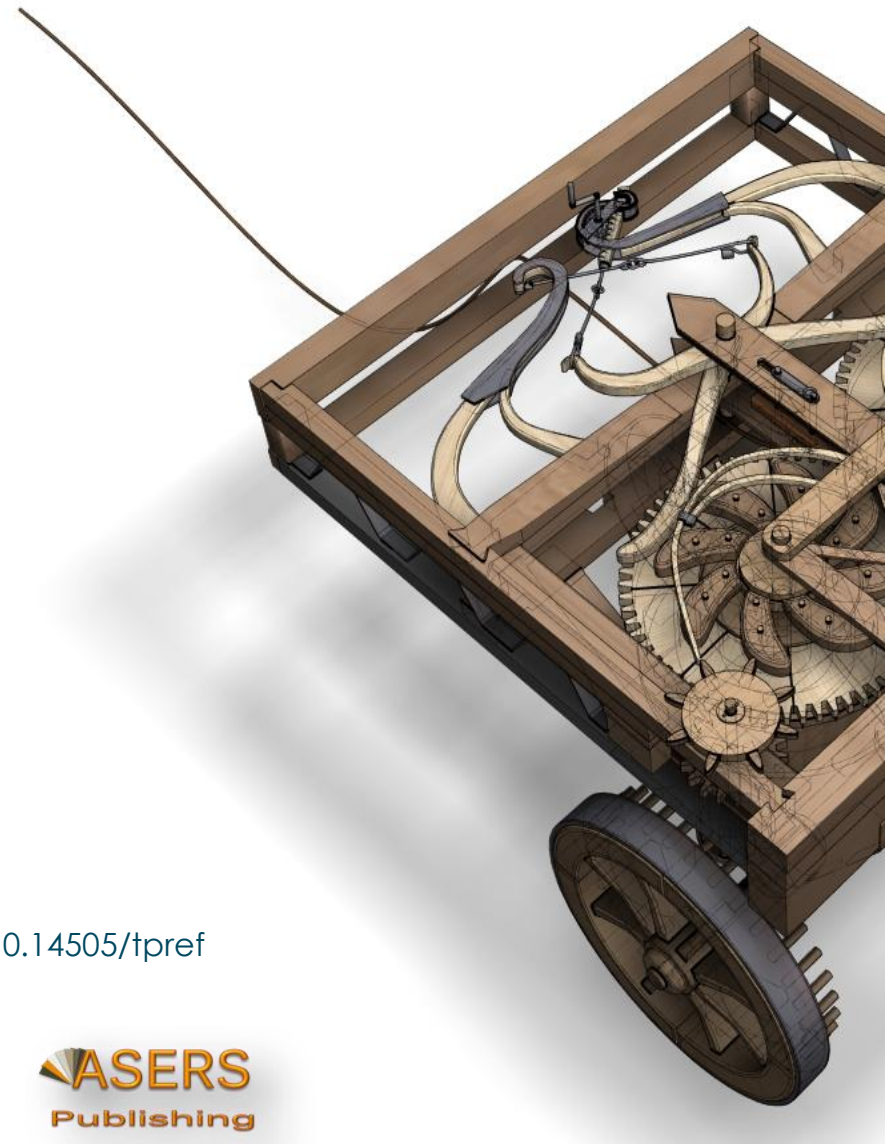
Theoretical and Practical Research in Economic Fields



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The Role of Digital Technologies in Creating Competitive Advantages of Modern Entrepreneurship

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Abstract: Digital technologies have become a key factor in transforming entrepreneurship and strengthening its competitiveness in the current global instability and growing competition. Digitalization is especially important for countries that are undergoing post-crisis recovery and integration into the European space, where it forms new mechanisms for economic growth, opens access to new markets, and optimizes business processes. The aim of this article is to assess the impact of digital technologies on the creation of competitive advantages of enterprises in Moldova, Romania, Ukraine, Poland, and Germany using an econometric approach.

The research methodology is based on a panel data model for 2019–2024 considering fixed effects. The model includes five independent variables: the level of digitalization, the number of innovations, the share of R&D spending, export orientation, and enterprise size.

The modelling results showed that R&D has the strongest positive impact (β=8.70), followed by digitalization (β=0.52), and innovation (β=0.31). The highest average competitiveness was recorded in Germany (3.62), the lowest - in Poland (3.27), while Ukraine has a consistently positive dynamic.

The developed model confirms the importance of comprehensive digital transformation for ensuring long-term market advantage. Further studies may expand the model, considering industry specifics, digital environmental friendliness, sustainability, and regional characteristics of the countries of Central Asia, the Balkans, and the Baltics.

Keywords: digital transformation; enterprise potential; innovation-driven competitiveness; export-oriented SMEs; panel data econometrics; sustainable economic growth.

JEL Classification: M10; O33.

Introduction

Digital technologies have become a key factor in the transformation of modern entrepreneurship and the basis for the creation of its competitive advantages. They change the logic of economic growth, resource management and interaction with customers. Digitalization is especially important for countries that are in a state of post-crisis recovery and integration into the European space, such as Ukraine, Moldova or Romania, where it serves not only as a means of increasing efficiency, but also as a tool for adapting to global competition. In view of limited resources, an unstable environment and growing demands for innovation, digital tools enable maintaining flexibility, improving the quality of management decisions and entering foreign markets. However, in many enterprises, digital transformation still remains fragmented, inconsistent and often limited to basic automation. The lack of a strategic vision for digital development and the low level of research and development (R&D) investment limit long-term competitive advantages. There is also significant international variability in the effectiveness of digitalization, which increases the need for quantitative analysis of its effectiveness in comparison.

In addition, the study focuses on enterprise potential as an integral indicator that reflects digital maturity, innovation, institutional capacity, and scalability. Innovation is defined based on quantitative data on new products, processes and digital solutions that enterprises integrate to improve efficiency. These elements establish the core of competitiveness and correspond to the strategic priorities of sustainable entrepreneurship (SDG 8, 9).

Recent studies confirm that digital technologies contribute not only to profit, but also to the creation of social and environmental value (Gregori and Holzmann 2020). Digital resilience allows peripheral communities to quickly integrate into sustainable development models (Tim *et al.* 2021). Innovative entrepreneurship and the circular economy are recognized as prerequisites for long-term social progress (Manea *et al.* 2021). Digital solutions are creating new trajectories of sustainable entrepreneurship for countries in the Global South (Contreras and Dornberger 2023). At the same time, the creation of competitive advantages requires the integration of digital tools into business models and financial systems (Prokopenko *et al.* 2024). This approach enhances the adaptability of enterprises to the challenges of the global environment and accelerates innovation processes. Therefore, digitalization is becoming strategically important for enterprises in countries with economies in transition.

This context arises the problem of determining the real economic effect of digital technologies for enterprises in different countries. Despite numerous theoretical studies, there is still a lack of empirical estimates that would substantiate the relationship between digitalization, innovation, the size of enterprises, their export activity and competitiveness. This problem has led to the need to build an econometric model for a comprehensive assessment of the relationships between these variables.

The aim of the study is to determine the impact of digital technologies on the creation of competitive advantages of enterprises in an international context. The aim involved the fulfilment of the following research objectives:

- conduct a review of academic literature on the digitalization of business;
- collect, structure, and present data on enterprises in five countries for 2019–2024;
- build an econometric model for assessing competitiveness taking into account digital and innovation factors;
- conduct a comparative analysis of results between countries with different levels of digital maturity;
- draw conclusions and provide practical regarding digital strategies.

The object of the study is the economic behaviour of enterprises in the context of digital transformation. The subject of the study is the impact of digital technologies on competitive advantages. The hypothesis of the study is that digital technologies in combination with innovations and export orientation create a stable advantage in the market. The study combines the methods of econometric modelling, international comparison, statistical analysis, and content analysis of academic literature.

The academic novelty of the study is the complex combination of digital, innovative, and organizational factors in a single quantitative model. The study is the first that assesses the digital maturity of enterprises in the context of competitiveness in Ukraine, Moldova, Romania, Poland, and Germany. The proposed model is universal and can be used for other countries and sectors of the economy. The practical significance of the study

is the possibility of applying the results to develop digital transformation strategies, determine investment priorities in digital solutions, and develop policies to support small and medium-sized businesses (SMEs).

1. Literature Review

Recent studies confirm that digital technologies are increasingly penetrating sustainable business strategies, changing approaches to value creation (Fuerst *et al.* 2023). George *et al.* (2021) consider digital innovation as a tool to address climate challenges by rethinking business models. Baran and Berkowicz (2021) propose the concept of digital platforms as laboratories for sustainable innovation, where companies experiment with new products. Fernandes *et al.* (2022) add that digital entrepreneurship operates in complex digital ecosystems, where adaptation is a critical condition for competitiveness. Satalkina and Steiner (2020) analyse the digital economy as an element of national innovation systems, emphasizing an interdisciplinary approach.

Guandalini (2022) conducts a systematic literature review calling for standardization of approaches in the study of digital transformation. Lichtenthaler (2021) introduces the concept of digitainability that emphasizes the interdependence of digitalization and sustainable development as megatrends of the 21st century. Del Río Castro *et al.* (2021) argue that the implementation of the Sustainable Development Goals is only possible if there is a digital breakthrough in business practices.

Khanh *et al.* (2023) deepen the technical dimension by describing the impact of future 6G technologies on the digital entrepreneurship infrastructure. This approach brings digital strategy closer to technological foresight, which is relevant for countries with transformational economies. In general, agreement among the authors on the need for digital adaptation to remain competitive is growing.

Man *et al.* (2025) emphasize that the combination of digital technologies and proper intellectual property management can greatly increase the speed of sustainable innovation so that the enterprises keep competitive positions even in a long-term perspective and their intangible assets remain secure. According to Zheng and Zhou (2025), business model innovation holds a mediating effect on the firm-level digital transformation and competitive advantage in manufacturing, implying that technological absorption should be consistent with product value chain value redesign. Li (2025) offers a synthesis of research study on the business model innovation in terms of digital technology that clarifies significant gaps and directions in managing the integration of digital tools and strategic planning. Omidvar *et al.* (2025) combine innovation in the business model with corporate social responsibility illustrating how, in the digital age, the SMEs can excel through a combination of technological goals and social purpose. Zaman *et al.* (2025) examine the mediating effect of digitalization management in revealing that competent provisions of the control of digital efforts improve the extent and magnitude of digitalization performance. Jang and Lee (2025) discuss the relationship between digital entrepreneurial orientation, technology absorptive capacity, and digital innovation, and they establish that the combinations of these skills enhance the performance of the business. Lastly, Huang and Tang (2025) pay attention to the strategic positioning of digital platforms that disclose their ability to act as integrative infrastructures to promote enterprise-wide digital transformation strategies and develop sustained competitiveness.

At the same time, there is a gap between normative visions of digitalization and the real limitations of its implementation. Earlier studies mainly focus on qualitative or conceptual aspects of digital transformation. However, quantitative assessment of the effect of digital factors remains underdeveloped. In this context, our study fills the gap by proposing an econometric model for analysing the impact of digital changes on competitive advantages. The integration of international data allows considering both common and specific determinants of digital efficiency of enterprises. So, the proposed approach develops the ideas of previous researchers, combining strategic vision with practical measurability.

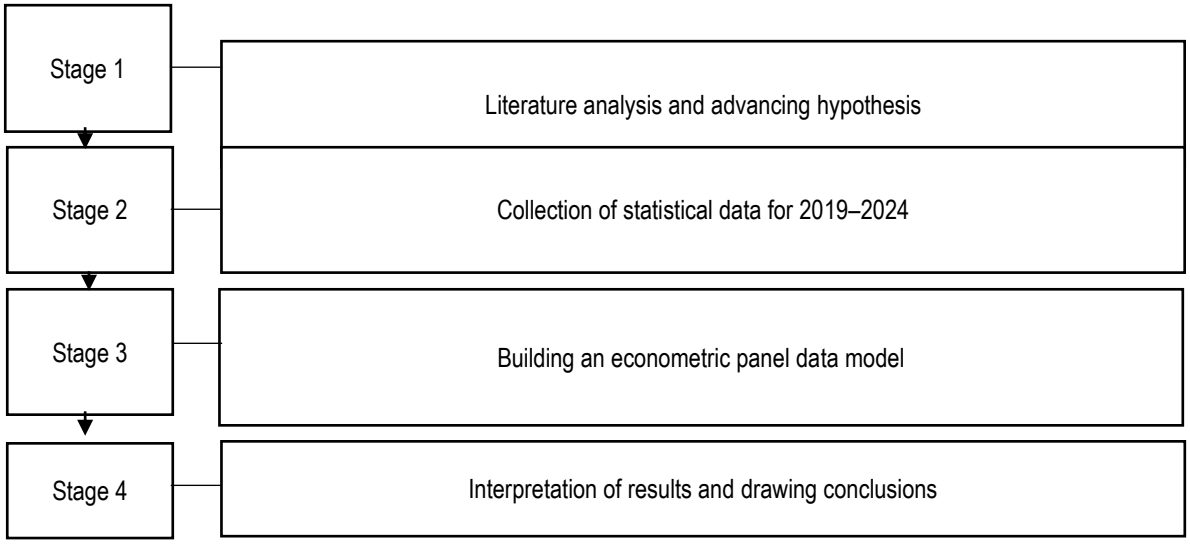
Therefore, the reviewed academic literature forms a holistic background for understanding the role of digital technologies in the strategic development of entrepreneurship. They demonstrate the interdisciplinary nature of digital transformation and its connection with sustainable innovation. However, most studies focus on the conceptual or technological level, neglecting the applied economic assessment of digital effects. There are insufficiently developed empirical approaches that can quantitatively measure the impact of digitalization on the competitiveness of enterprises in the international dimension. There is also a lack of models that consider the specifics of transformational economies, institutional barriers and asymmetries of digital access. This justifies the need for further research with an emphasis on quantitative analysis, international comparability and political aspects of digital modernization of business.

2. Methods

2.1. Research Design

The research included four stages, which ensured a logical sequence of data collection, processing, and analysis. The basis of the study was panel data on enterprises from five European countries. All stages are presented in the figure 1 below, which summarizes the methodological logic of the study.

Figure 1. Research Stages



Source: develop by the author.

The first stage identified key factors influencing the impact of digitalization on business. The second stage included the formation of an open-source database. The third stage involved the calculation of a model using regression analysis. The fourth stage provided for the comparison of results between countries and their generalization. This structure enabled combining quantitative methods with applied analysis. The procedure ensured the reliability and validity of the findings.

2.2. Sampling

Five countries were selected for the analysis, including Moldova, Romania, Ukraine, Poland, and Germany. The countries have different levels of digital maturity for the purpose of a comparative analysis. The period 2019-2024 covers transformational changes, including pandemics and crises. Small and medium-sized enterprises were selected as the most sensitive to digital changes. The main indicators are digitalization, innovation, R&D, exports, company size. Data sources include Eurostat, World Bank, national statistical offices, and industry surveys (Deloitte 2023; European Commission 2024; Gartner 2023; International Monetary Fund 2023; International Telecommunication Union 2023; McKinsey & Company 2023; National Bureau of Statistics of the Republic of Moldova 2024; OECD 2023; Polish Central Statistical Office 2024; PwC 2023; State Statistics Service of Ukraine 2024; Statista 2024; United Nations Conference on Trade and Development 2023; World Bank 2024; World Trade Organization 2023).

2.3. Research Methods

The methodological basis is a regression model with fixed effects. The model assesses the impact of digital factors on the competitiveness of enterprises. The dependent variable is the integrated index of competitive advantages. Independent variables: DIGI (digitalization), INNOV (innovation), R&D, EXPORT, SIZE. The model is as follows:

$$Y_{it} = \beta_0 + \beta_1 \cdot DIGI_{it} + \beta_2 \cdot INNOV_{it} + \beta_3 \cdot R\&D_{it} + \beta_4 \cdot EXPORT_{it} + \beta_5 \cdot SIZE_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where:
- Y_{it} - competitiveness index of enterprise i in year t;
- β_0 - constant (baseline level of competitiveness without the influence of variables);
- $DIGI_{it}$ - level of digitalization (implementation of CRM, ERP, AI, e-commerce);

- β_1 - impact of digitalization on competitiveness;
- $INNOV_{it}$ - number of innovative products or processes implemented in the enterprise;
- β_2 - effect of innovative activity on competitive advantages;
- $R\&D_{it}$ - share of R&D spending (% of total spending);
- β_3 - impact of R&D on the level of competitiveness;
- $EXPORT_{it}$ - share of exports in the structure of enterprise revenues;
- β_4 - effect of export orientation on competitiveness;
- $SIZE_{it}$ - size of the enterprise (number of employees);
- β_5 - marginal effect of scale of the enterprise;
- μ_i - fixed effect, which takes into account permanent differences between enterprises;
- ε_{it} - random error.

The model identifies how the combination of digital tools, innovations, and foreign economic activity shapes the competitive positions of enterprises in different countries. This approach enables a comparative analysis between countries with different levels of digital maturity and economic development. At the same time, the model takes into account the effect of the scale of the enterprise, which is especially important for countries with a dominance of small businesses.

The following hypotheses were advanced in the study:

Hypothesis 1 - increasing the level of digitalization of the enterprise significantly increases its competitiveness;

Hypothesis 2 – R&D investment and development have the strongest effect among all factors;

Hypothesis 3 - innovations are a key mediator between digitalization and performance;

Hypothesis 4 - export orientation enhances the effect of digital transformations;

Hypothesis 5 - the impact of the scale of the enterprise is positive, but marginal.

So, the model quantifies which digital development factors provide competitive advantage to enterprises in an international context. It is suitable for testing strategic scenarios, comparing countries and industries, and predicting the effects of future digital investments.

2.4. Instruments

The Python language with the Statsmodels library was used for calculations. Tables were created in Pandas and formatted for publication. Visualizations were performed in Matplotlib. Primary data were processed in Excel for aggregation and verification. Cross-validation ensured the stability of the results. Analytical interpretations were based on theoretical approaches and practical data.

3. Results

The article provides an empirical analysis of the relationship between digital technologies and enterprise competitiveness in five European countries. The study is based on panel data for 2019–2024. The analysis covers Moldova, Romania, Ukraine, Poland, and Germany. The main goal is to identify key determinants of competitive advantage in the context of digital transformation. The study uses variables reflecting digital maturity, innovation level, R&D investment, export orientation, and enterprise size. A fixed effect econometric model was built to assess the impact of these variables. Table 1 illustrates the initial parameters by country and year, while Table 2 summarizes the results of the regression estimation.

Input data show significant international differences in the levels of enterprise digitalization. The highest average values are observed in Germany (0.83) and Poland (0.78). These countries have a developed digital infrastructure and stable institutional practices to support innovation. Ukraine and Romania demonstrate moderate rates of digitalization, with active development of online services and Enterprise Resource Planning (ERP) solutions. In Moldova, digitalization indicators are lower (0.45–0.55), but positive dynamics are observed every year. Regarding innovation, the highest average values are recorded in Germany (8.1) and Poland (7.4), while they fluctuate within 3–5 in Moldova and Ukraine. R&D spending have the greatest variation. In Germany, they reach 7–8% of total expenditures, while in Ukraine and Moldova they are about 2–3%. The share of exports in total revenues is significantly higher in Poland and Romania. Moldovan enterprises are mostly focused on the domestic market, which limits the effects of scaling. Enterprise sizes are largest in Germany (average value over 400 people), smallest in Moldova (about 100 people).

Table 1. Input Data

Country	Year	DIGI	INNOV	R&D	EXPORT	SIZE	Competitiveness
Moldova	2019	0.52	8	0.05	0.18	264	4.24
Moldova	2020	0.31	2	0.06	0.57	435	2.69
Moldova	2021	0.41	5	0.05	0.41	302	3.11
Moldova	2022	0.67	3	0.04	0.59	180	2.59
Moldova	2023	0.82	7	0.02	0.13	437	3.82
Moldova	2024	0.53	5	0.03	0.22	493	3.25
Romania	2019	0.37	8	0.01	0.55	469	4.05
Romania	2020	0.56	6	0.05	0.19	240	3.38
Romania	2021	0.81	2	0.04	0.56	400	2.54
Romania	2022	0.46	5	0.05	0.58	237	3.16
Romania	2023	0.63	9	0.03	0.18	394	4.43
Romania	2024	0.74	1	0.05	0.56	90	2.23
Ukraine	2019	0.85	9	0.05	0.27	97	4.62
Ukraine	2020	0.70	8	0.03	0.38	276	3.97
Ukraine	2021	0.37	3	0.06	0.38	304	2.69
Ukraine	2022	0.56	3	0.01	0.42	101	2.20
Ukraine	2023	0.64	4	0.07	0.22	286	3.07
Ukraine	2024	0.87	7	0.03	0.18	115	3.65
Poland	2019	0.67	9	0.02	0.33	157	4.24
Poland	2020	0.84	7	0.07	0.24	332	4.30
Poland	2021	0.56	4	0.03	0.25	247	2.49
Poland	2022	0.43	3	0.03	0.22	364	2.46
Poland	2023	0.49	8	0.06	0.28	491	4.23
Poland	2024	0.47	1	0.03	0.59	269	1.93
Germany	2019	0.33	5	0.03	0.42	175	2.92
Germany	2020	0.89	7	0.06	0.48	172	4.00
Germany	2021	0.45	6	0.04	0.42	247	3.50
Germany	2022	0.78	9	0.03	0.19	398	4.45
Germany	2023	0.82	4	0.01	0.36	196	2.60
Germany	2024	0.86	8	0.04	0.57	178	4.22

Source: developed by the author based on the results of an econometric model using the data from (Deloitte 2023; European Commission 2024; Gartner 2023; International Monetary Fund 2023; International Telecommunication Union 2023; McKinsey & Company 2023; National Bureau of Statistics of the Republic of Moldova 2024; OECD 2023; Polish Central Statistical Office 2024; PwC 2023; State Statistics Service of Ukraine 2024; Statista 2024; United Nations Conference on Trade and Development 2023; World Bank 2024; World Trade Organization 2023)

Considering international comparison, digitalization in the selected countries has different depth, infrastructure, and sectoral orientation. In Germany, digital technologies are integrated into production chains, including the widespread use of ERP, Customer Relationship Management (CRM), artificial intelligence (AI) and the Internet of Things (IoT) in industry, mechanical engineering and the pharmaceutical sector. Poland demonstrates a high level of digitalization in logistics and retail, with active use of cloud services, e-commerce and data analytics, which ensures flexibility and scalability of business models. Cloud solutions, ERP systems and online tools have become the key areas of digitalization in Ukraine, especially in IT, agribusiness and small businesses, which is a response to crisis challenges. In Romania, digital transformation focuses on accounting automation, the implementation of mobile business applications and digital document management, which is actively supported in the export sector. In contrast, digitalization remains basic in Moldova, with a gradual transition to CRM solutions, mainly in small manufacturing enterprises and the service sector.

The structure of R&D also varies by country. In Germany, R&D spending exceeds 7% and is directed at biotechnology, IT solutions, and the green transition in the energy sector. Poland uses national start-up support programmes aimed at transport technologies, digital energy and innovations in the agricultural sector. Ukrainian

enterprises focus on applied developments in the areas of drones, cybersecurity, agrotechnologies and financial innovations, often attracting foreign funding. In Romania, R&D is focused on improving the efficiency of production processes, local software development and digital security solutions. In Moldova, R&D is concentrated in the food and light industry, mostly through participation in international technical assistance programmes. Such a detailed analysis of digital strategies and areas of R&D investment provides a better understanding of national models of digital transformation and their impact on competitiveness.

The regression model gives grounds for drawing conclusions about the impact of each variable on competitiveness. All independent variables are statistically significant at $p<0.01$, which confirms the reliability of the estimate (Table 2). The R&D variable has the largest coefficient (8.70), which means a strong positive impact of research investment on competitive advantages. An increase in the share of R&D spending by 1% increases the competitiveness index by 8.7 points. This is in line with global trends, where innovative companies have more stable positions in the market. The DIGI variable has a coefficient of 0.52, which indicates a direct positive impact of digitalization on competitiveness.

Table 2. Results of Econometric Modelling of the Impact of Digital Technologies on the Competitiveness of Enterprises in Moldova, Romania, Ukraine, Poland, and Germany for 2019–2024

Variable	Coefficient	Standard Error	t-statistic	P-value	95% CI (Lower)	95% CI (Upper)
Intercept	0.602	0.155	3.89	0.0007	0.283	0.922
DIGI	0.517	0.131	3.94	0.0006	0.247	0.788
INNOV	0.308	0.010	31.63	<0.0001	0.288	0.328
R&D	8.702	1.195	7.28	<0.0001	6.235	11.168
EXPORT	0.455	0.156	2.91	0.0076	0.133	0.778
SIZE	0.00083	0.00019	4.39	0.0002	0.00044	0.00122

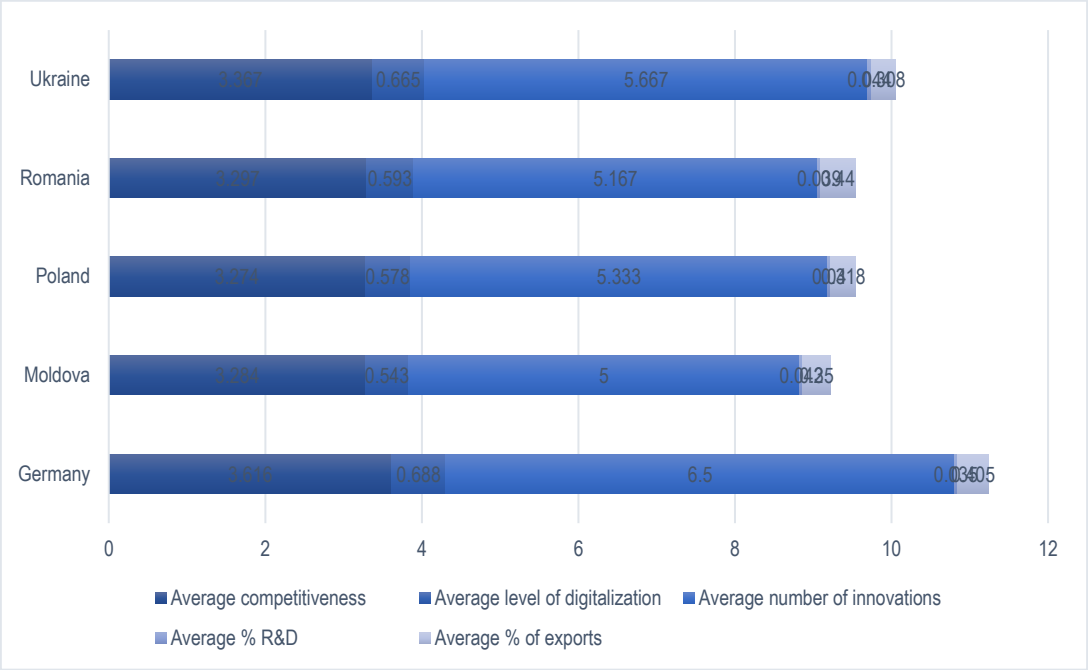
Source: developed by the author based on the results of an econometric model using the data from (Deloitte 2023; European Commission 2024; Gartner 2023; International Monetary Fund 2023; International Telecommunication Union 2023; McKinsey & Company 2023; National Bureau of Statistics of the Republic of Moldova 2024; OECD 2023; Polish Central Statistical Office 2024; PwC 2023; State Statistics Service of Ukraine 2024; Statista 2024; United Nations Conference on Trade and Development 2023; World Bank 2024; World Trade Organization 2023)

Enterprises with developed digital platforms and analytical tools demonstrate higher efficiency. The INNOV variable has a coefficient of 0.31, which is also statistically significant. Each additional implementation of an innovative product or process increases competitiveness by almost a third of a point. Export orientation (EXPORT) also plays an important role, with a coefficient of 0.46. This confirms that enterprises that are integrated into global markets have higher adaptability and resilience. Enterprise size (SIZE) also showed a positive effect, but the smallest among all variables (0.00083). Large enterprises have better opportunities to implement digital solutions, but the scaling effect is less pronounced.

In Germany and Poland, digitalization has become an organic part of business models, ensuring a steady growth of competitive advantages. The effect of R&D is particularly noticeable in these countries, as an active innovation ecosystem is maintained. In Ukraine, digital solutions are often implemented in response to external challenges, including war and economic instability. At the same time, this leads to rapid adaptation, especially in the IT and logistics sectors. Gradual digitalization is observed in Moldova, but the lack of investment in innovation reduces the effectiveness of transformations. Romania demonstrates balanced development, combining digitalization with export activity and moderate innovation efforts. It is clear that R&D, digitalization, and innovation are interrelated factors in increasing competitiveness in all countries.

The highest average competitiveness index is observed in Germany (3.62), which confirms a stable digital infrastructure and effective innovation management (Figure 2). Ukraine ranks second (3.37), due to active digital adaptation in times of crisis, namely destruction, military operations, the need for reconstruction, and a moderately high level of R&D (0.044). In Moldova (3.28), the competitiveness index is higher than in Poland (3.27), despite a lower level of digitalization, which indicates the effectiveness of other factors. Romania has the highest average export index (0.44), which compensates for relatively lower levels of innovation and digital solutions. The results demonstrate that the combination of digitalization, innovation, export activity, and R&D has a synergistic effect to increase the competitive advantage of enterprises.

Figure 2. Summary Data of Average Indicators for Selected Countries



Source: developed by the author based on the results of an econometric model using the data from (Deloitte 2023; European Commission 2024; Gartner 2023; International Monetary Fund 2023; International Telecommunication Union 2023; McKinsey & Company 2023; National Bureau of Statistics of the Republic of Moldova 2024; OECD 2023; Polish Central Statistical Office 2024; PwC 2023; State Statistics Service of Ukraine 2024; Statista 2024; United Nations Conference on Trade and Development 2023; World Bank 2024; World Trade Organization, 2023)

The results of the study confirm the key role of digital technologies in creating sustainable competitive advantages of modern entrepreneurship. Digitalization significantly improves management efficiency, reduces costs and expands market opportunities. Innovative activity acts as a multiplier of the digitalization effect. R&D investment, especially in high-tech sectors turned out to be the most effective factor. Export orientation enables enterprises to capitalize on digital advantages in international markets. The size of the enterprise has a secondary impact, but large firms have more resources for digital transformation. The results have practical significance for government programmes to support the digitalization of SMEs. In countries with innovative and digital economies, it is important to create institutional conditions to stimulate innovation and technological development.

4. Discussion

The results of the study confirm the key thesis of Lüdeke-Freund (2020) about the need to combine innovation, entrepreneurship and sustainability into a single business model. We agree with the author that successful entrepreneurship requires the integration of digital technologies and environmental responsibility. Verhoef *et al.* (2021) emphasize the interdisciplinary nature of digital transformation, which is fully consistent with our international approach to the analysis. Our model deepens their findings by adding an econometric dimension of the digital impact on competitiveness. Gavrila-Gavrila and De Lucas Ancillo (2022) argue that the pandemic has accelerated digitalization, which we confirm for Ukraine and Moldova. We complement their results with a comparative assessment of digital adaptation in countries with different digital bases. Anand *et al.* (2021) note in their bibliometric analysis that research on sustainable entrepreneurship is too fragmented. Our study compensates for this fragmentation by integrating digital, institutional, and innovation parameters into a single model. Bican and Brem (2020) raise the issue of the sustainability of digital business models. We fully agree with it. Our model shows that R&D investment that create the foundation for sustainability in the context of digitalization.

At the same time, the results confirm the importance of the regulatory environment, which Kussainov *et al.* (2023) cover in the context of digital security in the EU. Their focus on AI as a transparency tool complements our thesis on the importance of digital governance strategies. Melnyk *et al.* (2022) argue for the importance of anti-corruption mechanisms for institutional resilience, which supports our findings on the role of public administration in digital transformation. Nikonenko *et al.* (2022) emphasize the potential of Industry 4.0 for investment

attractiveness, having something in common with our focus on the impact of digital technologies on external markets. We extend these approaches by assessing specific factors of export activity in a competitive advantage model. Shafranova *et al.* (2024) consider digital currencies and quantum financial systems as the next stage of digital transformation. Although this is beyond the scope of our model, we acknowledge the value of their work as a strategic reference for further research. Koldovskiy (2024) and Kryvoviaziuk (2013) emphasize the importance of strategic digital infrastructure, which is consistent with our findings on the critical role of digitalization in transforming economies.

So, the results of our study confirm and deepen current academic approaches to the study of digital entrepreneurship in the context of sustainable development. We agree with the main provisions of earlier studies, also supplementing them with a quantitative cross-country assessment of digital advantages in business. So, our approach can also quantitatively assess the enterprise potential of modern enterprises in the context of the digital economy, which is an important indicator of their long-term sustainability.

4.1. Limitation

The study covers only five countries, which limits the scope of generalizations. The sample of enterprises does not cover all sectors of the economy. The data is obtained from open sources and may contain errors. The impact of digital technologies was estimated on an average across countries without sectoral detail. Changes in the regulatory environment that could have affected digitalization were not considered.

4.2. Recommendations

It is recommended to expand the geography of the study to other regions of Europe and the world. It is appropriate to conduct analysis at the level of individual business sectors. Sustainable development indicators should be integrated into the competitiveness model. It is appropriate to consider the impact of state digital policies on the effectiveness of transformations. It is advisable to include dynamic indicators to track changes in real time.

Conclusions

As a result of the study, the goal was fully achieved, and all the identified tasks were successfully completed. The developed econometric model confirmed a sustainable positive impact of digital technologies on the creation of competitive advantages of enterprises. The analysis covered data from five European countries for 2019–2024, considering international differences. All five variables of the model were statistically significant: digitalization, innovativeness, R&D spending, export orientation, and enterprise size. The highest coefficient was R&D – 8.70, which indicates its critical role in strengthening market positions. The level of digitalization showed a strong impact ($\beta = 0.52$), confirming the importance of technological maturity for strategic success. Innovative activity ($\beta = 0.31$) and orientation to foreign markets ($\beta = 0.46$) also significantly contribute to the growth of competitiveness. The effect of firm size was the smallest ($\beta = 0.00083$), but still positive and statistically significant.

The results of the study confirm that digital technologies are a catalyst for the development of enterprises regardless of their country of location. At the same time, the impact of digitalization is more pronounced in combination with innovation, expansion into new markets and internal development. Enterprises in Germany and Poland had the highest indicators of digital efficiency, which is associated with a high level of institutional support. In Ukraine and Moldova, digitalization was often a forced reaction to external challenges but demonstrated positive dynamics. The obtained results have practical significance for shaping national strategies for the digital transformation of entrepreneurship, digitalization is especially important for countries that are in a state of post-crisis recovery and integration into the European space. A key role in the creation of digital advantages is played by the combination of innovation and entrepreneurial potential, which includes the ability to adapt, scale, and integrate digital solutions.

Further research should focus on sectoral analysis of the effects of digitalization, taking into account the specifics of economic sectors. Special attention should be paid to small businesses in the fields of healthcare, education, agribusiness, and digital services. Another promising direction is the integration of indicators of sustainable development, digital environmental friendliness, and cybersecurity into the competitiveness model. Analysis of the effectiveness of state policy on digital transformation also requires deeper study in subsequent empirical work.

Credit Authorship Contribution Statement

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solutions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Use of Generative AI and AI-assisted Technologies

The authors declare that they have not used generative AI and AI-assisted technologies during the preparation of this work.

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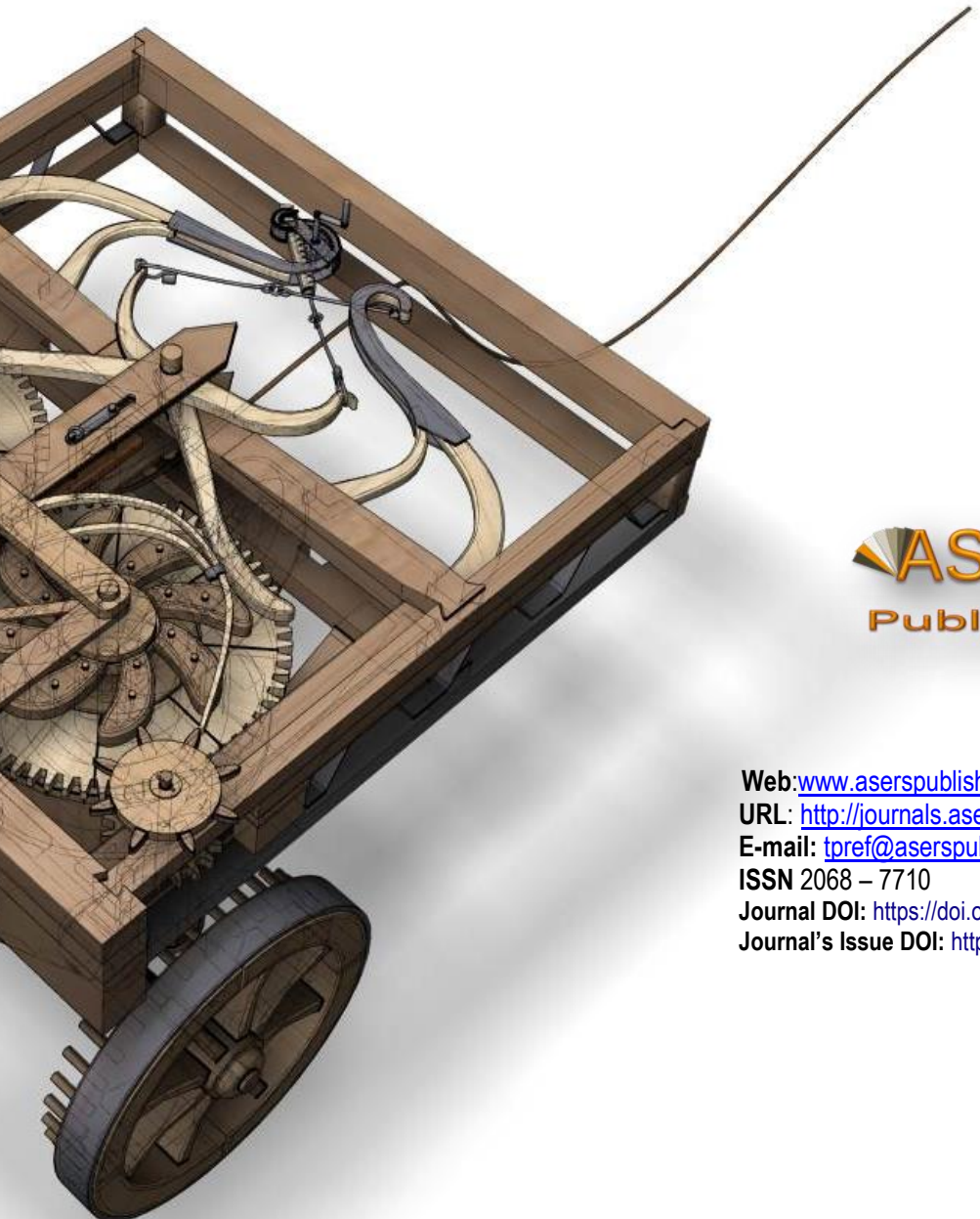

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