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The role of innovation in the internationalisation process of Slovakian businesses

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ABSTRACT

Objective: The article aims to examine the relationship between innovation and export performance among Slovak firms. In particular, we investigated whether innovative activities, including process and product/service innovations, significantly enhance export intensity, and how firm size moderates this relationship.

Research Design & Methods: This study adopted a quantitative research design to examine the relationship between innovation and export performance among Slovak firms. We based the empirical analysis on a sample of 292 firms, whose secondary data included measures of export performance and innovation indicators. The analysis employed both descriptive statistics and the Mann-Whitney U test. We performed data analyses using Excel and Statistica.

Findings: The empirical results revealed that innovative firms, regardless of their size, exhibited substantially higher export intensity compared to non-innovative counterparts. Specifically, small innovative companies exported an average of 19.34% of their total sales versus 8.33% for non-innovative ones; the difference increases for medium-sized firms (44% vs. 17.96%) and large companies (57.26% vs. 40.85%). Moreover, further analysis highlighted that firms implementing process innovations achieved markedly higher export sales, while those combining both process and product/service innovations experienced a synergistic boost in export performance. The Mann–Whitney U test confirmed that these differences are statistically significant, reinforcing the notion that innovation is a pivotal driver of international market success.

Implications & Recommendations: The findings suggest that policymakers and business leaders should prioritize fostering innovative practices to enhance export performance, especially among medium and large enterprises. To capitalize on innovation as a growth engine, recommendations include increased support for R&D, streamlined access to funding for innovative projects, and the development of strategic programs aimed at integrating process and product innovations simultaneously. Such measures are expected to contribute to improved competitiveness and greater international market expansion for Slovak firms.

Contribution & Value Added: The novelty of this article lies in its targeted focus on Slovak enterprises – a mid-sized economy – using a robust quantitative approach that integrates World Bank Enterprise Surveys data with the application of the Mann–Whitney U test. Unlike prior studies that primarily focus on larger economies, this research provides context-specific insights into the interplay between innovation and export performance in Slovakia, offering nuanced evidence on how different innovation types and firm sizes interact to shape international competitiveness.

Article type:	research article
Keywords:	product innovation; process innovation; internationalisation; export performance; quantitative analysis; international competitiveness; Slovakia
JEL codes:	F14, O31

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INTRODUCTION

The role of innovation in the internationalisation process of Slovak businesses is a topic of significant theoretical and practical relevance. In an era of globalization and intensifying international compe-

tition, innovation serves as a critical driver of competitive advantage for firms. Ivanova (2017) indicates that the small and medium-sized enterprise (SME) sector in Slovakia faces significant challenges in accessing external funding, primarily due to stringent financial capacity assessment criteria. Furthermore, the primary source of innovation financing for Slovak enterprises remains internally generated profits. For Slovakia's economy, which is highly open to foreign trade, understanding the impact of innovation on export performance is particularly crucial. This study contributes to the broader discourse on the relationship between innovation and international expansion, offering valuable insights for economic policy and business practice.

The novelty of this article lies in its integration of quantitative analysis using World Bank Enterprise Surveys (WBES) data for Slovakia with the application of the Mann-Whitney U test, which is particularly suitable for non-normal and unequal group distributions. Unlike prior studies, which have often focused on large economies, we addressed the specific context of Slovak firms, accounting for their size structure and innovation levels. Furthermore, the article advances the literature by empirically testing hypotheses regarding export performance differentials between innovative and non-innovative firms.

The primary objective of this study was to examine the relationship between innovation and export performance among Slovak enterprises, with particular attention to firm size and the types of innovations implemented. Specifically, we sought to answer the following research questions:

RQ1: Is there a statistically significant difference in export performance between innovative and non-innovative firms in Slovakia?

RQ2: How does firm size moderate the relationship between innovation and export activity?

RQ3: Which types of innovations (process or product) exert a stronger influence on firms' international competitiveness?

The article is structured into five sections. Following this introduction, a literature review outlines the theoretical foundations of the innovation-internationalisation nexus. Next, the research methodology is presented, including data sources and statistical tools. Subsequent sections detail the empirical findings and their discussion, while the concluding remarks summarize key insights, policy implications, and directions for future research.

This study enhances the understanding of innovation's role in firm internationalisation, particularly in the context of mid-sized economies such as Slovakia. The findings may inform policymakers and business leaders in designing strategies to foster innovation and enhance export performance.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Schumpeter (1934) introduced the concept of innovation into economic literature. He viewed it as the implementation of new or improved solutions concerning products, methods of production, forms of trade, raw materials, semi-finished goods, or the organization of processes. Similarly, Kotler (1997) defines innovation as an idea, product, or technological component that has been implemented and presented to customers, who perceive it as new. According to Lumpkin and Dess (2001), innovativeness constitutes one of the fundamental components of entrepreneurship at the organizational level.

The literature offers a wide range of studies dedicated to exploring the relationship between innovativeness and internationalisation. Researchers examining this phenomenon emphasise that innovation constitutes a key value in value creation and export performance, regardless of firm size. It can serve as a significant driver of export development both in the case of large multinational corporations (Barłożewski & Trąpczyński, 2021) and small and medium-sized enterprises (Oliinyk *et al.*, 2023).

Numerous empirical studies indicate that the relationship between the internationalisation process of a firm and the level of innovativeness of its solutions is complex and bidirectional (Damijan *et al.*, 2010; Wach, 2016; Moreno-Menéndez, 2018; Ahi *et al.*, 2022; Głodowska *et al.*, 2023). This suggests that internationalisation may both stimulate the development of a firm's innovative capabilities and, conversely, result from the firm's prior engagement in innovation-related activities (Daszkiewicz, 2016; Wach, 2016).

The first direction of this interdependence – frequently described in the literature as 'learning by exporting' – refers to a scenario in which a firm's involvement in international markets leads to enhanced innovation capacity. Through interactions with foreign markets, customers, business partners, and competitors, firms acquire new knowledge, skills, and experiences that can be subsequently utilised in the development and implementation of innovative solutions across products, processes, organisational structures, and marketing strategies (Boso *et al.*, 2013; Cieślik *et al.*, 2016, Freixanet & Rialp, 2022). From this perspective, internationalisation acts as a catalyst for innovation, broadening firms' perspectives and exposing them to novel technological and organisational opportunities.

The second direction of the relationship assumes reverse causality, whereby a firm's level of innovativeness constitutes a key determinant of its propensity and ability to internationalise. In this view, companies that possess advanced, original solutions – whether product-related, technological, or organisational – are better positioned to enter foreign markets successfully and to gain competitive advantage through innovation. Empirical findings (Chen *et al*., 2018) support this approach. They demonstrate that innovation – particularly technological innovation – enhances the likelihood of international expansion by facilitating firms' adaptation to diverse market conditions and the expectations of foreign customers.

Moreover, the study by Wach and Daszkiewicz (2023) demonstrates that research and development (R&D) activities are a significant driver of internationalisation among high-tech firms. The presence of an internal R&D unit and the allocation of financial resources to R&D substantially increase both the geographic scope of expansion and the level of firms' transnationality. These findings emphasise the importance of innovation intensity in enhancing firms' capabilities for successful entry into foreign markets. Similar conclusions can be drawn from the study conducted by Almodóvar *et al*. (2021) among Spanish enterprises.

The close relationship between a firm's innovativeness and its internationalisation is reflected in the thesis that entry into a foreign market can be regarded as a form of innovation (Kosała, 2015). Moreover, it may also serve as a source of innovation, inspiring further innovative activities in the areas of product, process, organisational structure, or marketing (Wach, 2014). A positive correlation between firm innovativeness and internationalisation has also been confirmed in numerous empirical studies conducted across various national contexts. For instance, research by Cieślik *et al.* (2018) highlights that both product and process innovations significantly increase the likelihood of export success among Chinese enterprises. Similar patterns are observed in the study by Bertarelli and Lodi (2018), who examined firms from several European Union member states that were formerly part of the communist bloc. Their findings underline the strategic importance of innovation as a driver of international market expansion.

The pro-export function of innovation is further reinforced by evidence from a range of other country-specific studies. In the United Kingdom Ganotakis and Love (2011) demonstrated a clear link between innovative activity and increased export performance. Comparable conclusions were drawn in Portugal by Rua (2018), in Italy by Brancati *et al.* (2018), in Germany by Bernardini *et al.* (2018) and in Australia by Palangkaraya (2012). Research among Romanian enterprises in the ICT sector (Burciu *et al.*, 2023) confirmed the positive relationship between innovation and enterprise internationalisation. Collectively, these studies provide robust cross-country evidence that innovation plays a pivotal role in enhancing a firm's export capacity and competitiveness in international markets.

The findings of survey-based research by Ayllón and Radicic (2019) indicate the presence of complementarity only in terms of contemporaneous effects while providing no evidence to support a causal relationship between previously implemented product and process innovations and the current export activity of firms. Bigos and Michalik (2020) and Bigos and Wach (2021) also demonstrated the positive impact of specific types of innovation on the increase in export activity of individual enterprises. In his empirical study conducted among Polish enterprises, Brodzicki drew similar conclusions. He highlights a pronounced heterogeneity among Polish manufacturing firms in terms of both innovation and internationalisation intensities. His findings further substantiate the strong interdependence between these two dimensions and confirm the directional impact of innovation on the degree of firms' international engagement (Brodzicki, 2017).

These prior empirical results allowed us to assume the following research hypotheses:

H1: Innovative firms that strategically invest in process innovations or product improvements achieve significantly superior export performance, underscoring the pivotal role of innovation in enhancing international market competitiveness.

To examine this hypothesis in greater detail and account for the possible heterogeneity of innovation effects, we developed a set of auxiliary (sub)hypotheses. These hypotheses aimed to disentangle the distinct contributions of product and process innovations, their potential synergistic effects, and the moderating role of firm size:

H1a: A company that has implemented process innovations achieves a statistically higher level of exports compared to companies that have not invested in such innovations.

H1b: Companies that invest in improving products or implementing product/service innovations achieve higher export sales intensity than those that do not.

H1c: Companies implementing process and product/service innovations at the same time achieve even higher export intensity than companies using only one of these forms of innovation.

H1d: The effect of innovation on export sales intensity is moderated by firm size – innovation effects are particularly strong in medium and large firms.

RESEARCH METHODOLOGY

In this study, we sourced the primary empirical data from the World Bank Enterprise Surveys (WBES) for the Slovak Republic on a representative sample of 292 companies (World Bank, 2023). We conducted a systematic review of the extant literature using academic databases such as Scopus, Web of Science, and Google Scholar to ensure that only peer-reviewed and methodologically rigorous studies informed the research framework. Given that the dataset did not satisfy the assumptions of normality and exhibited unequal group sizes between innovative and non-innovative firms, we employed the Mann-Whitney U test as the most appropriate inferential statistical method to assess whether firms exhibiting innovation differ significantly in export performance compared to non-innovative firms. This nonparametric test is particularly advantageous when the underlying data do not meet the assumptions of normality, especially in cases where the distribution is markedly skewed relative to the mean and when the assumption of equal group sizes is not satisfied and this test does not require that the data be normally distributed (Mann & Whitney, 1947). The test proceeds by ranking all observations from both groups together and then computing the U statistic for each group using the formula:

$$U = R - \frac{n(n+1)}{2} \tag{1}$$

in which:

R - the sum of the ranks for a given group;

n - the number of observations in that group.

To standardize the U statistic for hypothesis testing, we calculated the following Z score:

$$Z = \frac{U-\mu_U}{\sigma_U} \tag{2}$$

with the mean μ_U and the standard deviation σ_U of the U distribution defined as:

$$\mu_U = \frac{n_1 n_2}{2};\ \sigma_U = \sqrt{\frac{n_1 n_2 (n_1+n_2+1)}{12}} \tag{3}$$

in which n_1 and n_2 are the sample sizes of the two independent groups. The resulting Z value and its corresponding p-value facilitated the assessment of statistical significance.

The variables employed in the analysis included the percentage of total sales exported directly, the percentage of total sales exported indirectly, firms that introduced a process innovation, and firms that introduced new or improved products or services. In addition to the Mann-Whitney U test, we computed basic descriptive statistics to provide a comprehensive overview of the data distribution. This combined approach, integrating both inferential and descriptive statistical methods ensured a robust examination of the relationship between innovation and export performance.

RESULTS AND DISCUSSION

The analysis of the empirical data revealed several findings regarding the innovation profiles and export performance of Slovak firms. As illustrated in Figure 1, only 4.11% of the surveyed firms reported engaging in process innovations, 6.85% declared product or service innovations, and 10.27% implemented both types of innovations. Consequently, a striking 78.87% of the sampled enterprises did not report any innovation-related investments.

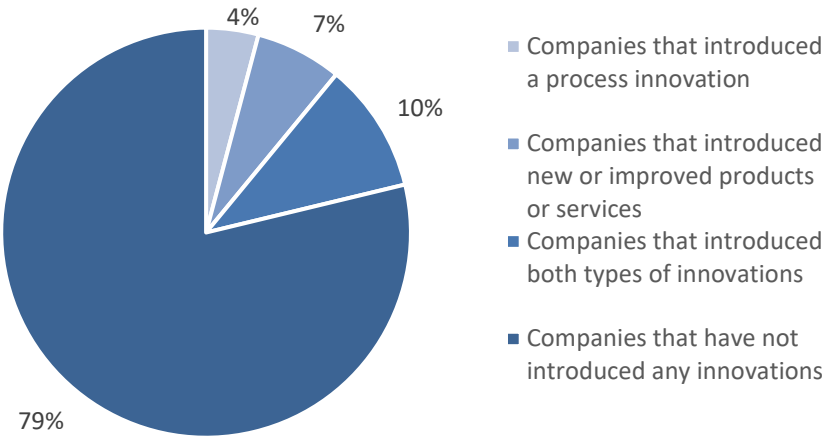

Figure 1. Share of innovative companies in the structure of enterprises in Slovakia
Source: own elaboration based on data from the World Bank Enterprise Surveys.

Export sales accounted for 20.7% of the total sales of Slovak firms. Internationalised companies accounted for 43% of all Slovak firms, and the largest number, 26% of all companies surveyed, were companies that indirectly exported at least part of their sales, as shown in Figure 2 below.

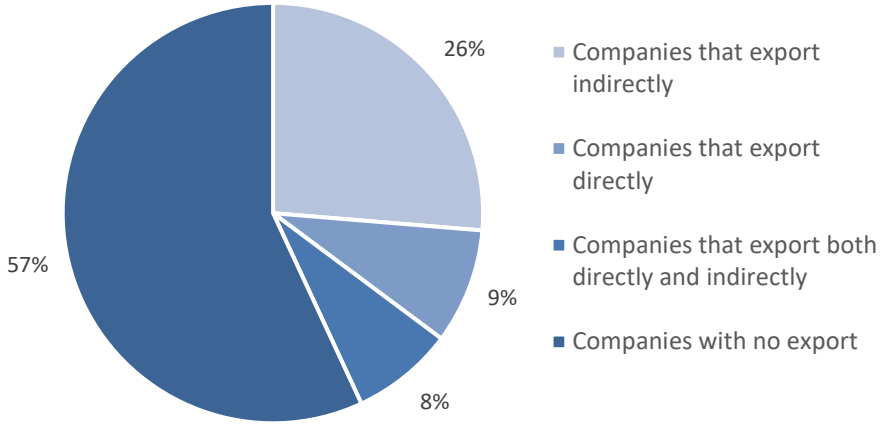

Figure 2. Share of internationalised companies in the structure of enterprises in Slovakia
Source: own elaboration based on data from the World Bank Enterprise Surveys.

For this study, we classified firms as innovative if they reported at least one type of innovation (either process or product/service). This classification enabled a direct comparison between innovative and non-innovative firms concerning their export performance.

Figure 3 below shows the average share of exports of innovative and non-innovative companies by their size.

Small innovative companies exported an average of 19.34% of their total sales, compared to only 8.3% for their non-innovative counterparts. The difference was even more pronounced among me-

dium-sized companies, where innovative firms exported 44% of their total sales, compared to 17.96% for non-innovative firms. Among large companies, innovative firms showed the highest export intensity, with 57% of their exported sales, compared to 40.5% for non-innovative firms.

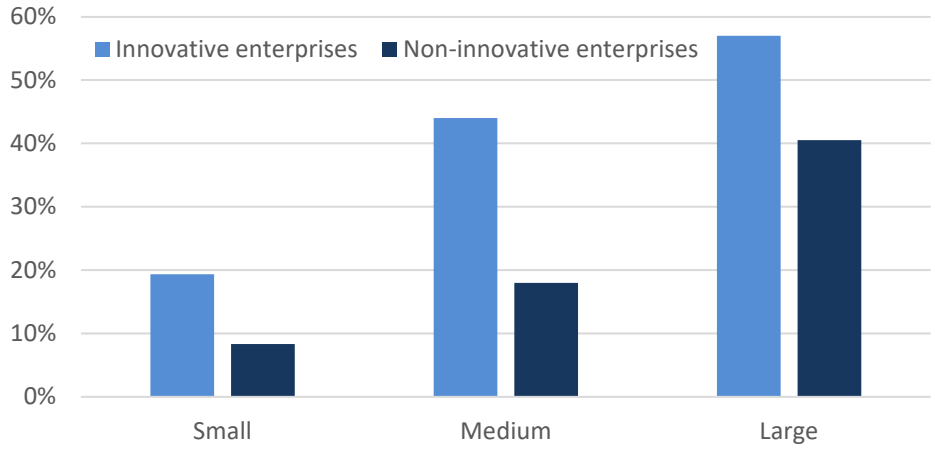

Figure 3. The average share of exports of innovative and non-innovative companies by their size
Source: own elaboration based on data from the World Bank Enterprise Surveys.

This pattern strongly supports the idea that innovation is positively associated with export intensity across all firm sizes. Notably, the export performance gap between innovative and non-innovative firms widened as firm size increased. While small innovative firms exported more than twice as much as their non-innovative peers, this difference grew even further among medium and large companies. These findings suggest that firm size moderates the effect of innovation on export performance, which directly supports hypothesis H1d. In particular, medium and large firms appear to leverage innovation more effectively to expand their presence in international markets, benefiting from economies of scale, greater resources, and more structured international strategies.

Table 1. Average export intensity (%) by firm size and innovation status

Firm size	Innovative firms (%)	Non-innovative firms (%)
Small	19.34	8.33
Medium	44.00	17.96
Large	57.26	40.85

Source: own study based on data from the World Bank Enterprise Surveys.

These results reinforce the moderating role of firm size in the relationship between innovation and export intensity, emphasizing that larger innovative firms experience the strongest export advantages. The observed patterns were consistent with previous findings by Damijan *et al*. (2017), who explored the relationship between firms' export status and various types of innovation activities. While aggregate data indicated that innovation outcomes generally improve with firm size, their study revealed that the impact of exporting on innovation is particularly strong among medium-sized firms. We may attribute this to the fact that medium-sized enterprises possess greater technological absorption capacities than small firms, while still maintaining a level of flexibility that allows them to adapt more swiftly to the demands of international markets compared to large corporations (Cai *et al*., 2020).

To assess the differences between the international activities of innovative and non-innovative companies, we used the Mann-Whitney U test. Table 2 shows the obtained parameters.

Table 2. The obtained parameters from the performed Mann-Whitney U test

U	Z	p-value	Z adjusted	p-value
5536	-2.701	0.007	-2.989	0.0028

Source: own study in Statistica.

The U statistic represents the sum of the ranks for the group with the lower export performance (in this case, non-innovative firms). The non-innovative firms tend to occupy lower positions compared to their innovative counterparts which suggests that non-innovative firms generally exhibit lower export levels. The Z statistic is a standardized measure that shows how many standard deviations the observed U is from the expected U under the null hypothesis (which posits no difference between the groups). Z = -2.70 means that the observed U was approximately 2.70 standard deviations below the mean U. The negative sign further indicates that non-innovative firms, on average, perform worse in export activities compared to innovative firms. The adjusted Z statistic accounts for potential issues such as tied ranks and provides a more accurate reflection of the test outcome. With a value of -2.98, the adjusted Z further reinforces the finding that non-innovative firms have significantly lower export performance. The more negative adjusted Z indicates an even stronger deviation from the expected value under the null hypothesis. A p-value is below the conventional significance level which confirmed that the difference in export performance between innovative and non-innovative firms was statistically significant.

Figure 4 below shows the differences in export activity between innovative and non-innovative companies. This chart shows the distribution of export values (the vertical axis) for both groups (the horizontal axis), considering the median, quartiles, and potential value outliers.

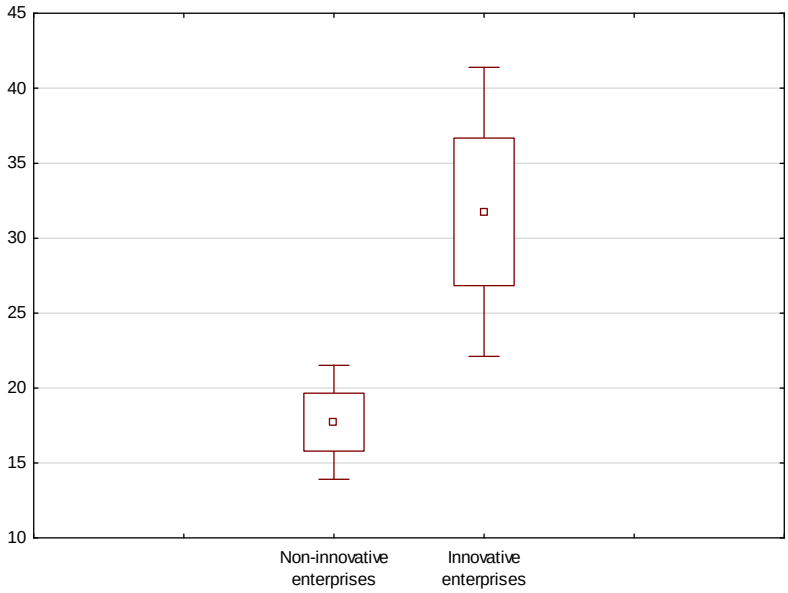

Figure 4. Export activities of innovative and non-innovative companies
Source: own elaboration based on data from the World Bank Enterprise Surveys.

The results highlight that despite a relatively low prevalence of innovation among Slovak firms, those that are innovative exhibit markedly superior export performance. This effect is most pronounced among medium and large enterprises. The empirical findings, corroborated by both descriptive statistics and the Mann–Whitney U test, lend strong support to the hypothesis that innovation is a key driver of export success in the Slovak context.

Furthermore, the analysis offers robust empirical support for hypotheses H1a, H1b, and H1c. Firms that implemented process innovations achieved an average export intensity of 37.60%, significantly outperforming firms that did not invest in such innovations (17.86%). Similarly, companies that introduced product or service innovations reported an average export intensity of 31.74%, compared to 18.42% among firms without product innovations. These findings confirm that both types of innovation, independently, are positively associated with stronger export performance, consistent with H1a and H1b. Additional insights from firms operating in EU countries similar to Slovakia – such as Poland and Hungary – indicate that process innovations are particularly critical for maintaining competitive advantages on international markets, especially in medium-high technology sectors (Cieślik & Michałek, 2017). Further support comes from the case of Moroccan SMEs, where scholars found that

licensing foreign technologies (a form of process innovation) enhances export intensity by facilitating know-how absorption and production standardization (Haddoud *et al*., 2023).

Regarding product innovations, evidence from Portuguese enterprises shows a strong correlation between the introduction of new goods or services and higher export intensity (Ricardo, 2024). Similarly, studies from emerging markets, including countries in Latin America, emphasise that product innovations enable firms to tailor their offerings to the diverse needs of foreign consumers, thereby contributing to increased export shares (Heredia *et al*., 2019).

More strikingly, firms that simultaneously implemented both process and product innovations reached an average export intensity of nearly 40%, whereas firms that introduced only one type of innovation (either process or product) achieved a significantly lower average of 24.13%.

Table 3. The obtained parameters from the performed Mann-Whitney U test

Innovation Status	Average Export Intensity (%)
With process innovation	37.6
Without process innovation	17.86
With product/service innovation	31.74
Without product/service innovation	18.42
With both types of innovation	39.9
With only one type of innovation	24.13
Without any innovation	17.8

Source: own study based on data from the World Bank Enterprise Surveys.

This pattern substantiates H1c, indicating that the combined effect of multiple innovation types creates a synergistic boost in export outcomes, surpassing the effect of either innovation implemented in isolation. Suárez and Guisado-González (2014) identified a similar relationship in the Spanish manufacturing sector, where firms implementing both product and process innovations achieved higher performance and were better prepared to respond to international market demands. Their findings also indicated that companies combining these two innovation strategies reached higher export intensity, particularly among medium-sized enterprises in medium-high technology industries. Scholars have observed comparable evidence in other contexts as well, for instance, Polish firms from the machinery sector that implemented both product and process innovations recorded, on average, 31% higher export intensity compared to those applying only one type of innovation. This further supports the notion that synergistic innovation strategies significantly strengthen a firm's international competitiveness (Cieślik *et al.,* 2016). This trend is now also observable among Slovak firms, reinforcing the relevance of dual innovation strategies in enhancing export potential across different national contexts.

CONCLUSIONS

We aimed to examine the relationship between innovation and export performance among Slovak firms by employing quantitative analysis on WBES data and the Mann–Whitney U test. The empirical results indicate that innovative firms demonstrate significantly higher export intensity compared to non-innovative firms, with the gap widening in relation to firm size; small, medium, and large firms exhibit progressively greater differences, thereby validating the proposed hypotheses. Firms engaged in process innovations, product/service innovations, or both, outperform their non-innovative counterparts, with the synergistic effect of dual innovation further elevating export performance. These findings underscore the critical role of innovation as a driver of international competitiveness, suggesting that supportive policies such as enhanced R&D investments, streamlined funding mechanisms for innovation projects, and strategic integration of process and product improvements could substantially benefit firms and the broader economy.

Notwithstanding these valuable insights, we must acknowledge certain limitations. The study relied on a sample of 292 firms and secondary survey data, which may constrain the finding's generalisability. Moreover, the cross-sectional design restricted causal interpretations of the innova-

tion-export relationship. Measurement issues inherent in self-reported innovation and export metrics could also introduce biases into the analysis.

Future research should consider longitudinal designs to better capture the dynamic nature of innovation and its long-term impact on international market performance. Comparative studies across different mid-sized economies could enhance understanding of contextual factors affecting the innovation-internationalisation nexus. Furthermore, employing advanced statistical methodologies and incorporating qualitative case studies would further refine the insights into the mechanisms by which innovation shapes export outcomes.

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Use of Artificial Intelligence

The manuscript is free of AI/GAI usage.

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