American Journal of Economics and Business Management

Vol. 9 Issue 2 | **pp.** 365-369 | **ISSN:** 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

Assessing the Effectiveness of Digital Mechanisms Applied in Free Economic Zones

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Abstract: This article provides a comprehensive analysis of the impact of digital governance mechanisms implemented in free economic zones (FEZs) on economic efficiency. The research is based on institutional economics and transaction cost theory and utilizes statistical data for the period 2022–2025 to assess the level of digital development through a composite index. A multiple regression model and the DEA (Data Envelopment Analysis) method were applied to evaluate the influence of digital mechanisms on investment volume, export performance, and resource utilization efficiency. The findings indicate that digital governance infrastructure serves as a significant institutional factor enhancing the competitiveness of free economic zones by simplifying administrative procedures, reducing transaction costs, and increasing investment attractiveness.

Keywords: Free Economic Zone, Digital Mechanisms, Institutional Efficiency, Digital Governance, Transaction Costs, Investment Attractiveness, Export Potential, Econometric Analysis, DEA Method, Composite Index

1. Introduction

In the context of modern globalisation and digital transformation, free economic zones (FEZs) are of significant importance as a strategic institutional mechanism for ensuring the structural modernisation of the national and regional economies. In the global economy, SEZs are emerging as an effective instrument for attracting foreign and domestic investment, expanding export potential and fostering high value-added manufacturing. According to statistics from international institutions, by 2025 the total number of free economic and special economic zones operating worldwide will exceed 5,000, their contribution to global integration and trade networks continues to be significant. In some developing countries, the volume of exports realised through SEZs reaches 20–60 per cent of total industrial exports. These indicators confirm the growing role of free economic zones in international production and logistics chains.

At the same time, the rapid development of the digital economy is creating new demands for the management of SEZs. According to World Bank reports, in countries with a high level of digitisation of public services, the process of business registration and obtaining permits is on average accelerated by 30-50 per cent, and transaction costs are significantly reduced. Digital 'single window' systems, electronic customs platforms and online licensing mechanisms save investors time and money. As a result, the investment attractiveness of EIZs increases and production efficiency improves.

Citation: Nasirovna S. R. Assessing the Effectiveness of Digital Mechanisms Applied in Free Economic Zones. American Journal of Economics and Business Management 2026, 9(2), 365-369.

Received: 12th Jan 2026
Revised: 26th Jan 2026
Accepted: 8th Feb 2026
Published: 18th Feb 2026

Today, leading economic zones, including the Shenzhen Special Economic Zone and Jebel Ali Free Zone, have succeeded in reducing project approval times several-fold and lowering operational costs by fully digitising their administrative processes. This experience shows that a digital governance infrastructure is becoming a key determinant of the effectiveness of SEZs.

However, the introduction of digital mechanisms does not, in itself, guarantee economic outcomes. Their actual effectiveness needs to be assessed comprehensively based on concrete indicators such as growth in investment inflows, the number of resident enterprises, export volume, production efficiency, and the speed of administrative processes. Therefore, the scientific analysis of the effectiveness of digital mechanisms applied in free economic zones is not only a practical but also a theoretically significant issue. This research is aimed at developing an efficiency model for the management of EIZs within the frameworks of the digital economy and institutional development concepts, and serves to improve the scientific basis for accelerating regional economic growth.

Literature Review

In recent years, the operation of free economic zones (FEZs) and their digital transformation has become one of the most pressing areas of economic research. In particular, scientific works published in Russian between 2023 and 2025 extensively examine the institutional development of SEZs, their investment attractiveness, and the impact of digital governance mechanisms on economic efficiency.

In her research, N.V. Kuznetsova demonstrates that the introduction of electronic administrative services and digital platforms in EIZs accelerates investment processes [1]. The author, based on transaction cost theory, demonstrates that digital infrastructure reduces administrative barriers and creates a favourable institutional environment for investors. A.P. Mironenko, analysing the institutional mechanisms for the development of EIZs, emphasises that digital customs and logistics systems are a key factor in the growth of export volumes [2]. The study empirically demonstrates that in zones with a high degree of digitalisation, licensing procedures are simplified and foreign trade operations are accelerated.

I.S. Lavrentyev examines the impact of digital management tools on the efficiency of export-oriented production in EIZs [3]. The author notes that the availability of digital infrastructure serves to expand production volume and export diversification. E.A. Gorshkova analyses the digital transformation of state regulatory mechanisms and scientifically substantiates that the ‘single window’ system increases the transparency of investment processes and reduces institutional risks [4]. The author evaluates digitalisation as a new determinant of the effectiveness of public administration. D.M. Polyakov, based on econometric modelling, evaluates the efficiency of EIZs and identifies a positive statistical correlation between the level of digital maturity and the volume of investments [5]. His research is aimed at quantitatively measuring the impact of the digital management infrastructure on economic outcomes.

The analysis shows that although existing scientific works have studied the impact of digitalisation on the efficiency of EIZ from various perspectives, an integrated assessment of the complex impact of digital mechanisms on investment, export and production efficiency has not been sufficiently developed [6]. This scientific gap defines the relevance of the present study.

2. Materials and Methods

This study is aimed at assessing the impact of digital mechanisms applied in free economic zones on economic efficiency, adopting the institutional economics and transaction costs approach as its methodological basis [7]. Based on statistical data from 2022 to 2025, the level of digital development was assessed using a composite index, and

its impact on investment, export, and production indicators was quantitatively analysed using multiple regression and DEA methods.

3. Results

Between 2022 and 2025, the phased introduction of digital governance mechanisms in the Free Economic Zones (FEZ) has elevated the effectiveness of existing institutional mechanisms to a new level. While SEZs were initially established on the basis of a special legal and tax regime, customs preferences and infrastructural support, In recent years, the integration of these mechanisms with digital management tools has begun to deliver even higher economic results [8].

The main institutional pillar of SEZs is the mechanism of a special legal and tax regime. Tax incentives, exemption from customs duties and reduced land and property taxes reduce the investor's initial capital expenditure. For example, in the Navoi Free Economic Zone, tax incentives ranging from 3 to 10 years, depending on the size of the investment, ensure long-term financial stability for the investor. However, for these incentives to translate into tangible economic results, administrative processes must be swift and transparent [9]. This is where digital mechanisms enhance the practical effectiveness of legal preferences.

The customs preferences mechanism is also an integral part of the EIZ model. Importing raw materials and equipment free of customs duties, or under a simplified procedure, encourages export-oriented manufacturing. For example, the Jebel Ali Free Zone has become a global logistics hub through 100% customs exemption and an expedited declaration system [10]. The reduction in customs clearance time from 5.2 days to 2.1 days between 2022 and 2025 demonstrates that digital automation in FZs has enhanced the real-world effectiveness of customs preferences.

The administrative simplification mechanism, i.e., the ‘single window’ mechanism, forms the basis of the EIZ's agile management model. In the Angren Free Economic Zone, the centralised implementation of resident registration and licensing processes has reduced bureaucratic stages [11]. The average time for resident registration was 18 days in 2022, which was reduced to 7 days by 2025. This administrative efficiency has been a key factor in enhancing the EIZ's investment attractiveness.

The mechanism for providing infrastructure is also a strategic element of the SEZ model. The availability of ready-made industrial sites, energy, and logistics networks reduces an investor's operational costs [12]. The success of the Shenzhen Special Economic Zone has been closely linked to its advanced infrastructure and efficient logistics system. The introduction of digital monitoring mechanisms has further increased the efficiency of infrastructure utilisation.

The digital governance and monitoring mechanism integrates all institutional elements within the SEZ into a single system. In the Alabuga Special Economic Zone, the real-time monitoring of investment projects has accelerated management decisions. The increase in the use of electronic services from 46% to 81% between 2022 and 2025 indicates a deepening of the digital transformation [13]. As a result, transaction costs were reduced by 27-32%, which means that the main task of the SEZ—to create a low-cost and fast economic environment—has been further strengthened.

The investment support mechanism also increased efficiency in tandem with digital governance. In the Navoi Free Economic Zone, partial reimbursement of infrastructure costs for major investment projects reduced investor risk. Digital oversight and transparency ensured the targeted operation of state guarantees and subsidy mechanisms.

Indicators of investment activity also demonstrated significant growth. While the volume of foreign direct investment attracted to EIZs was US$1.8 billion in 2022, by 2025 by 2025, this figure reached $2.9 billion, representing a 61% increase. It was noted that the

rate of investment growth was 18-22% higher in zones where digital services were fully implemented [14].

The volume of exports increased from $3.4 billion in 2022 to $5.1 billion in 2025 (a 50% increase). In zones managing export operations via an electronic monitoring system, the time taken to formalise foreign trade deals was reduced by 40%, which increased the turnover of exports. The number of resident enterprises increased from 1,245 to 1,782 between 2022 and 2025.

Table 1. Results of the assessment of the impact of the digital development index on the volume of investment in free economic zones (2022-2025)

	Variable	Koeffitsient (β)	t-statistika	p-value
1	α (Const)	0.52	2.41	0.031
2	RD	0.38	3.87	0.004
3	EXP	0.29	2.96	0.012
4	RES	0.17	2.11	0.048

According to the econometric analysis results, the correlation coefficient between the digital development index and the volume of investment was r = 0.74, indicating a strong positive relationship. In the multiple regression model, the effect of the digital index on investment volume was found to be statistically significant ($p < 0.05$). According to the model's results, an increase in the digital development level by 1 unit was observed to lead to an average increase in investments of 0.38 units.

When relative efficiency was assessed using the DEA method, the average efficiency coefficient for the zones was 0.71 in 2022, rising to 0.89 by 2025. This indicates a significant increase in the efficiency of resource utilisation.

Overall, the analysis results show that 2022-2025 the introduction of digital mechanisms in free economic zones during the 2022-2025 period significantly increased economic efficiency through attracting investment, expanding export volumes, and optimising administrative processes [15]. Empirical results confirm that digital governance infrastructure has become a key determinant of the competitiveness of SEZs.

4. Conclusion

The implementation of digital governance mechanisms in Free Economic Zones has significantly increased their institutional and economic efficiency. Digital technologies have further enhanced the investment environment by simplifying administrative processes, increasing the speed of decision-making, and reducing transaction costs. As a result, the free economic zones have become a more competitive economic environment for attracting capital, expanding export activities, and increasing production efficiency.

The research findings confirm that digital governance mechanisms are a crucial institutional factor that facilitates the effective implementation of the special legal and customs regime of free economic zones. Deepening digital transformation, fully integrating management processes and developing a data-driven decision-making system remains a priority for enhancing the sustainable development and investment attractiveness of SEZs.

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