“Determinants of innovativeness of Slovak SMEs”

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DETERMINANTS OF INNOVATIVENESS OF SLOVAK SMEs

Abstract

The integration of the Slovak Republic into the European Union and the globalization process create conditions that significantly reduce barriers to entry into particular markets, but, on the other hand, enhance the intensity of competition. The relevance of the study lies in the extent of the European Union's support for the effectiveness of innovation activities in Slovakia. This paper investigates the influence of endogenous and exogenous factors on the competitiveness of Slovak enterprises over the period 2006–2018. The study is aimed at determining the causal relationship of factors that determine the competitiveness of enterprises. To investigate the relationship between the endogenous and exogenous factors, the Granger causality method is used. Mathematical models are used to identify the relationship between innovation expenditures on the one hand and different types of innovation activity with market expansion on the other. The results of the study provide a statistically significant relationship between the performance measured by the percentage of revenues of enterprises that have introduced innovations with a two-year lag and the concentration measured by the total R&D expenditure of an enterprise. The results of this study should also be used to ensure that, in the case of the Slovak SME sector, R&D expenditure is a significant driver of innovation in enterprises, as innovation in enterprises is expected to improve the quality of products and services, increase profits and expansion in domestic and foreign markets.

Keywords innovation activity, sector analysis, Granger causality, innovation environment, small and medium-sized enterprises

JEL Classification M21, O31, O32

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INTRODUCTION

Innovation is a key mainspring of economic growth. Through innovation, enterprises can create new markets, increase their competitiveness and efficiency and ensure themselves higher economic growth. In the current turbulent time characterized by a high degree of openness, enterprises are forced to innovate to a much greater extent than in the past. R&D innovation and new knowledge are considered to be a way out of the economic crisis. Many of the European Union member states have high intellectual potential, but most of them do not have sufficient funds to conduct the necessary research and development, provide innovative activity and market innovation. The lack of funding is manifested in the tertiary sector of science, R&D, and in the case of individual enterprises that find it difficult to innovate and improve their production facilities. The European Union has been addressing the issue of R&D and innovation for a long time. It is clear that all these issues contribute to a country's economic growth, initiate job creation and increase its competitiveness. There are many obstacles linked to enterprise innovation in Slovakia such as the lack of financial resources (both own and foreign) or the quality of personnel capacities, which in many cases is considerably limited. In Slovakia, the share of enterprises that use innovation has a long-term declining trend, despite the

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growing volume of funds spent on research and development. In comparison with global or European innovation leaders, the innovation activity in Slovakia lags significantly behind in almost all evaluated areas. According to the European Commission (RIS, 2019), Slovakia took place below the EU average in evaluating innovation performance. Despite the year-to-year improvement by one place in the position of Slovakia within the EU27, the value of the innovation score of Slovakia has been decreasing from year to year. This indicates that innovation activities are not improving in Slovakia and therefore this topic is more than relevant and current. These objectives take into consideration individual conditions and characteristics of each member state. Europe 2020 set a target of increasing investment in R&D to 3% of GDP by 2020. Innovative small and medium-sized enterprises (SMEs) play a key role in the development of knowledge-based economies.

1. LITERATURE REVIEW AND ANALYSIS

Innovation is the most important factor to improve and maintain competitiveness, generate job creation and improve the quality of life (Kaufmann et al., 2012; Tilford & Whyte, 2010). Therefore, promoting innovation is one of the primary objectives of the EU development policy (Lundvall & Lorenz, 2011; Kovaľová & Klučár, 2017; Chehabeddine & Tvaronavičienė, 2020). Globalization and integration of Slovakia into the European Union shaped new economic conditions that have increased the intensity of competition, but they also significantly reduced barriers to market entry (Kotaskova & Rozsa, 2018; Halasi et al., 2019; Milošovičová et al., 2018). To maintain the market position and competitiveness, companies must constantly adapt to market changes, whether it is a change in consumer preferences or in the behavior of competitors. Thus, the competitiveness of enterprises is affected by many endogenous and exogenous factors. The innovation activity of the business determines the competitive ability of the organization (Hudáková et al., 2017; Kijek et al., 2013). Innovation represents fundamentals for the economic expansion that are crucial for the development and survival of the organization (Acs et al., 2002; Kovaľová et al., 2018; Čižo et al., 2020; Vekic et al., 2020). Knowledge-based societies are characterized by transferring and using knowledge and innovation (Mura & Mazák, 2018; Havierniková et al., 2017). Innovation is a crucial element of a knowledge-based economy, because creating, exchanging and the market success via innovation are source of growth of many economic indicators and the prosperity of society (Mucha, 2019; Virglerova et al., 2020; Stock et al., 2002; Cvetanovič & Despotovič, 2014).

Many studies are the most important resource of the competitiveness, job creation (Lazikova et al., 2018; Mészáros & Divékyová, 2019; Haviernikova et al., 2019; Hao et al., 2020) and economic growth (Zamanbekov et al., 2020; Milovic et al., 2020). Their willingness and capacity to innovate are crucial to the benefit of the organization and the economy. Innovative SMEs can be easily involved in the acquisition activity not as the passive but pro-active players (Metzker & Streimikis, 2020; Funta, 2012). Positive changes that reduced structural weaknesses of SMEs, e.g. limited possibility to achieve economies of scale, accelerated the importance of SMEs in innovation proceedings (Prokopenko et al., 2014; Prokopenko et al., 2018).

The dynamic development of SMEs is one of the basic pillars of the market economy of every developed country (Prasetyo & Kistanti, 2020; Pimonenko et al., 2017). The studied segment of the national economy in Slovak Republic accounts for 99.89 % of the total number of companies, which provides employment opportunities for almost three quarters (73.8%) of actively working groups in the companies and about the larger half (53.6%) in the creation of the added value. SMEs and family SMEs play a very important role in the field of employment (Horecký & Blažek, 2019; Pekerşen, & Tugay, 2020; Kiselyova, 2020). 96.9% of SMEs are the enterprises with a small number of employees (less than 10). They conduct their activity mainly in services, trade and construction. The implementation of the research and development activities is one of the basic prerequisites for the maintaining of the Slovak economy competitiveness (Bajzíková & Bajzík, 2020). Various indicators are used to assess the R&D status, one of the most used is the assessment of R&D spending and structure. SMEs finance the research and de-

Source: Authors' calculations.

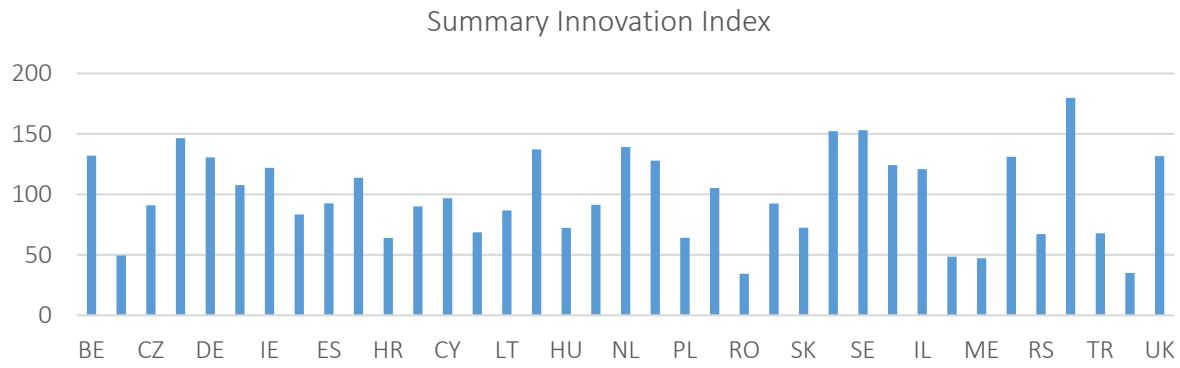

Figure 1. European innovation scoreboard 2019

velopment activities from their own profit. In 2017, these resources covered almost three quarters (73.0%) of total R&D expenditure for SMEs. The share of state resources accounted for 15.0%, and the foreign funding sources accounted for 12.0% of the SME R&D expenditure.

Compared to other EU countries, Slovakia is one of the EU countries with a relatively small share (38.3%) in the expenditure on research and development in the SME sector. The higher share of R&D expenditure is recorded by small and medium-sized enterprises in EU countries such as Cyprus (76.4%), Portugal (46.9%) and Hungary (45.6%). The lowest rates are in Germany (8.6%), the United Kingdom (23.0%) and Denmark (26.9%). The Slovak Republic is one of the countries with the lowest performance in the field of R&D activities of SMEs. Romania (0.07%), Cyprus (0.08%) and Greece (0.11%) have lower R&D expenditures in GDP (0.13%) than in the Slovak Republic. The highest ratios are reported by Slovenia (0.73%), Belgium (0.7%) and Denmark (0.51%). Slovak SMEs also lag behind other V4 countries. In Hungary, R&D expenditure in GDP reached 0.46%, 0.37% in the Czech Republic, and 0.17% in Poland. Innovation is a term used for a technological invention that is related to the development of new products or new production processes (Kijek, 2013). The first economist to focus on innovation goals was Joseph Schumpeter. He specified five kinds of innovation: the introduction of a new product or a change in the quality of an existing product, implementation of innovative production processes, acquisition of another and more efficient source of supply of domestic resources, and introduction of an innovative industrial organization (Schumpeter, 1934). Innovation can also be the result of a response to changes in the external environment or a preventive action affecting the environment (Mansfield, 1968). In some EU countries, there may be significant differences in overall innovation performance and performance across dimensions. On average, the EU's innovation performance has increased by 8.8% since 2011. Since 2011, innovation performance has increased in 25 EU member states. Performance increased the most in Lithuania, Greece, Latvia, Malta, the United Kingdom, Estonia and the Netherlands, and decreased the most in Romania and Slovenia. Figure 1 shows EU countries' innovation index in individual dimensions.

Innovation in small and medium-sized enterprises is the driving force behind economic growth. In comparison with global or European innovation leaders, the innovation activity of the Slovak Republic lags significantly behind in almost each of the evaluated areas. Slovak SMEs have significant shortcomings in the implementation of business innovations, which results not only from the internal but also the external environment. Apart from limited investment in innovation, they do not pay enough attention to new trends in digitization and R&D.

2. AIMS, HYPOTHESES AND RESEARCH VARIABLES

The paper deals with the assessment of the problem of innovation, its impact on family businesses and expenditure on innovation in the SME sector. It is very important to examine the causality of the rela-

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tionship between spending on types of innovation activities and the impact of innovation on market expansion. The study focuses on the effectiveness of financial support for innovation. The aim of this study is to verify the basic hypothesis that declares the existence of causal relationships between the most problematic areas of innovation such as finance and support, the innovation environment and the underperformance of enterprises, using established independent and dependent variables. The following hypothesis is formulated to achieve this goal:

H0: The most problematic areas in the field of innovation are finance and support, barriers to the innovation environment and insufficient competitiveness of enterprises represented by the set variables.

Adequate data has to be collected to analyze the relationship between innovation and enterprises. The variables used in the analysis are as follows: the percentage of revenues of organization that introduced innovations (P_2), the percentage of enterprises that implemented product innovation developed by other enterprises or institutions (P_7), and the percentage of enterprises that developed process innovation (P_8). The following variables were used as explanatory variables: total expenditure in extramural R&D at the enterprise (X_2), total expenditure of acquiring external knowledge (X_3), total spending on purchasing machinery, equipment, software and buildings (X_4).

3. METHODOLOGY AND DATA

The innovation statistical survey methodology is being developed as part of the process of implementing the statistical methodology of the EU member states. It is based on the OSLO manual methodology of OECD/Eurostat and it is harmonized with the Community Innovation of the EU member states. It refers to issues of product and process innovation, on-going and completed innovation activities and R&D spending. Enterprises are defined as statistical units in this study, and the set of the reporting detachment is based on the official statistical business register as a combination of transparent and stratified survey sample in specific sectors of economic activity.

According to the Eurostat methodology, the survey involves all organizations with main economic activities in important industry sectors, e.g. construction and services (NACE, Rev. 2): deep charging (05-09), industrial production (10-33), electricity, gas and water supply (35-39), construction (41-43), wholesale without vehicles (46), logistics, transport (49-53), communication services (58-63), banking, insurance (64-66), engineering (technical services) (71), research and scientific development (72), marketing.

The variables are analyzed according to the methodology of the Community Innovation Survey, and they are introduced bellow. Innovation expenditure represents all spending concerning scientific, technological and commercial steps thanks to which there is an implementation of new or significantly innovative products or improved processes, expenditure on on-going or abandoned innovation. The study also takes into account the costs of intramural and extramural research and development, the cost of acquiring external knowledge, costs of machinery, equipment, software and buildings.

The data is obtained from the Statistical Office of the Slovak Republic as a result of the innovation survey Inov1-99 and Inov1-92 from the years 2006–2018. Content of the survey is related to the reference periods 2006–2008, 2008–2010, 2010–2012, 2012–2014, 2014–2016, and 2016–2018.

As a proper method, a regression model is applied in the form of Granger test- causality. The Granger causality is a method for detecting causality between the subjects of the variables. In this study, the observed data are the values that represent time series. Granger (1969) introduced several models that can help determine what kind of causality results from the variables. One of these models Granger introduced is an autoregressive model with distributed delay. The Granger causality test is used to test a zero hypothesis, where one variable does not affect the second variable in the Granger sense. This null hypothesis is confirmed if the p-value is higher than the selected level of significance (e.g. 0.05). It is necessary to adopt an alternative hypothesis, which is a matter of determining how the selected variable affects another variable.

The null hypothesis for Granger non-causality test from x to y is as follows:

$$H0: \quad \beta_i = 0, \forall\, i = 1, 2, 3, \ldots n, \quad (1)$$

For many variables, the simple causal model is:

$$\begin{aligned} X_t &= a_1(U)X_t + b_1(U)Y_t + c_1(U)Z_t + \varepsilon_{1,t}\ , \\ Y_t &= a_2(U)X_t + b_2(U)Y_t + c_2(U)Z_t + \varepsilon_{2,t}, \\ Z_t &= a_3(U)X_t + b_3(U)Y_t + c_3(U)Z_t + \varepsilon_{3,t}, \end{aligned} \quad (2)$$

As $\varepsilon_{i,t}$, $i = 1, 2, 3, \ldots n$ are uncorrelated. For $\alpha = a_1 - 1$, $\beta = b_1 - 1$, $\gamma = c_3 - 1$ and

$$A = \begin{bmatrix} \alpha & b_1 & c_1 \\ a_2 & \beta & c_2 \\ a_3 & b_3 & \gamma \end{bmatrix} \quad (3)$$

$$\text{where } k = \begin{bmatrix} \sigma_1^2 & 0 & 0 \\ 0 & \sigma_2^2 & 0 \\ 0 & 0 & \sigma_3^2 \end{bmatrix}.$$

The causalities between X_t and Y_t:

$$C_r^{xy,z}(\omega) = = -\frac{\left[\sigma_1^2\sigma_2^2 b_3 a_3 + \sigma_1^2\sigma_1^2\beta a_2 + \sigma_2^2\sigma_3^2 b_1\alpha\right]}{f_z^{'}(\omega)}, \quad (4)$$

where

$$\begin{aligned} f_z^{'}(\omega) &= \sigma_1^2\left|\beta\gamma - c_2 b_3\right|^2 + \\ &+\sigma_2^2\left|c_1 b_3 - b_1\gamma\right|^2 + \sigma_3^2\left|b_1 c_2 - c_1\beta\right|^2. \end{aligned} \quad (5)$$

This condition has to be confirmed before the Granger test of causality is used.

The condition is that the given data are stationary. The stationarity means that the probability function does not depend on time. It is important not to meet the condition of stationarity at the original level in the Granger analysis, however, it must be confirmed for the first differences. To determine the stationarity of the given variables that represent the subjects of interest, the Augmented Dickey-Fuller test (ADF) test was chosen to verify that the examined data have a single root. To study the mentioned relationship, the panel Granger causality approach was used.

4. RESULTS

This study analyzes the relationship between innovation expenditures and different types of innovation activity and market expansion applying the panel Granger causality framework. It can be stated that the support of business activities will have an effect only on the basis of a time lag. The exact time shift to the quantitative one is determined on the theoretical basis of the Schwarz condition. In this case, it is a two-year delay.

Before proceeding to determine the causality of the selected variables, it is necessary from a methodological point of view to conduct ADF tests on panel data. The specified variables must satisfy the condition of non-stationarity. It is assumed that not all variables for determining causation are stationary. Stationary data are tested using the ADF test. The null hypothesis in both tests assumes that the data show non-stationarity. The results show the stationarity analysis (see Table 1) and allow rejecting the null hypothesis at the 1st differences.

This statement is verified using F-statistics. The null hypothesis is accepted if the probability was

Table 1. ADF test

Source: Own calculations.

Variable	Test	Levels		1st differences	
		Statistics	Probability	Statistics	Probability
X_2	ADF	–3.0056	0.1893	–3.9532	0.02489
X_3	ADF	–3.4956	0.0645	–3.9906	0.02580
X_4	ADF	–3.0328	0.1789	–4.0013	0.02321
P_2	ADF	–2.7015	0.3051	–3.9835	0.02383
P_7	ADF	–2.5700	0.3552	–3.9276	0.02660
P_8	ADF	–2.4385	0.4053	–3.6484	0.04654

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greater than the significance level of 0,05. Panel ordinary least squares (OLS) are used to test causality. The results are summarized in Table 2, both in the case of causality of relationships between the innovation expenditures and also for different types of innovation activity and market expansion. *H0* hypothesis is tested to accept that there is no Granger causality between the variables. The zero hypothesis is rejected if the probability falls below 0.05. In this case, the alternative hypothesis is accepted. Table 3 shows only those results where the Granger causality is proved.

Granger causality results from the percentage of revenues of organization that introduced innovations to the total expenditure on extramural R&D, percentage of enterprises that implemented product innovation developed by other enterprises, the percentage of enterprises that developed process innovation separately to total procurement of machinery, equipment, software and premises.

It is declared that Granger causality occurs: P_2 to X_2; P_7 to X_2; P_8 to X_4; P_2, P_7 k to X_2; P_2, P_8 to X_2; P_8, P_7 to X_2; P_8, P_7 to X_4; P_8, P_7, P_2 to X_2. It can be confirmed that the percentage of revenues of the organization that introduced innovation causes the total expenditure in extramural R&D at the enterprise; the percentage of enterprises that implemented product innovation developed by other enterprises or institutions, the percentage of enterprises that developed process innovation causes equipment, software and buildings.

These results are consistent with the hypothesis that there is a negative relationship between innovation spending and market expansion.

Figure 2 presents the analysis of individual variables – the percentage of revenues of organizations introducing innovation, the percentage of organizations that implemented product innovation developed by other enterprises or institutions, and the percentage of organizations that developed process innovation on their own. As explanatory variables, the following variables were used: the total expenditure on extramural R&D at the enterprise, the total expenditure for acquiring external knowledge, the total expenditure for purchasing machinery, equipment, software and buildings. A Q-Q (quantile-quantile) plot is created by plotting two sets of quantiles against each other. If the two distributions are similar, then the points would lie close to the identity line.

Table 2. Granger causality test – F statistics

Own calculations Null hypothesis	F statistics	Probability	Result
There is no evidence of causality between P_2 and X_2	5.7632	0.0257	Reject *H0*
There is no evidence of causality between P_2 and X_3	0.0020	0.9650	Accept *H0*
There is no evidence of causality between P_2 and X_4	0.4586	0.5057	Accept *H0*
There is no evidence of causality between P_7 and X_2	5.4332	0.0298	Reject *H0*
There is no evidence of causality between P_7 and X_3	0.2479	0.6237	Accept *H0*
There is no evidence of causality between P_7 and X_4	3.2548	0.0855	Accept *H0*
There is no evidence of causality between P_8 and X_3	0.9657	0.3369	Accept *H0*
There is no evidence of causality between P_8 and X_4	5.3103	0.0315	Reject *H0*
There is no evidence of causality between X_2 and P_2	0.6803	0.4187	Accept *H0*
There is no evidence of causality between X_2 and P_7	0.0371	0.8491	Accept *H0*
There is no evidence of causality between X_2 and P_8	2.1097	0.1611	Accept *H0*
There is no evidence of causality between X_3 and P_2	0.1950	0.6633	Accept *H0*
There is no evidence of causality between X_3 and P_7	0.1316	0.7204	Accept *H0*
There is no evidence of causality between X_3 and P_8	1.1962	0.2865	Accept *H0*
There is no evidence of causality between X_4 and P_2	0.9761	0.3344	Accept *H0*
There is no evidence of causality between X_4 and P_7	0.5886	0.4515	Accept *H0*
There is no evidence of causality between X_4 and P_8	0.164	0.6896	Accept *H0*

Source: Own calculations.

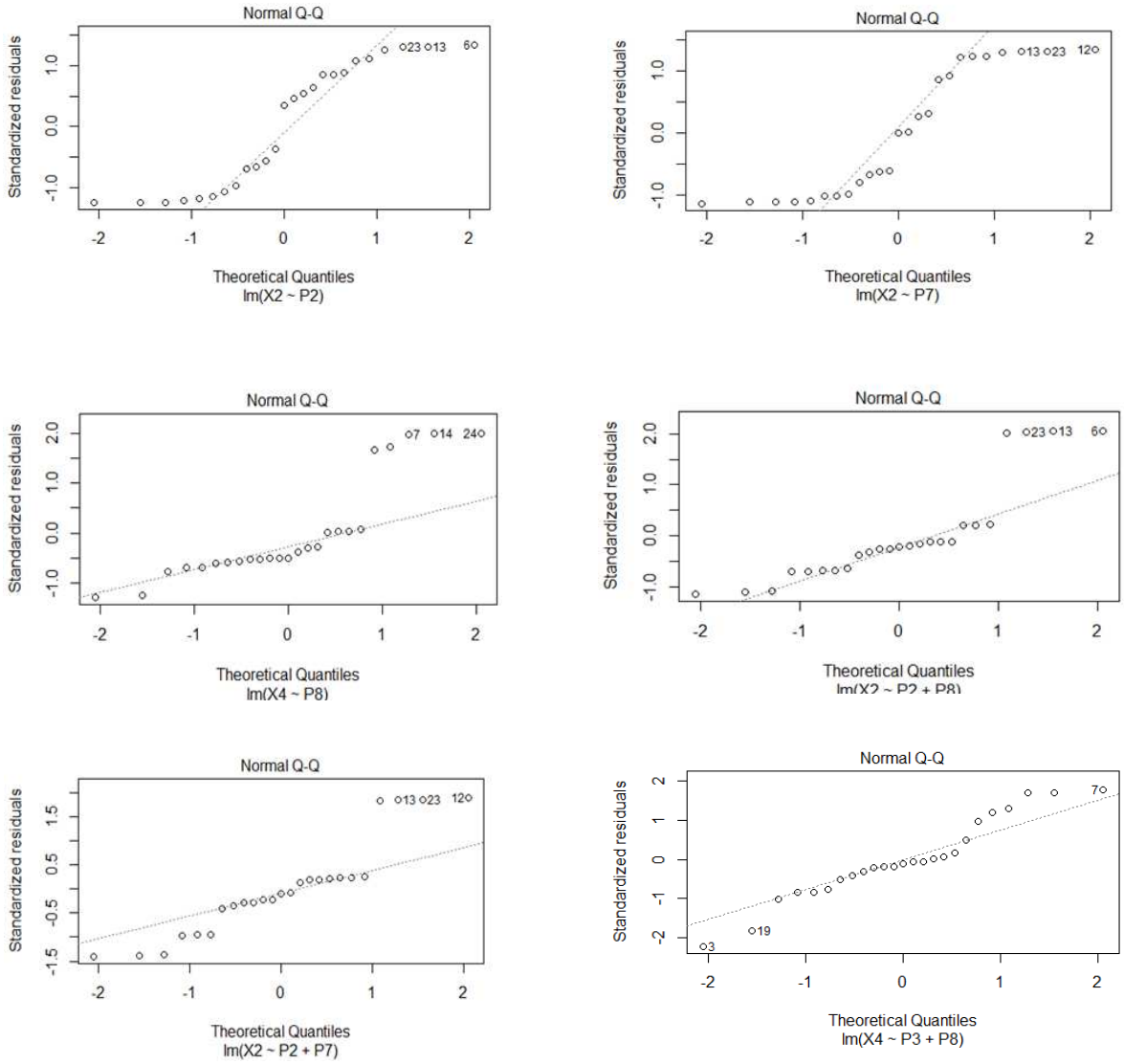

Figure 2. Q-Q plots for X_2, X_3, X_4, P_2, P_7, and P_8

Table 3. Granger causality test for combinations – F statistics

Source: Own calculations.

Own calculations Null hypothesis	F statistics	Probability	Result
There is no evidence of causality between P_2, P_7 and X_2	5.5791	0.02576	Reject *H0*
There is no evidence of causality between P_2, P_8 and X_2	6.1659	0.02155	Reject *H0*
There is no evidence of causality between P_7, P_8 and X_2	4.3462	0.04948	Reject *H0*
There is no evidence of causality between P_7, P_8 and X_4	5.0912	0.03483	Reject *H0*
There is no evidence of causality between P_2, P_7, P_8 and X_2	6.0230	0.02293	Reject *H0*

According to the obtained results, all variables show a negative correlation; the strongest correlation is found between the revenues measured by enterprises that have introduced innovation. A strong relationship is found between the performance measured by the percentage of companies

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that implemented product innovation developed by other companies or institutions.

The innovative activities of Slovak SMEs are compared with other EU countries at a low level. Despite the fact that not only entrepreneurs themselves, but also the government realize the importance of introducing innovations, the development of recent years does not indicate that the innovation environment in Slovakia is getting to be significantly improved.

Hypothesis *H0* was confirmed – *The most problematic areas in the field of innovation implementation are finance and support, barriers to the innovation environment and insufficient competitiveness of enterprises presented by the set variables* P_2, P_7, P_8, X_2, X_3, X_4.

CONCLUSION

The financial crisis has affected the impact of innovation on Slovak small and medium-sized enterprises. According to the available data, the level of R&D activities of SMEs, as measured by R&D expenditure, is improving slightly. Compared to EU countries and other V4 countries, the performance of Slovak SMEs in this area lags far behind.

Using the selected indicators such as the percentage of enterprises that have introduced innovations, the percentage of enterprises that implemented product innovations developed by other enterprises or institutions, the percentage of enterprises that developed process innovation separately, the total external spending enterprise R&D, total external business acquisition expenditure, total procurement of machinery, equipment, software and buildings, a significant causal relationship is confirmed between the percentage of sales of enterprises that have introduced innovations and total spending on external R&D at an enterprise and the relationship between product innovations developed by other enterprises or institutions and total spending on external R&D at the enterprise. This relationship is one-way, and the opposite effect has not been proven. The competitiveness of enterprises depends on the impact of many processes and mechanisms, both endogenous and exogenous. In the field of research, production, business, management and financial activities, innovation of their approach is an important factor determining the competitiveness of companies.

In the case of the Slovak SME sector, R&D expenditure appears to be a significant driver of innovation. The results of the study confirm that companies are aware of the importance of innovation. The main barriers to innovation are mainly the lack of financial resources, according to which financing innovation in Slovakia is one of the biggest problems. While companies are aware of the need for innovation, they do not pay enough attention to it. However, the COVID-19 pandemic has shown reality to many companies. Many small and medium-sized enterprises were unable to react quickly to the situation, which affected the functioning of many of them. However, the increased innovation activity of Slovak SMEs will certainly contribute to the creation of a more suitable innovation environment.

AUTHOR CONTRIBUTIONS

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