

DIGITAL TECHNOLOGIES AS A TOOL FOR INCREASING THE BUSINESS COMPETITIVENESS

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ABSTRACT

Digital technologies provide businesses with numerous benefits, but their positive effect of enhancing competitiveness is most strongly manifested in interaction with other influencing factors, in particular, innovations. The aim of the study is to assess the joint impact of digitalization and innovation on the business competitiveness taking into account macroeconomic and corporate factors. The study employed the methods of regression, variance, and correlation analysis. The analysis found that digitalization has a statistically significant impact on the competitiveness of countries through the indicators Digital Skills Among Active Population and Individuals Using the Internet. The relative impact of these indicators on the competitiveness of countries is 0.6833 and 0.3024, respectively. Innovation plays a mediating role in the impact of digitalization on competitiveness through the Institutions indicator. This gives grounds to conclude that enhancing the competitiveness of the country and the business sector requires not only technological development. It also requires improving the quality of the institutional environment to fully realize the potential of digital technologies. Analysis of the impact of companies' research and development (R&D) spending on revenue revealed a positive correlation between these indicators. With an increase in R&D spending by 1 unit, expected revenue increases by 0.5571 units. Accordingly, an increase in R&D spending has the potential to increase the efficiency of business activities, which ultimately leads to increased revenue through innovation and process optimization. The findings can be useful for entrepreneurs for improving business strategies by focusing on the identified determinants of the impact of digitalization on competitiveness. Determining the role of innovation in this process is also important for innovation policymakers to optimize the environment for enhancing competitiveness through the effective use of digitalization and innovation.

Keywords: *Digitalization; Innovation; Institutions; Competitive Advantage; Entrepreneurship*

1. INTRODUCTION

Digital technologies have become a challenging issue in all areas of people's lives, and entrepreneurship is no exception. Digitalization affects businesses both at the macro level, creating appropriate conditions for development, and at the micro level – through the introduction of new technologies directly into the companies' activities [1]. The level of company's digitalization, as well as the level of digitalization in the country as a

whole, determine the competitiveness of businesses through numerous factors [2]. A high level of digitalization in a country implies the existence of a favourable institutional environment to support competitive advantages, as well as the development of technologies and innovations, effective infrastructure, state educational programmes, etc. The introduction of digital technologies into the companies' activities improves the collection of information and data, maintaining customer statistics, improving the customer experience,

increasing profits, and reducing costs. Digital technologies increase efficiency and flexibility, productivity, improve the decision-making process, and open up new opportunities [3],[4]. The mentioned benefits ultimately lead to more sustainable competitive advantages.

At the same time, the introduction of digital technologies into business activities should be rational and correspond to the key objectives of the activity [5]. Otherwise, digitalization may lead to excessive costs without obtaining the expected return. Regarding digitalization at the macro level, companies should take into account the existing opportunities and limitations associated with the environment in which they operate.

The above-mentioned fact urges the research into key influencing factors of digitalization on the business competitiveness and the state as a whole. It should be noted that digitalization by itself may have a smaller impact on competitiveness than digitalization in combination with other influencing factors. One of such factors is the level of innovative development, which, in addition to the introduction of new technologies, also covers other areas. These include R&D, government initiatives to improve the innovation climate, regulatory features, market development, human capital, infrastructure, etc. The impact of digitalization on competitiveness can be mediated by the observed factors of the innovation environment, they can both stimulate digital development and inhibit it. Therefore, the assessment of the impact of digital technologies on competitiveness should include other potentially influencing factors. This will enable identifying the key determinants of the impact of digital technologies on competitiveness and influence them through economic, regulatory, and management mechanisms.

So, the key hypothesis of the study is that the level of business competitiveness is largely determined by the synergistic impact of digitalization and factors of the innovation environment. Specifically, the research hypothesis states that innovation acts as a mediating factor in the relationship between digitalization and business competitiveness, and that this mediating effect is most significantly realized through institutional support mechanisms. The approach to identifying key determinants that mediate the impact of digitalization on the business competitiveness proposed in this study is new. This is important given that digitalization itself may not bring the expected efficiency in the absence of appropriate conditions and predictors. Identifying mediating

factors will make it possible to develop effective measures to influence them, which will lead to an increase in the positive impact of digitalization on competitiveness. The study covers the macroeconomic and corporate levels of the impact of digitalization and innovation on competitiveness, limited to quantitatively measured indicators, which may not fully reflect all qualitative aspects of competitiveness. Also, the study does not take into account industry specifics, which may affect the strength of the identified relationships, which should be taken into account when interpreting the results. The purpose of the study is to develop and test a new approach to assessing the synergistic impact of digitalization and innovation development factors on the competitiveness of companies, taking into account macroeconomic and corporate determinants. The aim involved the fulfilment of the following research objectives:

- Assess the impact of digitalization on the overall competitiveness of countries;
- Analyse the role of innovation as a mediator between digitalization and competitiveness;
- Assess the impact of R&D investment on the companies' revenue.

2. LITERATURE REVIEW

The use of digital technologies significantly affects various dimensions of business competitiveness, which is confirmed in many studies. Hermundsdottir and Aspelund [6] found that innovation and competitiveness are positively related. Zahra et al. [7] provides a thorough discussion of the impact of digital technologies on the creation, development, and growth of new companies. Agustian et al. [8] emphasized that digital transformation has become a necessity to maintain competitive advantages of businesses, and not a matter of their free choice. However, the papers do not provide a quantitative assessment of the extent to which digital transformation contributes to productivity or profitability. Thus, the contribution of the noted papers is mainly theoretical and requires empirical verification.

Some studies focus on more specific indicators of digitalization and competitiveness. Leão and da Silva [9] noted that digital transformation affects companies' competitiveness mainly through innovation, modernization, efficiency, management, etc. But the researchers' analysis is limited to the macro level, making it difficult to apply the results to assess the competitiveness of individual companies. Using

quantitative analysis, Dabbous et al. [10] proved that digitalization affects entrepreneurial activity and sustainable competitiveness. However, the focus of this work is somewhat different from the author's work, as it focuses on sustainability aspects. Lányi et al. [11] found a positive impact of some aspects of digital transformation on business competitiveness. But scholars have only considered the presence of websites as an indicator of digitalization, which is a simplistic approach to a complex phenomenon. Knudsen et al. [12] presented opposing views on the impact of digitalization on the sustainability of competitive advantage. On the one hand, digitalization can lead to hyper-competition, making such an advantage less sustainable. On the other hand, it provides benefits for development and sustainability. However, their study mainly focuses on the role of big data and network effects, which does not encompass the broader context of digital transformation.

Many studies focus on specific industries or regions. Llopis-Albert et al. [13] showed that investments in adapting to digital transformation are necessary because they contribute to increased profits, increased productivity and competitiveness of companies. But the limitation to only one (automotive) industry does not allow us to extrapolate these results to other sectors of the economy. Burinskiene and Daskevici [14] provided important conclusions based on the results of assessing the impact of digital technology implementation on competitiveness. But the paper lacks cross-sectoral comparability or an assessment of the universality of the proposed conclusions. Fan et al. [15] found a direct impact of digital technology on the competitiveness of the enterprise, but the study sample covers only Chinese companies, which limits the relevance of the study in a global context. Matalamäki and Joensuu-Salo [16] found that digitalization affects all key factors of business growth, but focus on a small sample of Finnish companies. Finland is a leader in innovation and digitalization, so the authors' conclusions may not be relevant for companies in less developed countries.

Martínez-Peláez et al. [17] found that the innovation process improves the competitiveness of enterprises at the local and global levels. Farida and Setiawan [18] considered the impact of innovation in the process of assessing the impact of business strategies on improving the competitive advantages of enterprises. Corvello et al. [19] found that innovation in business is a prerequisite for survival, especially during significant shocks, such as the

COVID-19 pandemic. Hasan et al. [22] proved that the implementation of digital technologies increases the long-term productivity and resilience of enterprises. Rambe and Khaola [21] confirmed the direct relationship between innovation and technology transfer and the productivity and competitiveness of enterprises in developing countries. But these studies only concern SMEs and do not take into account the specifics of large enterprises – the key drivers of innovation in most economies.

In addition to the impact on business competitiveness, some researchers noted the important role of digitalization in increasing the overall competitiveness of countries. Marti and Puertas [22] hold that the competitiveness of countries can be assessed through the level of digitalization and innovation potential, however, the focus on the macro level does not allow for assessing effects for specific types of businesses or industries. Ordóñez de Pablos [23] noted the significant potential of digital technologies to accelerate economic recovery after shocks and create long-term competitive advantages. However, the study lacks an in-depth assessment of the impact of important aspects of digitalization on competitiveness. Boikova et al. [24] identified determinants of the competitiveness of European Union (EU) countries, including: macroeconomic stability, digitalization, R&D, trade openness, and foreign direct investment (FDI). However, their assessment is limited to the national level, which leaves corporate practices out of consideration.

A number of studies examined the relationship between digitalization and innovation, as well as their joint impact on competitiveness. Gao et al. [25] demonstrated the positive impact of high levels of digitalization on innovation performance. Wen et al. [26] found an indirect impact of digital transformation on the companies' competitive strategies. However, studies focus on specific industries (e.g., manufacturing), which reduces the generalizability of findings. Rambe and Khaola [21] examined the relationship between innovation, technology transfer, productivity, and competitiveness, but paid less attention to digitalization indicators.

Despite numerous studies, empirical findings on the relationship between digitalization, innovation, and competitiveness remain controversial. For example, Hermundsdottir and Aspelund [6] and Fan et al. [15] confirm the positive impact of digital technologies on the growth of competitive advantages. In contrast, Knudsen et al. [12] note that digitalization can lead

to hyper-competition, reducing the sustainability of competitive positions. A significant part of the research [14], [16] focuses on individual industries or countries, which limits the generalizability of their results. In addition, insufficient attention has been paid to the role of the institutional environment as a mediator between digitalization and competitiveness. It is this gap that necessitated the need for a comprehensive study that takes into account the macro- and micro-levels of the impact of digitalization, with an emphasis on innovation institutions as a key determinant.

3. METHODOLOGY

3.1. Research design

Stage 1. Data collection and preparation

Data sources:

For analysis at the country level, data from official international databases (IMD World Competitiveness Center, World Bank, World Intellectual Property Organization) were used.

For analysis at the company level, financial and innovation indicators from reports of leading innovative companies, including FDI Intelligence data.

Data processing:

Cleaning of omissions and anomalies.

Data normalization and standardization.

Formation of a representative sample: 44 countries for the macro level, 65 companies for the corporate level.

Stage 2. Analysis of the impact of digitalization and innovation on competitiveness

Assessment of the impact of digitalization on the competitiveness of countries

Method: multivariate linear regression analysis.

Variables:

Dependent: World Competitiveness Score (competitiveness index).

Independent: Digital skills among active population, Individuals using the Internet (% of population).

Purpose: to identify the direct impact of digital factors on the overall level of competitiveness.

Assessment of the impact of innovations (GII sub-indices) on the competitiveness of countries

Method: multivariate linear regression analysis.

Variables:

Dependent: World Competitiveness Score.

Independent: GII sub-indices (Institutions, Human capital and research, Infrastructure, Business sophistication, Creative outputs, Knowledge and technology outputs, Market sophistication).

Purpose: to determine which components of the innovation environment are most significant for competitiveness.

Analysis of the impact of digitalization on the innovation sub-index Institutions

Method: multivariate linear regression analysis.

Variables:

Dependent: Institutions sub-index.

Independent: Digital skills among active population, Individuals using the Internet (% of population).

Purpose: to assess how digitalization affects the institutional environment, which is a component of innovation.

Assessment of the joint impact of digitalization and innovation (Institutions) on competitiveness

Method: multivariate linear regression analysis.

Variables:

Dependent: World Competitiveness Score.

Independent: Digital skills among active population, Individuals using the Internet (% of population), Institutions.

Purpose: to investigate the interaction of digitalization and institutional factors in the formation of competitiveness; identify a potential mediation effect.

Stage 3. Assessment of the impact of research and development (R&D) spending on company revenues

Method: linear regression.

Variables:

Dependent: company revenue growth rate (Revenue growth).

Independent: R&D investment growth rate (R&D Growth).

Purpose: to determine the extent to which investments in research and development affect the financial performance of leading innovative companies.

Additional methodological details for repetition:

Software:

Excel, StatPlus.

Checking regression assumptions:

Testing heteroscedasticity (White test).

Checking autocorrelation (Durbin-Watson test).

Checking the normality of the distribution of residuals (Shapiro-Wilk test).

Assessing multicollinearity:

Using VIF (Variance Inflation Factor) and Tolerance to control for multicollinearity between independent variables.

Visualization:

Constructing scatter plots to detect correlation between variables, detecting outliers.

Outlier processing:

Identifying and removing observations with excessive influence on the model (high values of Cook's D, DFFITS).

This approach was aimed at identifying determinants of the impact of digitalization on competitiveness and identifying potential mediators. This approach also took into account the assessment at both the country and company levels. The final stage of the research involved drawing conclusions and providing recommendations based on the obtained results.

3.2. Sample

The impact of digitalization at the country level was assessed by making a sample of countries and the corresponding indicators of digitalization, competitiveness, and innovation. First of all, a sample of indicators was made. The indicators of digitalization included the indicators Digital Skills among Active Population and Individuals Using the Internet (% of population). These indicators reflect the level of digital literacy of the population and the availability of Internet technologies, which are key factors of digitalization. The level of competitiveness was characterized by the World Competitiveness Score, which assesses the countries' ability to create and maintain an environment for the development of the companies' competitiveness. The indicator covers government efficiency, economic efficiency, business efficiency, and infrastructure. The GII was used to assess innovation, which measures the countries' innovation efficiency in various areas through its sub-indices. These are Institutions, Human Capital and Research, Infrastructure, Business Sophistication, Creative Outputs, Knowledge and Technology Outputs, Market Sophistication. The sample of countries consisted of 44 countries from different regions of the world, the inclusion criterion was the availability of data for the specified indicators.

The impact of R&D investment on companies' revenue was assessed using data from 65 companies from the Top 100 global innovation leaders list [27]. A total of 35 companies from the

list were excluded from the study due to significant discrepancies in their results. These companies had anomalous residuals (their actual values were significantly different from the predicted ones) and high leverage (unusual values of independent variables). High Cook's D and Difference in Fits (DFFITS) for companies indicated too strong an impact on the regression model, which could lead to unstable results*. The sample included companies from the US, Netherlands, China, UK, Germany, Sweden, Japan, Taiwan, Ireland, Finland, Switzerland, Denmark, France, South Korea. At this stage, the impact of the increase in companies' R&D spending on their revenue growth was analysed. Investment in R&D, which can include costs for innovation and digitalization, have the potential to make a significant impact on competitiveness, which is realized through the creation of new technologies, products, and services.

* Note: Anomaly residuals ($> \pm 2$), meaning their actual values were significantly different from the predicted ones. High leverage, meaning they had unusual values of the independent variables. High Cook's D and DFIT, showing that they strongly influenced the regression model.

3.3. Methods

The main method of the study was the analysis through linear regression. This method revealed the influence of the studied independent variables on the dependent indicators, as well mediation effects. The general formula of the regression model used in the work has the form:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \varepsilon$$

where:

Y – dependent variable;

X_1, X_2, \dots, X_n – independent variables;

β_0 – Intercept;

$\beta_1, \beta_2, \dots, \beta_n$ – regression coefficients;

ε – random error of the model.

All constructed models are statistically significant according to the F-statistic and p-values, which confirms their reliability in explaining the variation of the variables. The R indicator for the models assessing the impact of digitalization at the country level ranges from 0.80 to 0.89, which indicates a strong correlation between the variables in the models. The R² indicator in these models ranges from 0.63 to 0.76, which indicates that the models explain from 63 to 76% of the variation in the dependent variables. Slightly lower R² values are observed for the model assessing the impact of

R&D investment on the companies' revenue – 0.4, therefore, it explains 40% of the variation. However, the R indicator for this model is also quite high (0.64). The results of the regression analysis were checked using statistical tests to assess their validity and reliability. In particular, these are the White test for heteroscedasticity, the Durbin-Watson test for autocorrelation, and the Shapiro-Wilk test for normality of the distribution of residuals. The results of the regression analysis were supplemented by the use of correlation and variance analyses. Correlation analysis using the Pearson correlation coefficient was used to assess

the strength and the correlation between variables. Analysis of variance (ANOVA) identified potential variations in the data that complement the conclusions of the regression model.

5. RESULTS

The first stage of the analysis assessed the direct impact of digitalization on overall competitiveness. The dependent variable was the World Competitiveness Score, and the independent variables were digitalization indicators. Table 1 presents the results of the regression analysis.

Table 1: Results Of The Analysis Of The Impact Of Digitalization Indicators On Overall Competitiveness

	Coef.	Standard error	LCL	UCL	t-statistic	p	H0 (5%)	VIF	TOL	Beta
Y-intercept	-32.8480	13.0669	-59.2783	6.4178	-2.5138	0.0162	rejected			
Digital skills among active population (1-7)	0.8939	0.1215	0.6482	1.1396	7.3585	0.0000	rejected	1.1500	0.8696	0.6833
Individuals using the Internet (% of population)	0.5097	0.1565	0.1932	0.8261	3.2572	0.0023	rejected	1.1500	0.8696	0.3024

Source: developed by the author based on [28],[29]

Table 1 shows that both of the included digitalization indicators have a significant direct impact on competitiveness. According to Beta, the impact of Digital Skills among Active Population has the strongest impact on competitiveness. The next stage of the analysis involves assessing the impact of innovations on competitiveness, which

can provide deeper insights into the relationship between the indicators under study. Instead of the integral GII indicator, its subindices were used for this analysis to determine which dimensions of innovation can have the greatest impact on competitiveness (Table 2).

Table 2: Results Of The Analysis Of The Impact Of Innovations (GII Subindices) On Competitiveness

	Coef.	Standard error	LCL	UCL	t-statistic	p	H0 (5%)	VIF	TOL	Beta
Y-intercept	87.564	2.3845	82.7229	92.404	36.7226	0.0000	rejected			
Institutions	0.1775	0.0589	0.0579	0.2970	3.0128	0.0048	rejected	2.7091	0.3691	0.3698
Human capital and research	0.0814	0.0875	-0.0962	0.2589	0.9301	0.3587	accepted	4.6038	0.2172	0.1488
Infrastructure	0.1696	0.0850	-0.0029	0.3422	1.9956	0.0538	accepted	4.0966	0.2441	0.3012
Business sophistication	0.0802	0.1124	-0.1481	0.3084	0.7130	0.4806	accepted	5.0129	0.1995	0.1190
Creative outputs	-0.0394	0.1149	-0.2727	0.1939	-0.3426	0.7340	accepted	6.7643	0.1478	-0.0664
Knowledge and technology outputs	-0.0664	0.1086	-0.2868	0.1540	-0.6118	0.5447	accepted	7.3849	0.1354	-0.1240
Market sophistication	0.1436	0.0769	-0.0126	0.2997	1.8663	0.0704	accepted	3.5551	0.2813	0.2624

Source: developed by the author based on [28],[30]

The results of the analysis show that only one of the GII sub-indices has a statistically significant direct impact on competitiveness –

Institutions. This means that a stable regulatory environment, effective public administration, the availability of innovation laws and appropriate

business conditions create a favourable climate for increasing competitiveness. The next step is to check the impact of digitalization on innovation. In this case, instead of the integral GII indicator, its sub-index – Institutions, was taken, which, according to the results of the previous analysis, showed the greatest impact on competitiveness (Table 3).

Table 3: Results Of The Analysis Of The Impact Of Digitalization Indicators On Innovation (Institutions Sub-Index)

	Coef.	Standard error	LCL	UCL	t-statistic	p	H0 (5%)	VIF	TOL	Beta
Y-intercept	228.77	31.3807	165.29	292.2404	7.2901	0.0000	rejected			
Digital skills among active population (1-7)	2.0609	0.2917	2.6510	1.4709	7.0645	0.0000	rejected	1.1500	0.8696	0.7190
Individuals using the Internet (% of population)	0.6885	0.3758	1.4486	0.0715	1.8323	0.0745	accepted	1.1500	0.8696	0.1865

Source: developed by the author based on [29],[30]

The results indicate a statistically significant positive impact of Digital Skills among Active Population on the Institutions subindex. The Individuals Using the Internet indicator does not have a statistically significant impact on the dependent indicator. Therefore, digitalization significantly affects both competitiveness and innovation – mainly through the digital skills of the

population. The next step is to assess the joint impact of digitalization and innovation on competitiveness to identify how digitalization and innovation interact in the process of building competitiveness. The impact of innovation was assessed by using the Institutions indicator only, which has a significant impact on competitiveness.

Table 4: Results Of The Analysis Of The Impact Of Digitalization And Innovation Indicators (Institutions Subindex) On Competitiveness

	Coef.	Standard error	LCL	UCL	t-statistic	p	H0 (5%)	VIF	TOL	Beta
Y-intercept	11.2178	18.0397	-	47.7373	0.6218	0.5378	accepted			
Digital skills among active population (1-7)	0.4969	0.1647	0.1634	0.8304	3.0164	0.0045	rejected	2.6215	0.3815	0.3798
Individuals using the Internet (% of population)	0.3770	0.1465	0.0805	0.6735	2.5742	0.0141	rejected	1.2490	0.8007	0.2237
Institutions	0.1926	0.0599	0.3139	0.0714	3.2165	0.0027	rejected	2.8462	0.3513	0.4220

Source: developed by the author based on [28],[29],[30]

The table above shows that the analysis of the joint impact confirmed the statistically significant impact of all the studied indicators of digitalization and innovation on competitiveness. It is worth noting that according to Beta, the impact of digitalization indicators has slightly decreased, and that of innovation (the Institutions subindex) has increased. This may indicate that innovations, in particular the Institutions dimension, play a

mediating role in the impact of digitalization on competitiveness. In other words, digitalization increases competitiveness by itself, but its impact is increasingly strengthened due to the improvement of the institutional environment. The observed decrease in the impact of regression coefficients on digitalization indicators may indicate that a share of their impact is intercepted by institutional factors, which indicates a partial mediation effect. The

significant impact of Institutions may indicate that the positive effect of digitalization is realized through this factor. This means that digitalization creates favourable conditions, but it may have a smaller impact on increasing competitiveness without effective institutions. Therefore, increasing the overall competitiveness of countries depends not only on the available digital skills and access to the Internet, but also on the creation of an effective institutional environment.

An additional stage of the analysis is identifying the impact of R&D spending on the income indicators of the world’s leading innovative companies. This will assess the impact of innovation and digitalization at the company level and show how R&D spending is related to their income, which is one of the important indicators of competitiveness. Table 5 presents the results of the analysis.

Table 5: Results Of The Analysis Of The Impact Of R&D Investment On Company Revenue

	Coef.	Standard error	LCL	UCL	t- statistic	p	H0 (5%)	VIF	TOL	Beta
Y-intercept)	1.0272	0.0218	0.9837	1.0707	47.2093	0.0000	rejected			
R&D Growth	0.5571	0.0841	0.3890	0.7252	6.6211	0.0000	rejected	1.0000	1.0000	0.6406

Source: developed by the author based on [27]

The results of the regression analysis showed a statistically significant direct effect of the increase in R&D spending on the growth of revenue of innovative companies. The regression coefficients show that with an increase in R&D spending by 1 unit, the expected growth in income

increases by 0.5571 units. The adjusted regression coefficient shows that the increase in R&D spending explains about 40% of the variation in revenue growth. A scatter plot for the observed variables is presented below, which clearly shows the identified correlations (Figure 1).

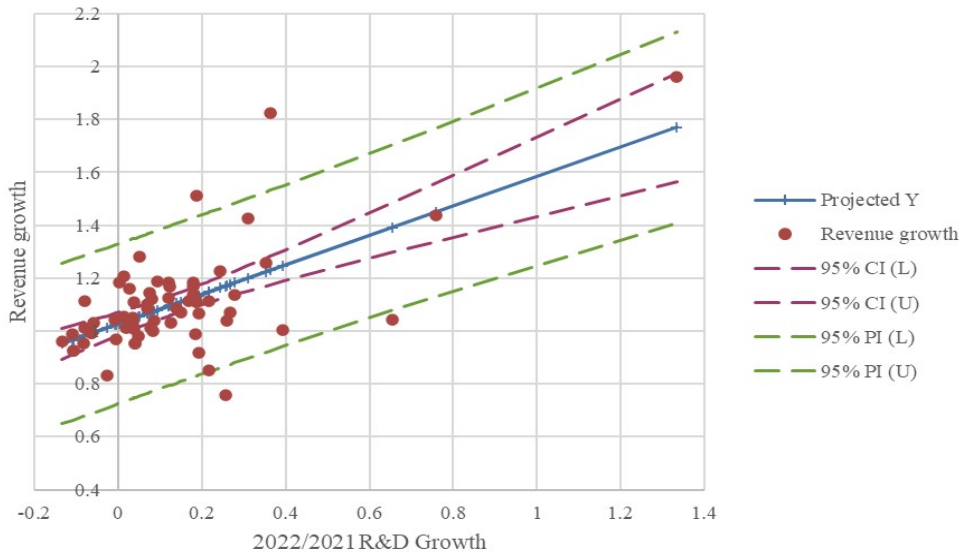


Figure 1: Scatter plot of Revenue Growth vs. R&D Growth

Figure 1 illustrates that the trend line has a positive slope, reflecting the correlation between the variables under study. The density of points around the line confirms the high correlation. The confidence interval indicates sufficient accuracy of the model. At the same time, outliers are noted — some points deviate significantly from the trend line, for example, the point (1.3344, 1.9617). This

point indicates the Chinese company BYD, which experienced significant revenue growth, exceeding that expected by the value of R&D Growth. Accordingly, other factors, in addition to R&D spending, have a significant impact on the income of such a company. In the case of BYD, this is the rapid growth in demand for electric vehicles, increased production, the abandonment of the

production of gasoline-powered cars, government support (subsidies for electric vehicles), etc. Therefore, spending on digitalization, innovation, R&D in general plays an important role in strengthening the companies' competitiveness. However, as with the impact of digitalization and innovation on competitiveness, this relationship is quite complex and is not reduced to technological and human factors. Other important factors may include internal company decisions (e.g. in marketing or management) as well as macroeconomic factors such as government support.

5. DISCUSSION

The analysis suggests that digitalization has a significant impact on competitiveness, but this impact is partially mediated by innovation. A special role in this process is played by state support for innovation policy, the creation of favourable conditions for the development of innovation and digitalization, and the general stability of the political system. Companies' R&D spending affects revenue growth, but is not the only important factor in increasing competitiveness.

Our findings are fully consistent with the views of Burinskiene and Daskevici [14] and Fan et al. [15], which found that digital technologies enhance competitiveness. This demonstrates the reliability of the results obtained in different contexts and using different methodologies. Our study also relied on the results of Dabbous et al. [10], which found the impact of digitalization on sustainable competitiveness, taking into account the Internet Use and Digital Integration indicators. However, scientists have underestimated the role of digital skills, while this study found their statistically significant impact on competitiveness.

Our findings on the mediating role of innovation are confirmed by the results of Shehadeh et al. [31], who found that innovative capacity mediates the relationship between digital transformation and competitive advantage. The researchers are confident that innovative capabilities moderate the relationship between entrepreneurial orientation, competitive advantage, and digital transformation. Farida and Setiawan [18] also noted that innovation mediates the relationship between business strategies and competitive advantage. The author's research specifies which dimension of innovation plays the greatest role in the interaction between digitalization and competitiveness, namely institutions and state support for innovation. This

details and adds practical value to the discussion on the role of innovation. These findings are supported by the results of Marti and Puertas [22], who demonstrated the need for governments to promote research and investment in infrastructure, which will improve the innovative and technological development of countries. This strengthens the author's arguments in favor of an integrated national innovation policy [32].

Gao et al. [25] proved a reverse effect of digitalization on the efficiency of innovation. The analysis conducted in this paper confirms this, pointing to the important role of digital skills, which indicates the need for further study of the cyclical relationships between digitalization and innovation. The author found that such an effect is exerted mainly through the level of digital skills of the population. It can be concluded on this ground that the relationship between innovation, digitalization, and competitiveness is quite complex and requires comprehensive study. This statement is consistent with the conclusions of Hermundsdottir and Aspelund [6], who demonstrated a direct relationship between innovation and competitiveness. The researchers noted that there is a complex relationship between these categories, which requires a thorough analysis for a deeper understanding.

Separate studies support the author's conclusions by analysing the impact of innovation spending on business competitiveness. Using the example of the automotive industry, Llopis-Albert et al. [13] proved the significant impact of digital transformation on increasing profits, productivity, and competitiveness. The analysis in our study takes into account the indicators of a number of large automotive companies and also demonstrates that R&D investment is an important factor in increasing profits. Boikova et al. [24] also proved that digitalization and R&D investment are the most significant factors in the competitiveness of EU countries. However, this study concerns the macro level, without revealing the impact of R&D investment at the company level. So, the practical significance of our findings is the identified key determinants of the impact of digitalization on competitiveness and identifying the role of innovation in this interaction. One of the most interesting findings of this study is the identification of the role of institutions, state support for innovation, and political stability in increasing competitiveness through digitalization. The practical use of the results is implementing the proposed recommendations in the business strategy of enterprises and the innovation strategy of the

state, allowing to focus on strengthening the most influential areas of increasing the efficiency of digitalization.

5.1. Limitations

The main limitations of the study relate to the lack of data for a number of countries, which led to a reduction in the sample, but did not significantly affect the overall result. The sample contains data for 44 countries from different regions of the world and with different levels of development, which is sufficient for analysis and ensures the reliability of the results.

5.2. Recommendations

- given the significant impact of Digital Skills among Active Population on the countries' competitiveness, it is recommended to invest in education and develop the digital skills of the population through state initiatives; appropriate corporate programmes for improving the skills of employees should be implemented and the concept of lifelong learning (LLL) should be supported at the enterprise level;

- the exclusive role of institutions in enhancing the impact of digitalization on competitiveness should be supported by increasing the efficiency of public administration. In particular, by improving legislation on innovations and creating a favourable climate for the formation and implementation of competitive advantages of enterprises; enterprises should implement constant monitoring of state policies and initiatives to comply with legislative standards and receive the greatest benefits from available support programmes;

- the impact of R&D spending on company revenue growth indicates the effectiveness of digitalization and innovation in supporting competitive advantages. However, such spending should be clearly defined and targeted to ensure maximum efficiency in the implementation of new technologies and R&D results.

6. CONCLUSIONS

The study highlights the exceptional role of digitalization in increasing the competitiveness of enterprises, while at the same time focusing on the importance of related influencing factors, in particular, innovation.

The novelty of the work lies in identifying and quantifying the indirect role of innovation, in particular the institutional factor, in the relationship between digitalization and competitiveness. The

proposed analytical approach allowed us to trace not only direct, but also indirect effects, which emphasizes the importance of a comprehensive study taking into account both the macroeconomic and corporate levels.

Key empirical results indicate a statistically significant impact of digitalization indicators on the competitiveness of countries. The most significant is the impact of the Digital Skills among Active Population indicator (Beta coefficient = 0.6833). The Individuals Using the Internet indicator has a smaller but significant impact (Beta = 0.3024), which indicates that Internet access alone does not guarantee unconditional competitive advantages, but is an important accompanying factor.

Regarding innovation, it was found that among the sub-indices of the Global Innovation Index (GII), only Institutions has a significant impact on competitiveness. This confirms that a stable regulatory environment, effective public administration, developed legislation in the field of innovation and favorable conditions for doing business are critically important for increasing national competitiveness.

Digitalization, in turn, has a significant impact on the institutional environment (Beta = 0.7190), which once again confirms the mediating role of institutions in the relationship between digitalization and competitiveness. Thus, digitalization creates the prerequisites for increasing competitive advantages, but in the absence of effective institutions, its positive effect is much weaker.

At the corporate level, an analysis of 65 companies — world leaders in terms of innovation — showed that the growth of R&D spending explains about 40% of the variation in revenue growth. This emphasizes the importance of innovation and digitalization for maintaining the competitiveness of companies in the context of increasing profitability.

The results obtained confirm the hypothesis put forward in the study and have practical value for the formation of business strategies of enterprises and state innovation policy. They allow focusing efforts on the development of digital competencies and institutional support.

In the context of dynamic market changes, the study makes a significant contribution to understanding the complex impact of digitalization, which goes beyond the technical aspect and includes socio-institutional factors. Further research should focus on studying the integration of digitalization and innovation into companies'

business strategies. It is important to analyze in detail how these processes affect adaptation to changing market conditions and maintaining long-term competitiveness.

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