CHAPTER 6

Are Countries' R&D Expenditures Effective on Financial Development and Economic Growth?: An Application on Some Countries in the Developing Economies Class in Europe

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INTRODUCTION

In the twenty-first century, as in all countries of the world, a serious restructuring process has been experienced in countries with emerging economies. Technological innovations and inventions, which contribute greatly to both social and economic development, have played an important role in this structuring process. Countries that want to increase their financial diversity have started to reform their financial markets seriously, they have focused on the aim of realizing the financial liberalization and development, which gained momentum after 1980, by giving importance to open policies. In line with this purpose, the importance given to technological investments has started to increase and significant progress has been made in sustainable economic growth (Atamtürk, 2007).

It is seen that R&D expenditures have an effect on the financial development of countries depending on the economic events and technological developments that have developed in recent years. Countries think that the funds they use for R&D activities provide advantages in terms of manufacturing, employment, increase in national income and technological development. In order to take place in global markets and to keep up with the emerging competitive environment, many countries have turned to innovation and have started to support their activities within this scope through national policies. R&D activities are at the forefront of innovation activities that many businesses attach importance to. Within the scope of these activities, the expenditures of the countries increased; The understanding of transition from labor-intensive capital to technology-intensive capital has started to gain momentum (Knoll, 2003:3).

The accelerating financial liberalization in developing countries has created a basis for foreign investors to enter the market more easily, thus competition between countries has begun to increase. Depending on the increasing competition, financial investments

have also increased, so financial development has started to take place among the main objectives of the countries. For this reason, countries have begun to attach great importance to R&D expenditures. R&D expenditures, which are of great importance in the financial development of countries, contribute to the social, economic, political, etc. of the countries. may differ according to their circumstances. Again, situations such as the countries' financial liberalization and regulation policies, their desire to increase their financial instruments and usage have also been effective on R&D expenditures; revealed the fact that these two greatly influence each other (Ayouni et all., 2014; 678).

The fact that countries produce high value-added and technological products in exports in recent years increases the importance of R&D even more. For this reason, the share of R&D expenditures, which is the independent variable of the study, in GDP is important. In addition, developed countries are ahead of developing and underdeveloped countries in terms of technology, innovation and innovation. Therefore, developing and underdeveloped countries should attach as much importance to R&D as least developed countries.

The aim of the study is to investigate the effects of R&D expenditures on the financial development of countries in emerging economies. For this reason, research has been conducted on Some Countries in the Developing Economies Class in Europe. The 2003-2020 period was examined annually. Since there are two different dependent variables in the study, two models were established. In Model-1, the dependent variable is the indices in which the largest shares of countries are traded, representing financial development, and growth in Model-2. The independent variable is the ratio of R&D Expenditures to GDP. Westerlund cointegration test, MGE and AMG estimators were used as a method. The results of the study are expected to contribute to policy makers and academic studies in countries that follow innovations and focus on development.

LITERATURE

Recently, the importance of R&D activities and expenditures made in this context in terms of economic growth of countries has started to increase. Some of the national and international academic studies examining the relationship between R&D expenditures and financial development and economic growth from different perspectives are given below. Some of the studies that deal with and examine the relationship between R&D expenditures and financial development are as follows:

Chang et al (2005), in their study, wanted to examine the effects of these on the export performance of countries by taking into account the financial development levels and R&D expenditures of the countries. The researchers, who examined the 16 countries they included in their research with both theoretical and econometric findings, concluded that there is a positive relationship between R&D expenditures and financial development.

Hwang et al. (2010), based on macroeconomic indicators, mentioned the relationship between R&D activities and the financial system. The researchers, who reached the conclusion that there is a close bond between the two, argued that the efficiency and quality of the financial structure are closely related to R&D activities and that they affect each other positively.

Maskus et al. (2012) included 18 OECD countries and 22 manufacturing enterprises in their research, in which they examined the interaction between national and international financial market developments and R&D activities. As a result of the study, the R&D intensity for financial development at the national level; They concluded that foreign capital investments are effective for financial development from an international perspective. Another result obtained in the study is that there is a strong link between the application of different financing methods and R&D activities.

Meierrieks (2014) examined 51 developed and developing countries based on the years 1993-2008 in his study. In the study, it is aimed to reveal the effect of financial development of countries on innovation within the scope of R&D activities. In the study, it was concluded that positive increases in the level of financial growth strengthen R&D innovations.

Kocamış and Güngör (2014) examined the technology companies operating in Borsa Istanbul in this study, in which they wanted to investigate the effect of R&D expenditures on the profitability of enterprises. 16 companies were included in the research and as a result of the study, it was determined that there is a positive and significant relationship between R&D expenditures and firm profitability rates.

Ayaydın and Karaaslan (2014) wanted to examine the variables that affect the financial performance of companies in their study and focused on the impact of research and development investments in this direction. The researchers, who analyzed the data of 145 manufacturing companies traded in BIST for the years 2008-2013 using the GMM system estimator, determined that the intensity of R&D expenditures had a positive effect on the financial performance of the companies.

Yücel and Ahmetoğulları (2015) wanted to examine the effect of expenditures on R&D activities on the net profit changes and earnings per share values of the enterprises. In the study, technology, informatics and software companies registered in BIST were examined on the basis of a 14-year period. It is concluded that the effect on the earnings per share is lagged for three periods.Demirci (2017) examined the relationship between R&D expenditures and financial development level of private sectors in Turkey. The research was based on the periods between 1990 and 2014; preferred to use causality, cointegration, variance decomposition and impulse-response analysis methods. When the

findings obtained from the research were examined, it was revealed that there was a cointegrated situation between the two.

Tandoğan (2017), In the study, the effects of financial development on total factor productivity were examined based on Turkey between 1980 and 2015. In the study, in which the ARDL bounds test method was used, it was concluded that financial development greatly supported R&D expenditures and technological investments and were influenced by each other.

Ayaydın et al. (2018) investigated whether innovation and R&D expenditures in BRICS-TM countries have an effect on financial development. As a result of the study, it has been determined that there is a positive relationship between the financial development of innovation and R&D expenditures, and there is a one-way causality relationship from R&D expenditures to financial development.

Helhel (2018) used the Pedroni cointegration approach in his study, which deals with the relationship between financial development and R&D expenditures; E-7 analyzed country data. Another result obtained in the study, which concluded that there is a long-term relationship between R&D expenditures and financial development, is that financial developments have a positive effect on R&D expenditures.

Some of the studies showing the effect of R&D expenditures on the economic growth of their countries are given below:

Samimi and Alerasoul (2009) wanted to examine the effects of developing R&D activities on economic growth and included 30 developing countries in their studies. In their study using panel data analysis, they concluded that there is a statistically negative relationship between R&D expenditures and economic growth.

Yıldırım and Kesikoğlu (2012) aimed to reveal the relationship between R&D expenditures and exports by examining Turkey's 1996-2008 period. As a result of the study, it was determined that

there is a one-way causality relationship from R&D expenditures to exports. As a result of this determination, it has been concluded that R&D related policies can be a tool to be considered in increasing exports, but exports do not cause R&D expenditures.

Fung and Lau (2013), in the study in which the relationship between the incentives provided depending on the R&D expenditures and the economic growth of the countries was aimed to be examined, it was concluded that the incentives provided to carry out research and development activities had a positive effect on the economic growth of the countries.

Göçer (2013) used panel data analysis in the research based on the years 1996-2012 from Azerbaijan, China, S. Korea, India, Kazakhstan, Malaysia, Pakistan, Russia, Singapore, Thailand and Turkey. The aim of the research is to reveal the relationship between R&D expenditures and the export and economic growth of countries. In this context, the effects of expenditures on exports of high technology products, exports of information and communication technologies, total exports and economic growth, and the effect of exports of high technology products on foreign trade balance are examined. As a result of the research, it is concluded that a one percent increase in R&D expenditures increases the exports of high-tech products by six and a half percent, the exports of information and communication technologies by below zero point and the economic growth by zero point forty-three percent.

Dam and Yıldız (2016) investigated the relationship between R&D expenditures and innovation and economic growth. In line with this research, BRICS-TM countries were examined and as a result of the research, it was determined that there is a statistically positive and significant relationship between expenditures, innovation and economic growth.

Sungur et al. (2016), ; They examined the 1990-2013 Turkey data in their study, which aimed to analyze the impact on R&D

expenditures and all related exports and growth. As a result of the study in which Granger and Hatemi-J used the asymmetric causality test, it was determined that there were relations between the components.

As a result of the literature review, it is seen that there are studies on growth with R&D and different variables. However, there are almost no studies examining the relationship between R&D and financial development. This situation highlights the originality of the study. In addition, the use of both growth and financial development as the dependent variable, and the fact that different sample countries have been applied with different methods, differentiates the study from the studies in the literature and reveals its originality. It is expected to contribute to the literature with these aspects.

DATA AND METHODOLOGY

In this part of the study, the analysis findings of the variables of the countries will be included.

The aim of the study is to investigate the effect of research and development expenditures of some countries in the Developing Economies Class in Europe on the financial development and growth of the country. The information about the variables used is as follows:

Table 1. Variables Used in the Study

	Variable	**Formula**	**Reference**
RD	R&D Expenditures	R&D Expenditures of Countries/GDP	The World Bank
LogFD	Financial Development	Logarithm of Stock Market Indices of Countries	TR Investing
GDP	Growth Rate	GDP (%)	The World Bank

Since the stock market indices of the countries are in different amounts, the logarithm of the values is included in the analysis in order to make a healthy comparison and analysis. Countries in the emerging economies class in Europe constitute the sample countries of the study (Wikipedia, 2022). The sample countries and the stock market indices used to represent the financial developments of the countries are given below:

Table 2. Countries and Stock Indices Included in the Study

Country	Stock Market Index
Bulgaria	BES SOFIX
Hungary	Budapest SE (BUX)
Poland	WIG20
Romania	BET (BETI)
Russia	MOEX Russia (IMOEX)
Turkey	BIST-100
Ukraine	PFTS (PFTSI)

The period of the study was primarily determined as 1996-2020, and the 25-year period was considered, especially since the 2001 crisis was also included in the study. However, since some countries do not have financial development variables for the 1996-2002 period, the period of the study is 2003-2020 and the 18-year period has been examined. Since the problem of cross-section dependence between the variables exists for both models, secondary generation analysis techniques were used. In the cointegration test, which is based on the error correction model developed by Westerlund in 2007, two groups are expressed as average statistics and the other two groups are expressed as panel statistics. This method can be used if all series are stationary at the first difference (Westerlund, 2007, 718). In this method, the

relationship is investigated with four different panel cointegration tests. Of these four different tests, Gt and Ga represent the average group statistics, and Pt and Pa represent the panel statistics. At the root of these tests is to investigate the cointegration relationship as a result of each panel owning its own error correction. Taking into account the correlation between the panels, bootstrap simulations are used in this method (Yerdelen Tatoğlu, 2018: 200; Zeren, 2017:177).

In the case of a cointegration relationship, either causality tests or coefficient estimators are generally used in the literature. With these methods, the direction and degree of the relationship between the variables are determined. Parameter estimations averaged in the MGE estimator, which is one of these methods, are stable. However, it is known that this method includes the possibility of certain series and indicators being the same between groups (Özcan and Özer, 2018: 203; Şit, 2022: 98). For this reason, the AMG estimator was used as well as the MGE method. The AMG estimator technique, on the other hand, is a bitwise method that takes into account the common aspects of the variables as well as the common dynamic effects and enables the calculation of different coefficients between the sections (Göçer, 2013: 233; Acaravcı et al., 2015: 125). In the method, if the series is homogeneous, a coefficient is calculated for the panel in general, and if it is heterogeneous, a coefficient for the sections is calculated and the group average is calculated for the panel based on the weighted averages of these coefficients. The AMG test can be applied both in cases where the series are I(1) and in cases where the integration degrees are different (Songur, 2017: 127; Eberhardt, 2012). The basic equations of the two different models are as follows:

$$\ln FD_{i,t} = \beta_0 + \beta_1 RD_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$GDP_{i,t} = \beta_0 + \beta_1 RD_{i,t} + \varepsilon_{i,t} \quad (2)$$

The lnFD in Formula (1) represents the logarithmic values of the index values of the most traded shares of the countries representing

financial development, the share of R&D expenditures of R&D countries in GDP, the GDP in Formula (2), the growth rate of the countries in both formulas. represents the margin of error.

FINDINGS

The frequency values of the variables are given in Table 3:

Table 3. Statistical Values of Variables

Variable	Obs	Mean	Std. Dev.	Min.	Max.
R&D	126	0.8176821	0.2996818	0.38161	1.60766
FD	126	5042.532	8522.26	63.65667	41640.51
GDP	126	3.074605	4.35265	-15.13647	11.79535
LogFD	126	3.240456	0.6239314	1.803844	4.619516

As can be seen in Table 3, when the stock market indices of countries representing financial development are used in their raw form, it can be seen from the standard deviation value that there is a high difference in the stock market variables of the countries. When this value is taken as the logarithm, it is seen that the standard deviation has decreased considerably.

Table 4. Cross-Section Dependency Test

	Stat.	Prob
Model-1 (LogFD)	9.599	0.0000
Mode-2 (GDP)	10.964	0.0000

Since there is a cross-section dependency problem in both models, the analysis will be done with second-generation tests.

Table 5. CADF Unit Root Test

	t-bar	cv10	cv5	cv1	Z[t-bar]	P-value
LogFD	-1.037	-2.210	-2.340	2.600	-1.781	0.963
GDP	-1.946	-2.210	-2.340	-2.600	-0.555	0.289
R&D	-1.810	-2.210	-2.340	-2.600	-0.205	0.419

According to the unit root test results in Table 5, the fact that the statistical values of the variables are smaller than the critical values at 1%, 5% and 10% significance levels indicates that the variables are not stationary and have unit roots.

Table 6. Swamy Homogeneity Test

	Statistics	Prob.	Decision
Model-1 (LogFD)	1892.57	0.0000	The model is heterogeneous.
Mode-2 (GDP)	16.77	0.1584	The model is homogeneous.

The results of the Westerlund cointegration test to investigate the cointegration relationship between the variables are as follows:

Table 7. Westerlund ECM Panel Cointegration Test

	Value		Z-value		P-value	
Statistic	Model-1	Model-2	Model-1	Model-2	Model-1	Model-2
G_t	-4.385	-3.530	-6.683	-3.869	0.000 ***	0.000***
G_a	-19.495	-12.057	-3.022	-0.063	0.001***	0.475
P_t	-10.160	-8.807	-5.323	-3.747	0.000***	0.000***
P_a	-16.416	-13.957	-3.305	-2.216	0.001***	0.013**

******, ** denote 1% and 5% significance level, respectively. The AIC criterion was chosen as the lag length.***

According to both models, there is a cointegrated relationship between the variables in the long run. There is a long-term relationship between the financial development and growth rate, which are the dependent variables, and the ratio of countries' research and development expenditures to GDP.

AMG and MGE coefficient estimators were used to determine the direction and significance of this relationship. Analysis results are shown in Table 8.

Table 8. MGE Coefficient Estimator Results

	Coef.		**Std. Error**		**Prob**	
	Model-1	**Model-2**	**Model-1**	**Model-2**	**Model-1**	**Model-2**
Bulgaria	-0.3338534	-8.698711	0.2432479	4.411917	0.170	0.049 **
Hungary	0.5134064	-1.882589	0.1441134	3.605223	0.000 ***	0.602
Poland	-0.0488575	-3.322532	0.085498	1.75868	0.568	0.059*
Romania	1.815984	10.57368	0.7938865	22.19163	0.022**	0.634
Russia	-1.720141	-8.405996	0.5663083	13.63148	0.002***	0.537
Turkey	1.283835	-8.211441	0.130052	-8.211441	0.000***	0.086*
Ukraine	-0.4588288	11.86822	0.3109329	7.808822	0.140	0.129
Panel	0.1502206	-1.154196	0.4454775	3.35116	0.736	0.731

****, **, * denote 1%, 5% and 10% significance levels, respectively.***

According to the results of the Mean Group estimator developed by Pesaran & Smith in 1995; In the model, in which stock market indices are the dependent variable representing financial development, it is seen that R&D expenditures throughout the panel are not effective on the stock market. When viewed on a country basis; It is seen that R&D expenditures are effective on the financial development of countries at the 1% significance level in Hungary, Russia and Turkey, and at the 5% significance

level in Romania. While 1 unit increase in R&D expenditures of countries in Hungary, Turkey and Romania increased their financial developments by 0.51, 1.28 and 1.81, respectively, it decreased by 1.72 in Russia.

In Model-2, where the growth rate is the dependent variable, it is seen that the R&D expenditures are not effective on the growth throughout the panel. When viewed on a country basis; It is seen that R&D expenditures are effective on growth at the 5% significance level in Bulgaria and 10% significance level in Poland and Turkey. Unit increase in R&D expenditures in Bulgaria, Poland and Turkey reduces the growth rate by 8.69, 3.32 and 8.21, respectively. But since model 2 is homogeneous, the panel should be interpreted as a whole. That is, there is no relationship between the variables.

To consolidate the MGE estimator results, the Augmented Mean Group estimator (Eberhardt & Bond 2009; Eberhardt & Teal, 2010) results are listed in Table 9:

Table 9. AMG Estimator Results

	Coef.		**Std. Error**		**Prob.**	
	Model-1	**Model-2**	**Model-1**	**Model-2**	**Model-1**	**Model-2**
Bulgaria	-0.6259462	-0.7601832	0.2322716	2.545248	0.007***	0.765
Hungary	0.140428	6.774839	0.093988	2.500136	0.135	0.007***
Poland	-0.2847607	-1.088274	0.0371811	1.690322	0.000***	0.520
Romania	-0.5060069	11.91619	0.3184184	13.59934	0.112	0.381
Russia	0.112673	0.2012465	0.3473031	5.34954	0.746	0.970
Turkey	0.8861668	0.0802991	0.1322073	4.969999	0.000***	0.987
Ukraine	0.756167	-1.538032	0.2408142	4.711295	0.002***	0.744
Panel	0.0683887	2.226584	0.222844	1.935662	0.759	0.250

*** ***Indicates 1% significance level.***

According to AMG Estimator Results; In Model-1, it is seen that R&D expenditures are not effective on financial development throughout the panel. However, when viewed on a country basis; It is concluded that R&D expenditures in Bulgaria, Poland, Turkey and Ukraine have a strong effect on financial development at the 1% significance level. While a one-unit increase in R&D expenditures in Turkey and Ukraine increases financial development by 0.88 and 0.75, respectively, it decreases it by 0.62 and 0.28, respectively, in Bulgaria and Poland.

In Model-2, it was concluded that R&D expenditures were not effective on growth throughout the panel. However, it is concluded that R&D expenditures in Hungary have a strong effect on growth at the 1% significance level. In Hungary, 1 unit increase in R&D expenditures increases the growth by 6.77. Although there is a relationship for Hungary, it is seen that there is no relationship because the model is homogeneous.

RESULTS AND RECOMMENDATIONS

The role of growth and financial development, which are the basic economic barometers of countries, is inevitable. For the development of these indicators, countries are expected to prefer the way of producing technological and high value-added products. These productions will be possible by increasing the research and development activities of the countries. It would be preferable to increase the share of expenditures made by countries for research and development in their budgets.

The aim of this study is to investigate the effect of countries' research and development expenditures on the financial development and growth of countries. Analysis was made with 18 years of data for the 2003-2020 period. Some European Countries in the Developing Economies Class (Bulgaria, Hungary, Poland, Romania, Russia, Turkey, Ukraine) were chosen as the sample countries. The dependent variables are the stock market indices in which the largest

shares of countries are traded, representing financial development, and rates of change in GDP representing growth; As an independent variable, the share of countries' research and development expenses in GDP is taken. Westerlund ECM cointegration test, MGE and AMG estimators were used as a method.

As a result of the analysis, it is seen that there is a cointegrated relationship between R&D expenditures and financial development and growth in the long run. According to the MGE estimator results, it is seen that R&D expenditures are effective on the financial development of the countries at the 1% significance level in Hungary, Russia and Turkey, and at the 5% significance level in Romania. While 1 unit increase in R&D expenditures of countries in Hungary, Turkey and Romania increased their financial developments by 0.51, 1.28 and 1.81, respectively, it decreased by 1.72 in Russia. While R&D expenditures affect financial development more in Turkey and Romania, they affect less in Hungary. This can be explained by the fact that Hungary's R&D expenditures have less impact on the stock markets as a larger share is allocated in the budget. Russia is the country that allocates more money to research and development among the sample countries studied. For this reason, as these countries allocate a share above the average for R&D, their stock markets are adversely affected. This can be explained by the fact that if Russia invests in other investment areas instead of R&D, its stock markets can develop more. It is seen that R&D expenditures are effective on growth at the 5% significance level in Bulgaria and at the 10% significance level in Poland and Turkey. Unit increase in R&D expenditures in Bulgaria, Poland and Turkey reduces the growth rate by 8.69, 3.32 and 8.21, respectively. In this situation, it is expected that the budget deficit will increase if the R&D expenditures of the countries increase in the GDP, and the expected return from the R&D expenditures or if the goal is not achieved, it will have a negative effect on the growth.

According to the AMG estimator results, it is concluded that R&D expenditures in Bulgaria, Poland, Turkey and Ukraine have

a strong effect on financial development at the 1% significance level. While a one-unit increase in R&D expenditures in Turkey and Ukraine increases financial development by 0.88 and 0.75, respectively, it decreases it by 0.62 and 0.28, respectively, in Bulgaria and Poland. These results support the MGE results. In other words, while the stock markets are positively affected by this ratio in countries with lower R&D expenditures, which are allocated in GDP, countries with higher shares are negatively affected. It is concluded that R&D expenditures in Hungary have a strong effect on growth at the 1% significance level. In Hungary, 1 unit increase in R&D expenditures increases the growth by 6.77. As R&D expenditures positively affect the growth rate in Hungary, it is expected that Hungary, which aims for a higher growth rate, will increase the share of R&D expenditures in GDP.

In summary, since the first model is heterogeneous, there is a relationship between variables on the basis of countries. However, since the second model is homogeneous, although there is a relationship for countries, there is no relationship between variables because there is no relationship across the panel. The main limitation of the study can be stated that the study was only applied to some countries in the Developing Economies class in Europe, and the lack of research on other countries. While the findings obtained from the study gave results in parallel with the study of Meierrieks (2014), Chang et al. (2005), Hwang et al. (2010), Tandogan (2017), Ayaydın et al. (2018) gives partially similar results with their studies. The study can be improved by increasing the number of sample countries, the number of periods and applying different methods.

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