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DETERMINANTS OF R&D EXPENDITURE: AN EMPIRICAL EVIDENCE OF BULGARIA

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Abstract. Small and medium-sized enterprises (SMEs) place importance on the development of the global economy. Over 90% of the enterprises in the territory of the EU and in Bulgaria are of the SMEs type. The activity of SMEs is essential for the development of the economy of each country. The report aims to analyze the relationship between innovation expenditures of small and medium-sized enterprises (R&D_EXP_SMEs), real economic growth (R_GDP), index of economic freedom (IND_ECO_FRI) and corruption perceptions index (COR_PER_IND) for economy of Bulgaria. Annual data for the period 2000–2020 with 21 observations included were used. An econometric method Ordinary Least Squares (OLS) was applied. The results of the empirical research show that the positive coefficient of the corruption index, index of economic freedom and real economic growth leads to an increase in the expenditure for R&D of SMEs in Bulgaria. It can be concluded that the corruption perceptions index, index of economic freedom and real economic growth has an important role for the increase of the R&D expenditure of SMEs in Bulgaria. If the government wants to stimulate R&D expenditure of SMEs, it should implement policies to increase economic growth and decrease of the corruption in Bulgaria.

Keywords: SMEs, R&D, Real economic growth, Corruption perceptions index, Index of economic freedom.

JEL Classification: O30, O38, H30, L20.

Introduction

In current conditions, companies that implement innovations have an advantage, which allows them to increase the efficiency of business management significantly. Sustaining innovation in new products and improving existing products is vital. The creation of effective economic (market and non-market) mechanisms for continuous development, improvement and production of new competitive goods and services in enterprises is a prerequisite for sustainable innovative development of the country. Innovation has been intriguing to researchers, theorists, and practitioners for decades. The term innovation is derived from the Latin "innovation", meaning novelty or previously unknown scientific innovation. In the contemporary world, the term "innovation" is associated with the scientific works of Schumpeter (1934). He indicates that productions and industries must often revolutionize the scientific and technological process in order to achieve efficiency in the processes and the products created. According to Drucker (1985) innovation is primarily associated with the human and material resources of the enterprise, through which wealth is created. He believes innovation is the priority of entrepreneurship since resources in the organization acquire new capabilities to create wealth. According to Farinha, Ferreira, and Gouveia (2014) innovations, today are a key component for managing global competitiveness and companies must deal with the creation of new products and services. In this context, it can be stated that small and medium-sized enterprises (SMEs) are major tools for creating innovations and innovative products.

In this regard Danko et al. (2020) emphasizes that in most industries, SMEs cannot survive without continuous production of new products. SMEs need new products that are a source of growth and help maintain a balanced product mix. In every SME, it is necessary to provide conditions for the introduction of innovations, which is why it must have such a structure and processes that assume and implement appropriate innovative behavior. The innovative activity of SMEs is the main driving force for rationally determining the type

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and assortment of manufactured products, as well as the quality and competitiveness of individual products. "Innovation activity is the set of principles, methods and means for the selection and implementation of strategies and tactics for the continuous implementation of innovations in terms of products, technologies and organizational management practices, and innovations are the only means of the company to create competition and survive in the conditions of competition."

The innovative development of the enterprise is considered as a set of activities that are carried out purposefully and lead to organizational and production changes and expand the market opportunities of enterprises. The main goals of the innovative development of the enterprise are: to increase the competitiveness, economic and financial condition of the object of development; to improve the production process; to create new knowledge-based products/services; to create new organizational structures.

It is important to indicate that the innovation development of SMEs should be designed like any other system. It is necessary not only to identify the challenges facing SMEs and their management but also to create a system that will ensure the transition of SMEs to the desired state and determine the necessary R&D expenditures.

The main purpose of the study has to analyses the R&D expenditure of SMEs in Bulgaria.

In the particular context, it is possible to summarize the main points of the research:

- To analyses the theoretical foundations of innovation.
- To summarizes an relevant research in this field.
- To estimate empirically the impact of the real economic growth (R_GDP), index of economic freedom (IND_ECO_FRI) and corruption perceptions index (COR_PER_IND) for economy of Bulgaria.

The empirical results are discussed and argued in the context of other international studies The conclusion underlines the crucial findings and further challenges of the research. On this base are formulate suggestions for increase of the R&D expenditure of SMEs in Bulgaria, according the empirical results.

1. Literature review

A study by Subhan, Mahmood, and Sattar (2014) confirmed a positive relationship between innovation and economic growth. With a linear regression for the period 1980–2013 for the economy of Pakistan, they prove that registering patents and trademarks increases the economic growth of the country. Pece, Simona, and Salisteanu (2015) confirmed a positive connection between economic growth and innovations for the economies from Central and Eastern Europe, namely: Poland, Czech Republic and Hungary. Maradana et al. (2017) examines the long-run relationship between innovation and per capita economic growth in the 19 European countries over the period 1989–2014. They used six different indicators of innovation: patents-residents, patents-non-residents, research and development expenditure, researchers in research and development activities, high-technology exports, and scientific and technical journal articles to examine this long-run relationship with per capita economic growth. Confirmed that all these innovation indicators are considerably linked with per capita economic growth.

Mahagaonkar (2008) examined the relationship between innovation and corruption ratio in 3477 firms of different African countries from 2002 till 2004. Confirmed that the corruption has a negative effect on product innovation and organizational innovation. Corruption does not affect process innovation while it facilitates marketing innovation. Kabadurmus (2017) for twenty seven Eastern European and Central Asian countries empirically proved that corruption has a positive effect on the rate of innovation form 2002 till 2005. Nguyen (2021) examine the influence of the corruption for 36 countries in 2019. He confirms that the grand corruption tends to harm the innovation, while petty corruption enhances innovation. Pluskota (2020) with GMM for the period 1996–2017 empirically confirmed that the relationships between corruption and the measure of innovation, and corruption and economic growth are not linear. This means that the influence of corruption on innovation and economic growth is not the same for all levels of the corruption indicator, Viglioni, Ferreira, Aveline, and Alcântara (2022). The with dynamic panel data for local private and public firms from Latin American countries (Brazil, Chile, Mexico and Peru) during 2012–2019 using generalized method (GMM) confirmed negative effect of long-term R&D investments on firms performance. The main findings show that high levels of corruption harm even more long-term innovative activities. Pirtea, Sipos, and Ionescu (2019) confirmed for the period between 2002 and 2014 using the generalized linear model for 110 emergent countries that the corruption at governmental structures and institutional level has a significant negative impact on business innovation, adversely affecting innovation perspectives.

2. Methodology and empirical results

The relationship between the research and development expenditure of SMEs (R&D_EXP_SMEs), real economic growth (R_GDP), index of economic freedom (IND_ECO_FRI) and corruption index (IND_COR) for economy of Bulgaria was empirically investigated. Annual Eurostat and World Bank data for the period 2000–2020 were used, with 21 observations included. The dependent variable in the OLS model is (R&D_EXP_SMEs). The empirical analysis was performed in the following sequence: Applying of the natural logarithm; Summary Unit Root Test (Table 1); Pairwise Granger Causality Tests (Table 2, Table 3, Table 4); Correlation Test (Table 5); Applying of econometric method- (OLS- Table 6); Serial correlation

test – Breusch-Godfrey Serial Correlation LM Test (Table 7); Heteroscedasticity Test: Breusch-Pagan-Godfrey (Table 8); Ramsey RESET Test (Table 9); Dynamic stability of the model test – CUSUM test (Figure 1); Normal distribution of residuals test – Jarque-Bera statistics (Figure 2). Table 1 shows Summary Unit Root Test of the variable.

Table 1. Summary Unit Root Test of R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR (source: authors' calculation)

Method	Statistic	Prob.	Cross-sections	Obs.
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	–2.60816	0.0046	4	80

The Summary Unit Root Test of R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR (Table 1) shows that the variables are stationary as a group. Table 2, Table 3 and Table 4 shows the results of the Pairwise Granger Causality Test between R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR.

The Granger Test shows (Table 2) the presence of statistically significant causal relationships between R&D_EXP_SMEs and R_GDP at 1 lag. The null hypothesis should be rejected, which is a reason to state that the causal relationships are from real economic growth to R&D_EXP_SMEs in Bulgaria. Therefore, real economic growth is a Granger cause of the R&D expenditure of SMEs in Bulgaria. This means that the increase of the real economic growth leads to an increase in the R&D expenditures of SMEs in Bulgaria.

The Granger Test shows (Table 3) the presence of statistically significant causal relationships between R&D_EXP_SMEs and IND_ECO_FRI also at 1 lag. Therefore, index of economic freedom is a Granger cause of the R&D expenditure of SMEs in Bulgaria. This means that the increase of the index of economic freedom leads to an increase in the R&D expenditures of SMEs in Bulgaria.

The Granger Test shows (Table 4) the presence of statistically significant causal relationships between R&D_EXP_SMEs and IND_COR at 3 and 4 lags. Therefore, index of corruption is a Granger cause of the R&D expenditure of SMEs in Bulgaria. This means that the rise of the index of corruption leads to an increase in the R&D expenditures of SMEs in Bulgaria. Table 5 shows the correlation between R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR.

The correlation between R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR shows the presence of a positive and high value. The value between R&D expenditures of SMEs and the index of economic freedom is the highest. The values between SME R&D expenditure, the corruption index and real economic growth are lower. Therefore, a positive amendment in the index of economic freedom, the index of

Table 2. Pairwise Granger Causality Test of R&D_EXP_SMEs and R_GDP (source: authors' calculation)

Null Hypothesis:	Lags	Obs.	F-Statistic	Prob.
REAL_GDP does not Granger Cause RD_EXP RD_EXP does not Granger Cause REAL_GDP	1	20	6.00022 1.37639	0.0254 0.2569
REAL_GDP does not Granger Cause RD_EXP RD_EXP does not Granger Cause REAL_GDP	2	19	2.45434 0.49423	0.1220 0.6203
REAL_GDP does not Granger Cause RD_EXP RD_EXP does not Granger Cause REAL_GDP	3	18	1.87381 0.16360	0.1925 0.9186
REAL_GDP does not Granger Cause RD_EXP RD_EXP does not Granger Cause REAL_GDP	4	17	1.31134 0.11736	0.3439 0.9725
REAL_GDP does not Granger Cause RD_EXP RD_EXP does not Granger Cause REAL_GDP	5	16	2.74073 0.48440	0.1463 0.7774

Table 3. Pairwise Granger Causality Test of R&D_EXP_SMEs and IND_ECO_FRI (source: authors' calculation)

Null Hypothesis:	Lags	Obs.	F-Statistic	Prob.
IND_ECO_FRI does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_ECO_FRI	1	20	2.60645 3.10447	0.1248 0.0960
IND_ECO_FRI does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_ECO_FRI	2	19	0.82094 2.70095	0.4601 0.1019
IND_ECO_FRI does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_ECO_FRI	3	18	0.51863 1.31487	0.6781 0.3188
IND_ECO_FRI does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_ECO_FRI	4	17	0.37442 0.94323	0.8209 0.4865
IND_ECO_FRI does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_ECO_FRI	5	16	0.27777 1.56625	0.9070 0.3172

Table 4. Pairwise Granger Causality Test of R&D_EXP_SMEs and IND_COR (source: authors' calculation)

Null Hypothesis:	Lags	Obs.	F-Statistic	Prob.
IND_COR does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_COR	1	20	0.26144 2.46255	0.6157 0.1350
IND_COR does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_COR	2	19	0.19478 2.42404	0.8252 0.1247
IND_COR does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_COR	3	18	0.34749 1.42010	0.7917 0.2893
IND_COR does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_COR	4	17	3.87778 2.21861	0.0488 0.1568
IND_COR does not Granger Cause RD_EXP RD_EXP does not Granger Cause IND_COR	5	16	6.08706 3.33955	0.0347 0.1059

Table 5. Correlation Matrix of R&D_EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR (source: authors' calculation)

	R&D_ EXP_ SMEs	R_GDP	IND_ ECO_FRI	INDEX_ COR
R&D_EXP_ SMEs	1	0.474804	0.676506	0.583873
R_GDP		1	–0.431062	–0.153284
IND_ECO_ FRI			1	0.431979
IND_COR				1

corruption and real economic growth lead to a positive amendment in the R&D expenditure of SMEs in Bulgaria.

As it was proven (Table 1) the variables of R&D_ EXP_SMEs, R_GDP, IND_ECO_FRI and IND_COR are stationary as a group of base values and in this case a cointegration test is not applied. The modelling of the OLS model has the following form:

$$y = \beta_0 + \beta_1 X + \beta_2 X + \beta_3 X + \varepsilon\,, \qquad (1)$$

where: y – dependent variable (R&D expenditure of SMEs); β_0 constant; $\beta_1 X$ – independent variable (real economic growth- R_GDP); $\beta_2 X$ – independent variable (index of economic freedom – ND_ECO_FRI); $\beta_3 X$ – independent variable (corruption index – IND_ COR); ε – residuals.

The results of the equation of the **OLS** method with dependent variable **R&D_EXP_SMEs** are presented in Table 6.

The included variables in the OLS equation are statistically significant. The variables of R&D_EXP_SMEs, IND_ECO_FRI and IND_COR in the OLS equation are statistically significant at 5% critical level. The variable of R_GDP is statistically significant at 10% critical level. The relationship between the variables is a positive. The results show that the corruption index in Bulgaria (IND_ COR) has the highest value (0.228527). The positive coefficient of the independent variable IND_COR means that its increase leads to an increase in R&D expenditure of SMEs in Bulgaria. Therefore, unit decrease of the corruption in Bulgaria lead to increase of R&D expenditure by 22.8%. Similar findings are confirmed of Suleimenova, Sadvokassova, Rakisheva, and Nurmaganbetov (2018), Adomako et al. (2021), Kanu (2015). They proved that corruption decrease the SMEs activity.

Empirical analysis shows that the variables of index of economic freedom and real economic growth are positive. A positive value of the index of economic freedom leads to an increase in R&D expenditure by 12%. The similar conclusions are confirmed of Gohmann, Hobbs, and McCrickard (2008), Bradley and Klein (2016).

Table 6. OLS econometric estimation results (Eq. (1)) (source: authors' calculation)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–1.027361	0.424323	–2.421177	0.0269
R_GDP	0.012567	0.358812	2.126107	0.0719
IND_ECO_FRI	0.120167	0.053494	2.246359	0.0383
IND_COR	0.228527	0.104438	2.188161	0.0429

R-squared	0.609002	Mean dependent var	0.601054
Adjusted R-squared	0.540002	S.D. dependent var	0.166516
S.E. of regression	0.112936	Akaike info criterion	–1.354339
Sum squared resid	0.216829	Schwarz criterion	–1.155383
Log likelihood	18.22056	Hannan-Quinn criter.	–1.311161
F-statistic	8.826162	Durbin-Watson stat	2.107456
Prob(F-statistic)	0.000945		

The value of Real economic growth is (0.012567) and lead to an increase in SMEs expenditure by 1.2%. The similar conclusions are confirmed of Beck, Asli, and Levine (2003), Surya et al. (2021).

The value of the coefficient of determination (R-squared = 0.60) means that 60% of the change of the R&D_EXP_SMEs in Bulgaria can be explained through the changes of the independent variable.

The probability of the F-statistic (0,00) indicates that the alternative hypothesis of the adequacy of the model used is confirmed.

The test for an absence of a serial correlation of disturbances shows that the null hypothesis is valid in Eq. (1) (see Table 7). The results from the heteroscedasticity test on the residuals in the VEC model (see Table 8) is reason to accept the null hypothesis for lack of heteroscedasticity. In Table 9, the results for the model specification show that the null hypothesis should also be accepted.

Table 7. Results from the serial correlation test of residuals in Eq. (1) (source: authors' calculation)

F-statistic	1.692561	Prob. F(2,42)	0.2174
Obs*R-squared	3.866580	Prob. Chi-Square(2)	0.1447

Table 8. Results from the heteroscedasticity test of residuals in Eq. (1) (source: authors' calculation)

F-statistic	0.066890	Prob. F(4,44)	0.9767
Obs*R-squared	0.244995	Prob. Chi-Square(4)	0.9700

Table 9. Results from the specification of the model (Ramsey RESET Test) (source: authors' calculation)

t-statistic	1.223918	16	0.2387
F-statistic	1.497974	(1, 16)	0.2387
Likelihood ratio	1.879424	1	0.1704

The results from the CUSUM test (Figure 1) prove that Eq. (1) is steady in a dynamic time plan. The actual values of CUSUM are within the frames of the confidence interval at a 5% level of significance.

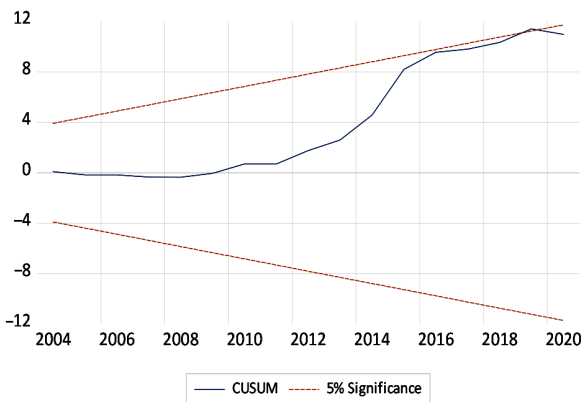

Figure 1. CUSUM test for dynamic stability of Eq. (1) (source: authors' calculation)

The probability of Jarque-Bera statistics is 0.32 (see Figure 2), which justifies the acceptance of the null hypothesis of normal distribution of the residuals in Eq. (1).

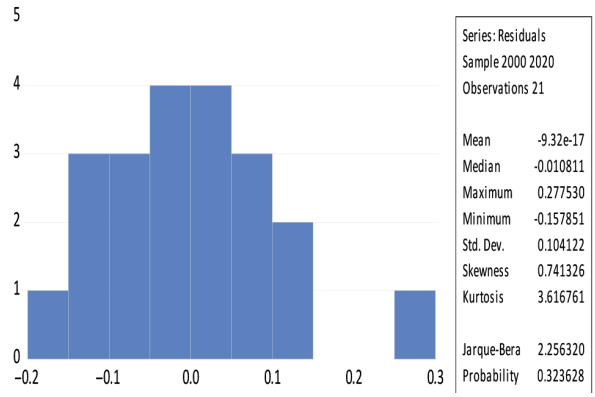

Figure 2. Test for normal distribution of residuals in Eq. (1) (source: authors' calculation)

Conclusions

Several important conclusions can be drawn from the empirical analysis.

The relationship between the variables of R&D expenditure, real economic growth, index of economic freedom and index of corruption for the economy of Bulgaria for the period 2000–2020 is positive and statistically significant.

The increase in real economic growth stimulated small and medium-sized enterprises (SMEs) in Bulgaria to increase R&D expenditure by an average of 1.2%. The decrease in corruption rate in Bulgaria encourages SMEs to increase their R&D spending average by 22.8%. Increasing of economic freedom in Bulgaria stimulates SMEs to spend on R&D by an average of 12%. As can be seen, reducing corruption has the biggest impact on R&D expenditure by SMEs. Based on these results, SMEs can to increase their R&D expenditure policy.

If governments increase real economic growth and economic freedom and reduce levels of corruption, these policies lead to an increase in R&D spending by SMEs. Therefore, the government should to implement policies which provide long-term economic growth, low levels of corruption, and a wide range of economic freedom.

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