

INNOVATION POTENTIAL OF SMEs AND ITS IMPACT ON ECONOMIC PERFORMANCE IN THE V4 COUNTRIES

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Abstract

SMEs are crucial in most economies. Although they have fewer resources than large enterprises, they strive to be at least as competitive. Innovation, among other things, is now seen as a key factor contributing to competitiveness and economic prosperity at both micro and macro levels. In this context, the innovation performance of SMEs and its impact on national economies is very often monitored. While in some countries the number of innovative SMEs is relatively high, in others it remains low for various reasons. These are mostly countries where economic growth is also lower. The article aims to identify the relationship between GDP per capita and the share of SMEs introducing product/business process innovations in the V4 countries, as well as to identify the dynamics of the evolution of the share of innovative SMEs in the total number of SMEs in these countries. The main sources of data for us were Eurostat databases and the European innovation scoreboard. The obtained data were evaluated using correlation analysis and single-factor analysis of variance.

Key words:

GDP, innovation, SMEs, V4 countries

JEL Classification D22, L26, O30

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INTRODUCTION

Micro, small and medium-sized enterprises play an important role in most economies. Although their resources are more limited compared to large enterprises, they are looking for ways to become competitive. Today, innovation is considered to be one of the key factors leading to economic prosperity and maintaining competitiveness. Innovation in the 21st century is becoming a driver of growth at both micro and macro levels. This is why, also in the context of SMEs, the focus is very often on their innovation performance. However, despite the fact that the introduction of innovation has undoubted benefits for all economic actors, it is still possible to encounter cases where not enough attention is paid to these activities by companies or national governments. Businesses are not sufficiently interested in innovation, particularly as it is very often associated with increased investment, which is often under-resourced, especially for SMEs. However, the situation varies considerably between countries. While in some countries the number of innovative SMEs is relatively high, in others it is

low and does not change significantly. These differences in the innovative activity of SMEs may be due to various factors, such as the economic situation in a given country, the legal and regulatory environment in that country, or the support of governments for SMEs.

Based on the above, our main objective was to identify the dependence between GDP and the share of SMEs introducing product/business process innovations in the V4 countries and consequently the dynamics of the share of innovative SMEs in the total number of SMEs in these countries. In order to fulfil the first part of the objective, we used the method of correlation analysis, which allowed us to find out to what extent GDP in individual V4 countries depends on the share of innovative SMEs.

For the second part of the objective, we used the single-factor analysis of variance method to analyse the differences in the shares of innovative SMEs between the V4 countries over the period 2016-2023.

LITERATURE OVERVIEW

SMEs are very important for the regional economy and the economic performance of European countries, as their innovative capabilities can influence the position of individual economies in global markets (Batrancea, 2022). In both developed and developing or transition economies, these size categories of enterprises have an important place. According to UNECE (2022), especially in transition economies, the number of SMEs is increasing quite significantly, which only testifies to their importance for economic development. Compared to large enterprises, SMEs are significantly more flexible, showing better adaptability to technological change, higher support for income distribution, and are also able to adapt more easily to market fluctuations and respond more flexibly to changed customer demands (Perez-Gomez et al., 2018). As stated by Mirza, & Baharudin (2024) SMEs influence individual economies by employing a significant portion of the workforce, are largely export oriented and thus contribute a significant portion of export or tax revenues. Of course, SMEs not only have advantages compared to large enterprises, but also some disadvantages that affect their functioning. The fact that SMEs have more limited access to resources than large enterprises is very often seen as the most significant disadvantage (Spithoven et al., 2013), but this barrier is not insurmountable and there are now many initiatives at national and international level to support SMEs. The EU is aware of this fact and has long sought to strengthen and support the innovation capacity of SMEs. A significant part of European resources in the field of research, development and innovation is dedicated to supporting SMEs, e.g. by supporting the purchase of technologies necessary for the deployment of innovations or supporting other related activities (Ministerstvo dopravy a výstavby SR, 2024).

Gruzina et al. (2021) state that in modern society, economic growth and prosperity are dependent on innovation. Also in the context of SMEs, a frequently monitored indicator is precisely their innovation performance, which has played a significant role in the survival of these enterprises not only during the Covid-19

pandemic, but is also an important prerequisite for ensuring their future prosperity (Rakib et al., 2024). Most SMEs are aware that innovation adoption especially in the 21st century is becoming a necessity, yet they mostly approach it in a non-systematic way based on the current market needs and especially with regard to the

innovation to be created and maintained at an adequate level, a high level of human capital must be ensured in companies, as only this is capable of generating innovations through creative thinking and the ability to learn. Investing in the development of human capital thus becomes a decisive factor for enterprises not only for the development of their innovative capabilities, but also, in a broader context, the basis of their competitive advantage or the maintenance of long-term prosperity in a constantly changing dynamic market environment. Moreover, knowledge-oriented innovative SMEs appear to be more resilient to crises as they are able to absorb new knowledge faster, seek innovative opportunities and focus on more technologically demanding activities, which increases their flexibility and adaptability not only in turbulent periods of potential crises (Hrivnák et al., 2021). However, what is important is not only the resilience of enterprises to crises, but also their ability to take advantage of the opportunities that a crisis can create. Caballero-Morales (2021) reports that the Covid-19 pandemic that broke out in 2020 significantly affected the innovation activity of enterprises and it was the development of innovation that became a key aspect of their recovery during this period.

The most advanced countries tend to have a higher share of innovative SMEs, and these tend to be more efficient. Istiqliler et al. (2023), however, point out that even SMEs that have to deal with many institutional constraints in transition economies may be able to outperform due to their innovative capabilities. Saridakis et al. (2019) suggest that innovative SMEs are more likely to export than non-innovative SMEs, with product innovation more clearly associated with a propensity to export than service or process innovation. Since product innovation is associated with a propensity to export and exporting is one of the factors that contributes to economic growth, it can be hypothesized that a higher share of innovating firms will be

associated with higher GDP across countries. However, not all SMEs have the same enthusiasm for innovation. The innovation performance of SMEs depends to a large extent on access to international and domestic finance (Ullah et al., 2021), as well as on economic developments in individual countries. In line with Gyamfi et al. (2024), high levels of financial support encourage micro, small and medium enterprises to cooperate with each other, which can also indirectly lead to the promotion of innovative activities. According to Sun et al. (2022), however, in times of crises, SMEs' access to government support can be significantly affected, as when there is a reduction in GDP due to a recession, very often investment directed towards supporting different areas also decreases. Therefore, crises can be a time when SMEs innovate less. However, increasing investment and the amount of government support are not the only ways of increasing innovation activity in enterprises. According to Teslenko et al. (2021), in addition to financial support, it appears that an increase in the level of human capital can also contribute to an increase in innovation activity. However, in addition to access to international and domestic finance and the level of human capital, there are other determinants that can influence the innovation performance of SMEs to a greater or lesser extent. The results of Marinho & Costa Melo (2022), for example, suggest that SMEs' openness to innovation tends to be influenced by factors such as the age and gender of the SME's managers, the length of time the SME has been on the market, as well as the nature of the SME or, in particular, whether or not it is a family-owned business.

GOAL AND METHODOLOGY

The aim of this article was to identify the dependence between GDP and the share of SMEs introducing product / business process innovations in the V4 countries (Czech Republic, Poland, Hungary, Slovakia) and consequently the dynamics of the share of innovative SMEs in the total number of SMEs in these countries. The analysis was carried out for the period 2016-2023, with Eurostat and the European innovation scoreboard as the main sources of data for our research.

We first carried out a correlation analysis. For the calculation we used Pearson's correlation coefficient:

$$r_{xy} = \frac{n \sum_{i=1}^n x_i y_i - \sum_{i=1}^n x_i \sum_{i=1}^n y_i}{\sqrt{[n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2][n \sum_{i=1}^n y_i^2 - (\sum_{i=1}^n y_i)^2]}}$$

The Pearson correlation coefficient takes values from -1 to 1. If the result is a positive number, the variables change in the same direction, i.e. both increase or decrease. If the result is a negative number, the variables change in the opposite direction, i.e. one increases and the other decreases. According to the value of the correlation coefficient obtained, we can determine the tightness of the dependence from very small ($r = 0 - 0.1$) to almost perfect ($r = 0.9 - 1$). In addition to the Pearson correlation coefficient, we also calculated the coefficient of determination r^2 , which verifies the goodness of fit of the chosen model, or the significance test of the correlation coefficient, which tells whether the observed dependence is not or is statistically significant:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

To assess the development of the share of SMEs introducing product innovations or business process innovations in the V4 countries, we used a single-factor analysis of variance (ANOVA). We examined whether there are statistically significant changes in the share of innovating SMEs in the total number of SMEs in the V4 countries in the period under review. We tested the null hypothesis against the alternative hypothesis:

H0: There is no statistically significant change in the evolution of the share of SMEs introducing product innovations in the total number of SMEs in the V4 countries in the period 2016-2023.

H1: There is a statistically significant change in the evolution of the share of SMEs introducing product innovations in the total number of SMEs in the V4 countries in the period 2016-2023.

The same procedure was applied to assess the evolution of the share of SMEs introducing business process innovations. As in the previous case, we tested the null hypothesis against the alternative hypothesis:

H0: There is no statistically significant change in the evolution of the share of SMEs introducing business process innovations in the total number of SMEs in the V4 countries in the period 2016-2023.

H1: There is a statistically significant change in the evolution of the share of SMEs introducing business process innovations in the total number of SMEs in the V4 countries in the period 2016-2023.

FINDINGS

In conducting the correlation analysis, we set the dependent variable Y as the value of GDP per capita in € in 2016-2023. We included GDP in the analysis because it is an important indicator of the economic performance and prosperity of any country, and we also assumed

that the evolution of this indicator of economic performance could depend on indicators such as indicators of innovation performance, as it is generally accepted that countries that are more efficient innovators also have higher GDP per capita (European Commission, 2023). As independent (explanatory) variable X, we determined the share of SMEs introducing product innovations in the total number of SMEs and the share of SMEs introducing business process innovations in the total number of SMEs in 2016-2023, respectively. We hypothesized that the correlation coefficient should exhibit a relatively high tightness of dependence between the selected indicators, as a higher share of innovative SMEs in the market should predict a higher potential for economic growth of the countries under study.

Tab. 1: Correlation analysis - Czech Republic

$\alpha = 0.05$	GDP per capita in €	Share of SMEs introducing product innovations in the total number of SMEs (%)	Share of SMEs introducing business process innovations in the total number of SMEs (%)
2016	16 790	23.38	26.92
2017	18 330	23.38	26.92
2018	19 850	23.38	26.92
2019	21 150	24.09	35.19
2020	20 170	24.09	35.19
2021	22 270	25.22	38.90
2022	25 850	25.22	38.90
2023	28 540	35.15	52.23
Pearson correlation	-	0.823	0.926
Correlation coefficient	-	0.012	0.001
Determination coefficient	-	0.677	0.857

Source: Eurostat, EISB, own processing

In the Czech Republic, the correlation analysis between the share of SMEs introducing product innovations in the total number of SMEs and GDP per capita showed a very strong positive tightness of the relationship between the variables with a value of $r = 0.823$, i.e. the situation in the Czech Republic was similar to the situation in the rest of the V4 countries, where we also found a very strong to almost perfect tightness of the relationship between the

variables mentioned above. The significance test of the correlation coefficient with a value of 0.012, i.e. lower than the chosen significance level $\alpha = 0.05$, confirmed that the result is statistically significant, which was also confirmed by the coefficient of determination $r^2 = 0.677$, which can still be considered a sufficient value. There was an even higher correlation coefficient between the proportion of SMEs adopting business process innovations in

the total number of SMEs and GDP per capita with a value of $r = 0.926$. The result was statistically significant as evidenced by the very low significance test value of the correlation coefficient of 0.001, which is well below the selected significance level of $\alpha = 0.05$. In this case, more than 85% of the total variability was

explained by the model. The results of the correlation analysis show that SMEs introducing innovations have an impact on the economic performance of the Czech Republic, as GDP growth has followed the increasing share of innovative SMEs in the country quite well.

Tab. 2: Correlation analysis - Hungary

$\alpha = 0.05$	GDP per	Share of SMEs	Share of SMEs
2016	11 850	11.10	15.94
2017	12 980	11.10	15.94
2018	13 920	11.10	15.94
2019	15 000	13.45	17.53
2020	14 150	13.45	17.53
2021	15 860	19.54	19.00
2022	17 410	19.54	19.00
2023	20 480	19.93	23.50
Pearson correlation	-	0.871	0.958
Correlation coefficient	-	0.005	0.000
Determination coefficient	-	0.759	0.918

Source: Eurostat, EISB, own processing

The correlation analysis in Hungary showed a very strong positive tightness of the relationship ($r = 0.871$) between GDP per capita and the share of SMEs introducing product innovations in the total number of SMEs. This means that when the share of SMEs introducing product innovations increased in Hungary, GDP also increased. A significance test of the correlation coefficient with a value of 0.005, which is less than the chosen significance level of $\alpha = 0.05$, indicates that the correlation is statistically significant. This is confirmed by the coefficient of determination $r^2 = 0.759$, which shows that 75.9% of the total variability was explained by the chosen model. Between the proportion of SMEs adopting business process innovations in the total number of SMEs and GDP, the

correlation coefficient $r = 0.958$ revealed an almost perfect positive tightness of the relationship. Its statistical significance was confirmed by the significance test of the correlation coefficient with a value of 0.000, as well as by the high value of the coefficient of determination, according to which 91.8% of the total variability was explained by the chosen model. Based on the above, we can therefore conclude that innovative SMEs have an impact on the economic performance of Hungary, since when the share of innovating SMEs increased, GDP also increased. Of course, this effect can be reciprocal and as a result of the increase in the economic level of the country, SMEs may be more motivated or able to invest in promoting innovation.

Tab. 3: Correlation analysis - Poland

$\alpha=0.05$	GDP per	Share of SMEs	Share of SMEs
2016	11 050	8.37	14.89
2017	12 120	8.37	14.89
2018	12 990	8.37	14.89
2019	13 870	8.73	15.86
2020	13 720	8.73	15.86
2021	15 100	12.18	17.26
2022	17 350	12.18	17.26
2023	19 920	14.23	25.47
Pearson correlation	-	0.930	0.889
Correlation coefficient	-	0.001	0.003
Determination	-	0.865	0.790

Source: Eurostat, EISB, own processing

In Poland, the correlation analysis revealed an almost perfect tightness of the relationship between the share of SMEs introducing product innovations in the total number of SMEs and GDP per capita with $r = 0.930$. This strong tightness of dependence reflects the increase in the share of SMEs adopting product innovation is proportional to the growth in GDP. A significance test of the correlation coefficient with a value of 0.001, which is below the chosen significance level of $\alpha = 0.05$, tells us that the correlation is statistically significant. The high value of the coefficient of determination $r^2 = 0.865$ indicates that the model has been correctly fitted and explains 86.5% of the total variability.

Between the share of SMEs adopting business process innovation in the total number of SMEs and GDP, the correlation coefficient took the value of 0.889, i.e. it is a very strong positive tightness of the relationship, which is statistically significant. The coefficient of determination took the value of 0.790, i.e. 79% of the total variability was explained by the model. As in the case of Hungary and the Czech Republic, in the case of Poland it can be stated that innovative SMEs have been confirmed to have a significant impact on the economic performance of the country, as an increase in the share of innovating SMEs leads to an increase in GDP.

Tab. 4: Correlation analysis – Slovak Republic

$\alpha=0.05$	GDP per	Share of SMEs	Share of SMEs
2016	14 960	11.25	23.43
2017	15 570	11.25	23.43
2018	16 500	11.25	23.43
2019	17 320	12.48	20.49
2020	17 110	12.48	20.49
2021	18 430	14.00	21.07
2022	19 980	14.00	21.07
2023	22 090	14.10	26.06
Pearson correlation	-	0.896	0.234
Correlation coefficient	-	0.003	0.576
Determination	-	0.803	0.055

Source: Eurostat, EISB, own processing

In the Slovak Republic, the correlation coefficient expressing the dependence between the share of SMEs introducing product innovations in the total number of SMEs and the GDP per capita in € has acquired the value of

0.896, which expresses a very high positive tightness of dependence between the variables under study, or indicates the proportionality of development. This can indeed be confirmed, as the evolution of the share of SMEs introducing

product innovations has either stagnated or increased year on year, while GDP per capita has also increased year on year, with the exception of 2020, when there was a slight decrease due to the effects of the pandemic. Based on the low p-value of the significance test for the correlation coefficient of $0.003 < \alpha$ (0.05), it can be argued that this is a statistically significant relationship. The coefficient of determination value of 0.803 obtained indicates that more than 80% of the total variability was explained by the model. However, in the case of examining the dependence between the share of SMEs introducing business process innovations in the total number of SMEs and the level of GDP per capita in €, the results in the Slovak Republic were diametrically opposed to the rest of the V4 countries. The correlation coefficient took the value of 0.234, which indicates the existence of only a small tightness of dependence between the variables under study. This result is due to

the fact that while GDP increased year-on-year in most of the years under study, with the exception of 2020, the share of SMEs introducing business process innovations alternately decreased and increased or stagnated. Also the significance test of the correlation coefficient with a p-value of 0.576, which is above the chosen significance level, showed that this is a statistically insignificant relationship.

After conducting the correlation analysis and assessing the situation in each country, we proceeded to identify statistically significant changes in the evolution of the share of innovating SMEs in the total number of SMEs in the countries under study by means of a single-factor analysis of variance. First, we examined whether there is a statistically significant change in the share of SMEs introducing product innovations in the total number of SMEs in the V4 countries in the period 2016-2023 (Tab. 5).

Tab. 5: Single-factor analysis of variance (ANOVA) - Share of SMEs introducing product innovations in the total number of SMEs

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	203.9811	7	29.14016	0.59867	0.750806	2.422629
Within Groups	1168.196	24	48.67483			
Total	1372.177	31				

Source: own processing

The calculations performed (see Table 1) show that the F-value (0.598) is lower than the observed critical value (2.422), implying that the differences between the V4 countries are not significant enough to be considered statistically significant. The p-value (0.750) is higher than the chosen significance level (0.05), thus we do not have enough evidence to reject the null hypothesis with 95% confidence. Thus, based on the results, we can conclude that there is no statistically significant change in the share of

SMEs introducing product innovations in the total number of SMEs in the V4 countries, i.e. the share of SMEs introducing product innovations did not change significantly over the period in the countries studied.

Subsequently, we examined whether there is a statistically significant change in the share of SMEs introducing product innovations in the total number of SMEs in the V4 countries in the period 2016-2023 (see Table 6).

Tab. 6: Single-factor analysis of variance (ANOVA) - Share of SMEs introducing business process innovations in the total number of SMEs

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	411.0689	7	58.72413	0.728513	0.649669	2.422629
Within Groups	1934.598	24	80.60826			
Total	2345.667	31				

Source: own processing

Again, the F-value (0.728) is lower than the observed critical value (2.422), indicating that the differences between the V4 countries are not large enough to be considered statistically significant. The p-value (0.649) is higher than the established significance level (0.05), so even in this case we do not have enough evidence to reject the null hypothesis. Therefore, we can conclude that there is no statistically significant change in the share of SMEs adopting business process innovations in the total number of SMEs in the V4 countries.

CONCLUSION AND DISCUSSION

The aim of the paper was to identify the dependence between GDP and the share of SMEs introducing product/business process innovations in the countries and consequently the dynamics of the share of innovative SMEs in the total number of SMEs in the countries. We set this objective based on the observation that SMEs can influence the economic performance of countries (Batrancea, 2022). The set objective has been met. The correlation analysis showed that in all V4 countries, an increasing share of SMEs introducing product innovations has a significant positive impact on economic performance as measured by GDP per capita. In the case of the Czech Republic, Poland and Hungary, an increasing share of SMEs introducing business process innovations also has a significant positive impact on economic performance. In the case of Slovakia, however, this dependence is small and statistically insignificant, which means that the positive development of GDP is not the result of an increasing share of SMEs introducing business process innovations in the total number of SMEs

in the economy, but is rather dependent on other factors. It could be beneficial to identify these factors, which could therefore be the subject of further research. Through a single-factor analysis of variance, we identified that there are no statistically significant differences between the V4 countries (Czech Republic, Poland, Hungary, Slovakia) in the evolution of the share of SMEs introducing product innovations, nor in the evolution of the share of SMEs introducing business process innovations in the total number of SMEs. As the share of innovating SMEs did not show significant changes among the V4 countries, we can conclude that the innovative activities of SMEs in the surveyed countries took place without significant fluctuations or differences that would disturb the stability of development. Thus, based on the above findings, we can conclude that innovations introduced by micro, small and medium-sized enterprises are one of the key factors influencing the economic performance of the V4 countries, and the rate of introduction of these innovations by SMEs is similar across the studied region, as no statistically significant differences were observed in the period 2016-2023.

Although we have managed to meet the stated objective, it should be noted that the conducted research also has its limitations. The analyzed period of 2016-2023 may not have been long enough to capture changes in the share of innovative SMEs in the total number of SMEs among the countries studied. Furthermore, although we can identify relationships between variables through correlation analysis, we are unable to establish causality through correlation analysis, and so a higher share of innovative SMEs may increase GDP (Batrancea, 2022), as we hypothesized, but equally, higher GDP may

positively affect the adoption of innovation in SMEs (Ullah et al., 2021), or other factors not

examined by us may enter into the correlation between these variables.

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