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The causality relationship between R&D expenditures and Unemployment in Turkey and Azerbaijan

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Abstract

Innovations resulting from R&D activities directly affect the production process positively. The improvement in R&D activities will increase efficiency and productivity, leading to an increase in the total output level. Therefore, developing countries are increasing their expenditures on R&D activities day by day in order to achieve their economic growth targets. However, although it is stated in the literature that increasing R & D activities positively affect growth, there is no consensus on the relationship between R & D expenditures and unemployment. The interaction between R&D and unemployment varies depending on the type of innovation countries experience. In this study, the causality relationship between R&D expenditures and unemployment in developing countries such as Turkey and Azerbaijan is analyzed by Emirmahmutoğlu and Kose (2011) panel causality test. According to the results of the analysis, a statistically significant one-way causality relationship between R&D expenditures and unemployment is determined at the significance level of 5% in Turkey. In Azerbaijan, a statistically significant one-way causality relationship is determined from unemployment to R&D expenditures at the significance level of 5%.

Keywords: R&D Expenditures, Unemployment, Panel Causality

Introduction

The first creative contribution to technological progress was made by Schumpeter (1942). The effect of increasing information stocks on economic growth and hence unemployment as a result of R&D activities was examined by Romer (1986) and Lucas (1988) and the New Growth Theory was introduced. Since then, economists have worked on this topic. Until the growth model developed by Solow (1956), technology has been accepted externally in growth models and capital accumulation has been shown as the main source of economic growth. With the Solow growth model, technology has now become endogenous. However, since this model does not explain the reason for technological progress, Romer developed the relevant model and included the content of the technology element in the model (Romer, 1990). According to Romer, an economy consists of three different sectors, intermediate goods, final goods and research. In his study, Romer (1990) says that the research sector creates innovations in the markets by using human capital and existing knowledge. These innovations in the research sector are used in the production of intermediate and final goods. From this point, directing more human capital to research and development activities leads to an increase in innovations and total output in the economy. Research and development activities increase productivity and efficiency, leading to an increase in the total output level. Countries having difficulties in producing innovation can increase their production levels by advancing technology transfer from developed countries. The technological progress resulting from the competition will lead

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to an increase in the output level. Because the new product or production process that emerges as a result of a successful innovative movement causes the researcher firm to gain profit by giving monopoly power. OECD (2012) defines R&D activities as creative works that include activities such as basic research, applied research and experimental development.

Even though it is stated in many academic literature that R&D activities affect production positively, there are different ideas about the relationship between R&D and unemployment. These differences of opinion are explained by the type of innovation in the literature. In product innovation, existing goods are improved and new goods are introduced to the market. The increase in demand for these goods causes the establishment of new companies and sectors and the decrease in unemployment (Oberdaberning, 2016). On the other hand, process innovation, on the other hand, leads to an increase in productivity, but a negative impact on employment, as it usually produces the same amount of output with less capital and/or labor. Here, the negative impact on unemployment varies depending on the marginal technical substitution rate. Today, there is the possibility of revealing this kind of unemployment problem in the positive developments experienced in the field of Industry 4.0, which is the subject of discussion in the economic literature.

The aim of this study is to analyze the relationship between R&D expenditures and unemployment for Turkey and Azerbaijan. Unemployment is seen as an important economic and social problem that is becoming serious for Turkey. Countries are now increasingly focusing on R&D activities to overcome such macroeconomic problems. It is important to make clear the impact of these activities on unemployment in terms of producing effective policies.

Short Literature Review

The studies in the literature are mostly focused on the relationship between R&D and economic growth. Few studies in the literature examine the relationship between R&D and unemployment. The first study on this subject was Brouwer et al. (1993). The study was carried out on 859 firms operating in the Netherlands using the least squares (OLS) method. As a result of the study, it was determined that there is a negative relationship between R&D expenditures and employment. Kirchhoff et al. (2007) stated that in their analysis on companies in the USA using the two-stage OLS and SUR model, the R&D expenditures made by universities make a positive contribution to employment. Bogliacino and Vivarelli (2010), using the GMM-SYS panel method, reached the conclusion that R&D expenditures positively affect employment in the manufacturing-service sector, in their analysis of 25 manufacturing and service sectors for 16 European countries. Coad and Rao (2010) analyzed industrial firms operating in the USA with the OLS method, and as a result of the analysis, there is a strong relationship between the sales of firms and increases in employment during the t + 1 period and the R&D expenditures in the t + 1 period. Bogliacino et al. (2014) analyzed 677 firms operating in Europe using the OLS method. As a result of the analysis, it was concluded that R&D studies positively affect employment in the high-tech manufacturing and services sector. Tamayo and Huergo (2016) applied the two-stage OLS method by classifying the companies operating in Spain. As a result of the analysis, there is a positive relationship between R&D and qualified employment. In their study, Piva and Vivarelli (2017) applied the corrected dummy variable OLS method for 674 European companies and found that R&D spending had a positive effect on employment. However, this effect was detected in high-tech firms, but not in low-tech firms. Agovino et al. (2018), in their studies, which included 879 R&D activities in their analysis, indicate that technological changes and R&D activities have significant effects on the employment of companies using the panel data method. In their study, Baş and Canöz (2020) examined 15 developed countries with the secret cointegration method and asymmetric causality tests, and although there was an opposite observation, the results of asymmetric causality analysis found that there was a causal relationship from R&D expenditures to unemployment. Çiftçioğlu and Sokhanvar (2020) investigated the effects of changes in R&D intensity on unemployment and economic growth in the short and long term. As a result of the ARDL border test and PMG estimator methods on the five selected European countries, it was concluded that in four of the five countries surveyed, there was a long-term relationship between R&D, unemployment rate and economic growth. In addition, it was emphasized that although an increase in R&D decreases unemployment in the long term, it does not have any effect in the short term.

Methodology

The variables and data sources used in this study, in which the relationship between R & D expenditures and unemployment is examined empirically for the countries of Turkey and Azerbaijan, are shown in Table1.

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

$$U_{it} = \beta_0 + \beta_1 RD + \varepsilon_{it} \quad (1)$$

Table 1: Variables Used in Analysis and Data Sources

Variables	Data Period	Data Sources
R&D Expenditures (% GDP) (RD)	1996-2019	World Bank Development Indicators Database
Unemployment Rate (U)	1996-2019	World Bank Development Indicators Database

The U symbol in Equality 1 refers to unemployment, the β_0 parameter refers to the constant term, the β_1 parameter refers to the slope coefficient, the RD variable refers to R&D expenditures, and the $\boldsymbol{\varepsilon_{it}}$parameter refers to the error term. Panel data analysis will be used as a method in the study. The advantage of panel data analysis in data with low time dimension has been effective in choosing this method. The main reason why the countries of Turkey and Azerbaijan are included in the analysis is that they generally accept that they are a single nation, even though they appear to be two separate states. These two countries, which are very close in cultural and socio-economic terms, have strengthened their friendship in the global world and have increasingly commercial relations. These trade relations should not be thought of as just goods and services. Recently, technology transfer from Turkey to Azerbaijan is also taking place. Increasing international trade and sharing of information and technology brings globalization (Şimşek and Yiğit, 2019: 170). The increasing economic relations in the globalized world lead to the spread of a cyclical fluctuation in one country to other countries. In Panel data analysis, cross-section dependence testing is performed to detect such interactions. This test results also determine the techniques that should be used to determine the relationship between variables correctly. CD_{LM1} developed by Breusch and Pagan (1980), CD_{LM2}-CD_{LM3} developed by Pesaran (2004) and LM_{adj} tests developed by Pesaran et al. (2008) are used. If the probability values calculated as a result of the tests are less than 0.05, it is decided that there is a cross-section dependency among the countries that make up the panel. Homogenity tests developed by Pesaran and Yamagata (2008) are used to determine whether the slope coefficients in the model are the same. Here, while $\tilde{\Delta}$ test is recommended for large samples; It is stated that $\tilde{\Delta}_{adj}$ test can also be used for small samples. If the probability values calculated as a result of these tests are less than 0.05, it means that the slope coefficients are different from each other (Gerceker et al., 2019: 424). In case of cross-section dependency and heterogeneity, panel causality test developed by Emirmahmutoğlu and Kose (2011) can be used.

Findings

Table 2 shows the results of the cross-section dependence test, which is primarily used to test the relationship between R & D expenditures and unemployment. (The symbols *, **, *** show statistically significant levels of 10%, 5%, and 1%.)

Table 2: Cross Section Dependence and Homogeneity Tests Results

Cross-Section Dependence Tests	Statistics	Probability Value
CD_{LM1}	13,209	0,000***
CD_{LM2}	8,633	0,000***
CD_{LM3}	8,590	0,000***
LM_{adj}	3,634	0,000***
Homogeneity Tests	**Statistics**	**Probability Value**
$\tilde{\Delta}$	4,525	0,000***
$\tilde{\Delta}_{adj}$	4,877	0,000***

As a result of the cross-section dependence tests, the probability values of all the tests were statistically significant at 1% significance level. In other words, it has been concluded that there is an economic interaction in the countries of Turkey and Azerbaijan that constitute the panel and that there is a cross-sectional dependence. As a result of homogeneity tests, it is observed that slope coefficients differ between horizontal sections. In this case, the second generation unit root tests, which take into account the cross-section dependence, should be applied when examining the stability of the country's data (Şimşek and Destebaşı, 2020: 815). Table 3 below shows the results of the Cross Section Augmented Dickey Fuller Test (CADF), a second generation unit root test developed by Pesaran. (The symbols *, **, *** show statistically significant levels of 10%, 5%, and 1%.)

Table 3: Pesaran CADF Unit Root Test Results

		Variables	***CADF***		***Variables***	***CADF***
Level	*Constant*	RD	2,583 (0.629)	*First Differences*	RD	23.219*** (0.000)
		U	4,168 (0.383)		U	14,512*** (0.001)
	Constant + Trend	RD	6,903 (0.1411)		RD	16,198*** (0.002)
		U	4,040 (0.400)		U	13,523*** (0.001)

When Table 3 is examined, the research and development expenditures and unemployment data included in the analysis are not stationary at the level; they are stationary when the first degree differences are taken. All series are statistically significant at 1% significance level.

As a result of the panel cointegration tests, there is no long-term co-integrated vector between research and development expenditures and unemployment for the countries of Turkey and Azerbaijan included in the analysis. Emirmahmutoğlu and Kose (2011) panel causality test results are given in Table 4, considering cross-section dependence and heterogeneity to determine the possible short-term causality relationship between the two variables. (The symbols *, **, *** show statistically significant levels of 10%, 5%, and 1%.)

Table 4: Emirmahmutoğlu and Kose Panel Causality Test Results

Country	Lag	RD=>U Wald	p-value	U=>RD Wald	p-value
Turkey	3	9.113	0.027**	0.958	0.811
Azerbaijan	2	2.583	0.274	8.984	0.011**
Fisher		9.747	0.044**	9.402	0.051*

When the panel causality test results in Table 4 were examined, the length of delay is determined as 3 for Turkey and 2 for Azerbaijan. In general, a causality relationship with a 5% significance level is determined from R&D expenditures to unemployment. In addition, a causality relationship of 10% significance level has been determined from unemployment to R&D expenditures. Looking at the country results, a statistically significant causality relationship from R&D expenditures to unemployment in Turkey is determined at a significance level of 5%. There is no causal relationship from unemployment to R&D expenditures. Azerbaijan is the opposite of the findings for the findings in Turkey. While there is no causality relationship from R&D expenditures to unemployment in Azerbaijan, a statistically significant causality relationship has been found at 5% significance level from unemployment to R&D expenditures.

Conclusion

In the Global World, firms must improve themselves in competition in order to maintain or increase their current position in the markets. This situation can only arise from companies pursuing strategies with innovations compatible with the market by increasing their R&D expenditures. R&D activities and expenditures are increasingly important in the world in order to reveal innovations. It is seen that countries that attach sufficient importance to innovation have achieved a significant economic growth rate. Technological developments, R&D activities and innovation are now among the driving forces of economic growth. When the effects of R&D activities on unemployment are analyzed, it is seen that there is no consensus in the literature yet. This study is intended to analyze the relationship between R & D expenditures and unemployment for the countries of Turkey and Azerbaijan based on annual data from 1996-2019.In accordance with this purpose, Emirmahmutoğlu and Kose panel causality test is applied. Since it takes into account the heterogeneity and cross-section dependency, this test allows the variables included in the analysis to produce more reliable results. According to the findings, a one-way causality relationship is determined from R&D expenditures to unemployment in Turkey, while a one-way causality relationship is determined from unemployment to R&D expenditures in Azerbaijan. As a result, it is seen that there is an interaction between R&D expenditures and unemployment. Countries need to improve their production techniques to achieve their economic goals. This development will only accelerate with R&D studies. In order for innovative activities not to create unemployment problems, the population should be subjected to a quality education by paying attention to the organic composition of the capital and to ensure efficiency in resource-income distribution.

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