türkiye üzerine bir uygulama*. İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi, 14(28), 37-53.
- Sungur, Onur, Halil İbrahim Aydın, and Mehmet Vahit Eren. 2016. *Türkiye’de AR-GE, İnovasyon, İhracat ve Ekonomik Büyüme Arasındaki İlişki: Asimetrik Nedensellik Analizi*. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 21.1.
- Türedi, Salih. 2016. *The Relationship between R&D Expenditures, Patent Applications and Growth: A Dynamic Panel Causality Analysis for OECD Countries*. Anadolu Üniversitesi Sosyal Bilimler Dergisi 16.1.
- Vuong, Van Anh, Florin Maican, Matilda Orth and Mark Roberts. 2016. *R&D Dynamics and Its Impact on Productivity and Export Demand in Swedish Manufacturing*.