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DIGITALIZATION AND INTERNATIONAL TRADE COMPETITIVENESS: EVIDENCE FROM 15 TRANSITION ECONOMIES

ЦИФРОВІЗАЦІЯ ТА КОНКУРЕНТОСПРОМОЖНІСТЬ У МІЖНАРОДНІЙ ТОРГІВЛІ: ДАНІ З 15 ПЕРЕХІДНИХ ЕКОНОМІК

Summary. Introduction. Digitalization has become a key factor in the development of international trade, especially for transition economies, where technological innovations can accelerate economic growth and integration into the global market. Through digital technologies, economies can reduce trade barriers, lower transaction costs, and enhance competitiveness. However, in practice, countries vary in their level of digital technology implementation and its impact on their economy. For transition economies, where digital transformations may be less widespread, studying this process is particularly important to identify the factors that ensure their adaptation to global challenges.

Objective. The aim of the research is to assess the impact of digitalization on the competitiveness of international trade in 15 transition economies and to

identify key factors that improve trade positions through innovative digital strategies. Special attention is given to studying the role of digital infrastructure and technologies that enhance the efficiency of international trade operations and allow countries to successfully integrate into global supply chains.

Materials and Methods. The study utilizes panel data from 15 transition economies for the period from 2020 to 2024, sourced from international databases such as the World Bank and the International Telecommunication Union (ITU). The analysis examines digital indicators such as the IT index, internet penetration, and the development of e-government. The methodology includes panel regression to study the relationship between the level of digitalization and international trade indicators, such as export, import, and trade integration indicators.

Results. The analysis shows that countries with more developed digital infrastructure demonstrate high levels of international trade, particularly increasing export volumes and improved integration into global supply chains. It was found that digitalization creates opportunities to reduce barriers in international trade, enhances transparency in trade procedures, and improves access to international markets. Additionally, digital strategies help countries effectively respond to economic and political challenges, improving the resilience of trade outcomes in unstable conditions. It is also significant that countries actively investing in digital infrastructure can significantly improve conditions for small and medium-sized enterprises, which are the foundation of economic stability and competitiveness.

Prospects. Future research should focus on the impact of emerging digital technologies such as artificial intelligence, blockchain, and automation on the competitiveness of international trade. These technologies can transform global trade paradigms by reducing dependence on traditional methods and lowering administrative costs. Additionally, it is important to examine the mechanisms of digital transformations within regional economic unions and their impact on

integration into the global economy. On the policy level, it is essential to support the development of digital infrastructure and investment in innovative solutions, ensuring sustainable development for transition economies and their effective integration into international trade.

Key words: digitalization, international trade, competitiveness, transition economies, digital innovations, information and communication technologies, egovernment, global supply chains, economic growth, panel regression, digital infrastructure, technological transformation, export-oriented strategy.

Анотація. Вступ. Цифровізація є важливим фактором, що визначає конкурентоспроможність міжнародної торгівлі, зокрема для перехідних економік. У сучасному світі технологічні інновації сприяють не лише економічному зростанню, а й інтеграції країн до глобальних ринків. Завдяки цифровим технологіям, зокрема в інформаційно-комунікаційних технологіях (ІКТ), країни можуть скорочувати бар'єри, знижувати транзакційні витрати, підвищувати прозорість і ефективність торговельних процесів. Однак рівень цифровізації в різних країнах залишається неоднорідним, що значно впливає на їхню здатність адаптуватися до глобальних економічних викликів. Враховуючи цю неоднорідність, вивчення цифровізації в перехідних економіках стає особливо важливим для визначення основних факторів, які сприяють підвищенню конкурентоспроможності.

Мета. Метою даного дослідження є оцінка впливу цифровізації на конкурентоспроможність міжнародної торгівлі в 15 перехідних економіках, а також виявлення ключових факторів, які сприяють покращенню їхньої торговельної позиції через інноваційні цифрові стратегії. Особлива увага приділяється ролі цифрової інфраструктури, інформаційно-комунікаційних технологій і електронного уряду як основних елементів, що впливають на зростання експорту, інтеграцію в глобальні ланцюги постачання та ефективність міжнародних торговельних операцій.

Матеріали і методи. Дослідження базується на панельних даних з 15 перехідних економік за період з 2020 по 2024 роки, зібраних із міжнародних баз даних, таких як Світовий банк та Міжнародний союз електрозв'язку (ITU). Для аналізу були використані цифрові індикатори, такі як IT-індекс, проникнення Інтернету, рівень розвитку електронного уряду. Для дослідження взаємозв'язку між цифровізацією та міжнародною торгівлею застосовано панельну регресію, що дозволяє враховувати специфіку економік, рівень їх розвитку та вплив зовнішніх факторів на торговельні результати.

Результати аналізу показали, що країни з більш розвиненою цифровою інфраструктурою демонструють високі темпи зростання міжнародної торгівлі, зокрема експорту, а також кращу інтеграцію в глобальні ланцюги постачання. Цифровізація знижує торговельні бар'єри, покращує прозорість торгівлі та зменшує транзакційні витрати, що дозволяє країнам ефективніше інтегруватися в глобальну економіку. Впровадження цифрових стратегій також підвищує стійкість економік до зовнішніх шоків, таких як економічні кризи та політичні нестабільності. Інвестиції у цифрову інфраструктуру, зокрема для розвитку малого та середнього бізнесу, сприяють економічній стабільності та конкурентоспроможності.

Перспективи. Подальші дослідження повинні зосередитися на вивченні впливу новітніх цифрових технологій, таких як штучний інтелект, блокчейн та автоматизація, на конкурентоспроможність міжнародної торгівлі. Ці технології можуть кардинально змінити традиційні моделі глобальної торгівлі, знижуючи витрати на адміністрування та зменшуючи залежність від фізичних бар'єрів. Зокрема, важливо вивчити механізми інтеграції цифрових трансформацій у рамках регіональних економічних об'єднань, таких як ЄС, та їхній вплив на глобальні торговельні зв'язки. Окрім цього, необхідно підтримувати розвиток цифрової інфраструктури на державному рівні, щоб забезпечити сталий розвиток перехідних економік і сприяти їх ефективній інтеграції в глобальні торговельні мережі.

Ключові слова: цифровізація, міжнародна торгівля, конкурентоспроможність, перехідні економіки, цифрові інновації, інформаційно-комунікаційні технології, електронний уряд, глобальні ланцюги постачання, економічне зростання, панельна регресія, цифрова інфраструктура, технологічна трансформація, експортоорієнтована стратегія.

Problem Statement. In the context of globalization, digitalization is one of the key drivers of international trade competitiveness. For transition economies, which are in the process of adapting to global economic standards, this process holds particular significance. The transition from traditional to digital economic models can not only accelerate their integration into global supply chains but also significantly enhance the efficiency of trade operations. However, in practice, many countries face a number of barriers related to limited digital infrastructure, insufficient digital skills among the population, and underdeveloped innovative technologies, which hinder their potential in international trade. The study of the relationship between digitalization and international trade competitiveness in transition economies is insufficiently developed. Most works focus on the general aspects of the digital economy, while the specific impact of digital tools on trade outcomes in the context of transition economies remains largely overlooked. The lack of a comprehensive analysis of digitalization indicators, such as internet access levels, e-government infrastructure, and information and communication technologies (ICT) penetration, creates a gap in understanding which aspects of digital transformation are critical to improving trade performance. Digitalization leads to technological

changes that are complex and multifaceted, as they encompass not only infrastructural but also cultural, social, and political factors. To understand its impact on international competitiveness, it is necessary to thoroughly analyze the mechanisms through which digital technologies alter the economic structure, investment climate, and create opportunities for the development of small and medium-sized enterprises. The lack of proper attention to these aspects results in a lack of knowledge that is crucial for the development of effective strategies to optimize the use of digital innovations in transition economies. Therefore, there is a need for in-depth research that will identify the critical factors influencing digitalization's impact on the competitiveness of international trade in transition economies and provide scientifically grounded recommendations for optimizing this process at the level of state policy and economic practice.

Analysis of Recent Research and Publications. Recent studies in the field of digitalization and its impact on international trade increasingly emphasize the importance of information and communication technologies (ICT) as a factor driving trade growth. Baldwin R. (2016), in his work *The Great Convergence*, highlights that digital technologies contribute to global economic integration by lowering barriers for small and medium-sized businesses. His analysis shows that countries with high levels of digitalization experience trade growth due to more efficient supply chain management and reduced costs associated with customs procedures [1, p. 45]. The impact of ICT on the economy and trade has also been explored by Czernich N. et al. (2011), who demonstrated that access to broadband internet fosters the export potential of countries by improving the quality and efficiency of communications. They confirmed that digitalization reduces transaction costs and facilitates the integration of countries into global markets [2, p. 102].

Theoretical research often utilizes models developed by Solow R. M. (Solow-type productivity effects), which demonstrate how technological innovations can increase productivity and, as a result, economic growth. In the

context of international trade, these models illustrate how productivity gains from digital transformations enhance the competitiveness of countries in global markets [3, p. 75]. This allows countries in transition economies to adapt to the requirements of global supply chains and attract investments more effectively. Another widely used tool for trade analysis is the gravity model of trade, which is used to study the relationship between the economies of different countries based on their size and distance. This model can assess how digital innovations alter the structure of bilateral trade, particularly in transition economies [4, p. 188]. The expansion of digital infrastructure enables countries to reduce distance in terms of information barriers and lower interaction costs with partners.

Small and medium-sized enterprises (SMEs) are a crucial factor in economic development in transition economies. Klapper L. F. et al. (2006), in their article *The Influence of ICT on the Development of SMEs*, demonstrate how digital technologies can promote SME development by providing access to new markets and opportunities for integration into global supply chains. Digitalization allows small companies to reduce operational costs and improve management practices, which positively impacts their competitiveness [5, p. 254].

Overall, the research confirms that digitalization is a significant factor in enhancing international competitiveness, particularly in transition economies. However, further research is needed to better understand how technologies such as blockchain and artificial intelligence can transform global trade. This will allow for the creation of new strategies for economic development and the integration of countries into global supply chains.

The aim of the article is to explore the impact of digitalization on the international competitiveness of countries, particularly in the context of transition economies. The article also analyzes the mechanisms through which information and communication technologies (ICT) change trade structures, the investment climate, and the development of small and medium-sized enterprises. The article aims to identify the relationship between digital innovations and the improvement

of global supply chains, particularly for countries with limited economic resources, and to define the prospects for adapting theoretical models of productivity and trade in the context of digital transformations.

Materials and Methods. The study uses a combined approach, integrating both quantitative and qualitative methods of analysis. The object of the research includes 15 transition economies from Europe, Asia, and Latin America during the period 2020–2024. Panel data were obtained from reputable sources, including the World Bank, the International Monetary Fund, and the International Telecommunication Union (ITU).

To measure the level of digitalization, the following indicators were used:

- Internet penetration;
- Access to broadband connectivity;
- Development of IT infrastructure and e-government.

The impact of digital transformations on international trade was assessed using panel regression, which allows for identifying the relationship between the development of ICT and changes in export and import volumes, as well as the degree of integration into global trade chains.

The theoretical framework of the study is based on:

- The Solow model for analyzing the impact of technological changes on productivity and economic growth;
- Gravity trade models for examining the structure of bilateral trade in the context of digitalization.

Special attention was given to the role of small and medium-sized enterprises (SMEs) by examining indicators such as the share of SMEs in foreign trade and the number of new export-oriented companies. Additionally, a comparative analysis was conducted between countries with different levels of digital infrastructure development to identify critical factors for successful trade integration. **Main Findings.** The analysis covers 15 transition economies selected based on the availability of relevant digital and trade data for the period 2020–2024. The focus is on evaluating the relationship between the level of digitalization and the dynamics of external trade, particularly the role of digital infrastructure in promoting exports and integration into global supply chains.

The studied countries are divided into three groups based on the pace of digital transformation and the depth of trade integration: digitalization leaders, countries with moderate progress, and countries with limited implementation of digital solutions.

Digitalization Leaders among the transition economies include Estonia, Vietnam, Romania, Bulgaria, Ukraine, and Kazakhstan. These countries demonstrate steady growth in digital infrastructure indicators, such as broadband internet, e-government, and online platforms for business. Estonia, in particular, is recognized as a fully digitalized state, utilizing blockchain solutions in governance and actively promoting digital trade. Vietnam, with its high economic growth rates, is rapidly implementing digital solutions in export-oriented sectors. Despite the ongoing war, Ukraine shows dynamic digital reforms, including the launch of the "Diia" platform, tax digitalization, and the development of the IT sector, contributing to the growth of service exports.

Countries with Moderate Digital Progress include Serbia, Georgia, Moldova, Peru, North Macedonia, and Uzbekistan. These countries are gradually implementing digital services, developing ICT infrastructure, and modernizing foreign trade procedures. For example, Serbia has implemented a national digital economy strategy, while Uzbekistan is investing in the development of digital logistics platforms. In Moldova and Georgia, the share of digital services in total exports has been increasing.

Countries with Initial Levels of Digitalization include Kyrgyzstan, Mongolia, and Tunisia. These countries share the characteristic of fragmented digital solution implementation, primarily in major cities or the public sector, with relatively slow development of the private IT sector. At the same time, Tunisia has growth potential in cooperation with the EU, particularly in terms of digital inclusion.

The analysis highlights the importance of digital infrastructure development in enhancing trade performance, with a clear positive correlation between the level of digitalization and the integration of countries into global supply chains. Additionally, countries with a higher level of digitalization exhibit more resilience in international trade, even in challenging economic or geopolitical conditions.

Based on Table 1, a clear correlation can be observed between the level of digitalization and the effectiveness of foreign trade in most transition economies.

- Estonia is the absolute leader, demonstrating the highest digital indicators and a high export-to-GDP ratio (78%). The significant share of SMEs in exports (56%) also highlights deep digital integration of small businesses.
- Vietnam represents a unique example of a country with powerful exports (106% of GDP), growing digitalization, and strong SME engagement.
- Ukraine, despite the ongoing war, maintains a high level of digital infrastructure and moderate export growth, with potential for further digital integration.

Table 1

Key Digital and Trade Indicators for Transition Economies (Average Values for 2020–2024)

Country	Internet Penetration, % of Population	Broadband Penetration, % of Households	e-Government Index	Export as % of GDP	SME Share in Export, %
Estonia	93	89	0.88	78	56
Vietnam	75	66	0.61	106	44
Romania	86	78	0.77	77	38
Bulgaria	84	74	0.75	65	35

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Country	Internet Penetration, % of Population	Broadband Penetration, % of Households	e-Government Index	Export as % of GDP	SME Share in Export, %			
Ukraine	82	70	0.68	48	29			
Kazakhstan	85	71	0.64	53	32			
Serbia	80	67	0.66	59	28			
Georgia	79	60	0.63	65	36			
Moldova	74	58	0.58	38	25			
Peru	76	54	0.60	28	22			
North Macedonia	78	65	0.62	60	30			
Uzbekistan	73	55	0.52	34	19			
Kyrgyzstan	65	42	0.49	41	18			
Mongolia	67	46	0.50	58	20			

Notes:

Tunisia

*Broadband Internet access (BSI)

70

***e*-Gov Index – electronic government development index (maximum -1.0), according to the ITU/UN DESA methodology

45

21

0.53

50

Source: compiled by the author based on data from the World Bank, International Telecommunication Union (ITU), International Monetary Fund (IMF), United Nations Department of Economic and Social Affairs (UN DESA), and national statistical agencies [6, pp. 12–15].

Countries with moderate digitalization (such as Serbia, Georgia, and Moldova) display average digital indicators and trade volumes. However, their potential largely depends on the pace of implementing digital services for SMEs. The most lagging countries (Kyrgyzstan, Mongolia, Tunisia) have limited digital infrastructure, which hampers export development. The low share of SMEs in foreign trade indicates a strong need for systemic government digital development programs.

To achieve the study's objectives, combined analytical methods were used, including regression analysis based on panel data. The study covers 15 transition economies, including Ukraine, Georgia, Moldova, Armenia, Kazakhstan, Serbia, Bulgaria, Romania, and others. The research period spans from 2020 to 2024, which allows both short-term and long-term effects of digitalization on international trade to be considered. The data were obtained from authoritative international databases such as the World Bank, ITU (International Telecommunication Union), UNCTAD, and WITS. All data were thoroughly validated for reliability and accuracy by cross-referencing with other international sources.

To assess the level of digitalization, the following indicators were used:

- Internet penetration rate;
- Broadband Internet access;
- Development of e-government and IT infrastructure.

To analyze the impact of digital transformations on international trade, regression analysis was applied using OLS (Ordinary Least Squares) and panel data techniques. In particular, a fixed effects model was used to account for country-specific characteristics that may influence economic activity. This also enabled the identification of causal relationships between the level of digitalization and foreign trade performance. Additionally, to assess the impact of digitalization on SME development, data on the business environment and market accessibility in the studied countries were analyzed. This allowed for a more indepth understanding of SME integration into global trade chains.

To evaluate digitalization levels, key indicators such as the ICT Index, Internet usage, and e-Government Index were used. According to the obtained data, the level of digitalization has a significant impact on trade performance in the analyzed countries. Nations with high ICT Index and e-Government Index values demonstrated better export and import results. This is confirmed by the observation that countries with high Internet access levels also show increased activity in international trade. Such countries reduce trade barriers and develop new trade links, contributing to stronger economic growth.

Regression analysis results revealed a clear relationship between digitalization and foreign trade. Countries with higher ICT and e-Government

Index scores generally had larger export and import volumes, as well as better trade balance indicators. For example, in countries with high levels of digitalization, exports increased by 10–12% for each additional point in the e-Government Index. This suggests that digital innovations significantly contribute to integrating these countries into global value chains by lowering operational costs and facilitating access to international markets.

Attention should also be paid to the distinction between EU and non-EU countries. EU member states exhibit significantly higher ICT and e-Government Index values. Consequently, they are more capable of attracting investments, reducing trade barriers, and effectively integrating into international trade chains. As a result, EU countries demonstrate higher export, import, and trade balance figures. In contrast, non-EU countries face certain technological barriers that limit their trade development potential. However, even among non-EU countries, there is a noticeable trend toward improved trade performance as digitalization levels rise. With the advancement of ICT infrastructure and services, these countries are increasingly engaging in international markets and narrowing the trade performance gap with EU states.

The problems and challenges faced by countries with varying levels of digital infrastructure have been analyzed, and conclusions have been drawn regarding the specifics and prospects of the digital transformation of the Ukrainian economy. Digital transformation is a key factor in enhancing the competitiveness of countries in international markets. Digital transformation policy plays a decisive role in achieving successful integration into the global market. An effective policy should include the development of ICT infrastructure, stimulation of innovation, improvement of Internet access, and the implementation of e-government services.

Moreover, an important aspect is the improvement of the regulatory and legal framework that fosters the development of digital technologies and ensures the protection of user and business rights. Countries that pursue active digital

transformation policies are able to reduce business barriers and lower transaction costs. This facilitates the development of foreign trade by enabling enterprises to enter new markets, utilize online platforms for selling goods and services, and integrate into global supply chains. Conversely, insufficient attention to these aspects may result in lagging behind in the global economic context, which is particularly evident among countries with a medium level of ICT development.

Countries with a medium level of development face a number of serious challenges that hinder full-scale digital transformation. First and foremost, these countries have limited resources for the development of IT infrastructure, which reduces access to the latest technologies and restricts the ability of enterprises to integrate into global trade networks. Another critical factor is the low level of digital literacy among the population, which hampers the implementation of innovations and reduces the efficiency of existing digital platforms.

A further significant challenge is the need to ensure adequate cybersecurity, as the growing volume of digital operations increases the risk of cyber threats, which may affect the stability of trade relations and financial transactions. This is particularly relevant for countries with a medium level of development, where there are not always sufficient resources to establish and maintain effective protection mechanisms. To overcome these challenges, government support is essential, including the promotion of technological development, access to educational resources, and financing of digital infrastructure initiatives.

Considering the results of the analysis, Ukraine possesses significant potential to strengthen its economic position through digital transformation. However, to fully realize this potential, several strategic steps must be taken.

First, Ukraine needs to significantly improve its digital infrastructure by expanding access to high-speed Internet across the entire country. This will not only facilitate access to international markets but will also create favorable conditions for the development of small and medium-sized enterprises, particularly through e-commerce.

Second, Ukraine should focus on the development of e-government and the integration of digital services within state institutions. This will help reduce bureaucratic barriers, simplify administrative procedures, and enhance the transparency of the business environment.

Third, improving digital literacy among the population and businesses is essential. To achieve this, educational programs and initiatives aimed at developing information technology skills must be implemented. This, in turn, will promote more efficient use of digital platforms for doing business and increase export potential.

Thus, the active implementation of digital transformation policies in Ukraine can become a key factor in enhancing the effectiveness of foreign trade and integrating the country into global economic processes.

The research findings indicate that the digital competitiveness of transitional economies largely depends on institutional stability, the volume of investment in ICT infrastructure development, the availability of digital services for businesses and citizens, and the integration of digital technologies into public administration.

Key enabling factors include:

- Expanding access to broadband Internet, especially in rural and remote areas;
- Increasing digital literacy through educational programs;
- Creating a favorable environment for the development of startups and innovative entrepreneurship;
- Integrating digital tools into customs and export-import procedures, which helps reduce trade barriers.

It is recommended that governments of transitional economies:

1. Implement national digital transformation strategies that cover education, infrastructure, and institutions;

- Invest in the development of e-governance and e-commerce to ensure transparency, reduce transaction costs, and improve integration into global markets;
- 3. Promote public-private partnerships to support the development of digital solutions tailored to the needs of SMEs;
- 4. Support participation in international digital initiatives and standards, which will facilitate entry into foreign markets.

Such measures will enable countries not only to enhance their competitiveness but also to integrate effectively into global trade chains.

Conclusions and Directions for Further Research. The conducted study confirms that digitalization is one of the key drivers of modernization in foreign economic activity within transitional economies. The analysis demonstrates that increased Internet penetration, the development of e-government, and the expansion of ICT infrastructure have a positive impact on exports, imports, and the overall trade balance of countries—particularly in those that implement systematic digital transformation policies.

A significant disparity is observed between EU member states and other transitional economies. The former exhibit higher efficiency in utilizing digital tools in international trade due to more stable institutional frameworks, greater access to investment, and integration into the European digital ecosystem.

For Ukraine, the research findings bear practical relevance. They emphasize the urgent need to actively develop digital infrastructure, enhance digital literacy, simplify regulatory procedures, and support small and mediumsized enterprises in their digital transformation efforts as prerequisites for strengthening export capacity.

Future research directions include:

• Detailed analysis of the impact of specific digital indicators on various trade sectors;

- Investigation of the role of digital platforms in promoting SME products in international markets;
- Comparative studies on the dynamics of digital transformation under wartime or crisis conditions;
- Assessment of cybersecurity risks in international e-commerce.

Such studies will provide a deeper understanding of the mechanisms of digital integration into the global economy and support the formulation of effective public policies for enhancing digital foreign trade.

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