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**CUSTOMS EFFICIENCY AS A DETERMINANT OF LOGISTICS
PERFORMANCE: RISK CLASSIFICATION AND COMPARATIVE
ANALYSIS UNDER PEACETIME AND MARTIAL LAW CONDITIONS**

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**МИТНА ЕФЕКТИВНІСТЬ ЯК ДЕТЕРМІНАНТ ЛОГІСТИЧНОЇ
РЕЗУЛЬТАТИВНОСТІ: КЛАСИФІКАЦІЯ РИЗИКІВ ТА
ПОРІВНЯЛЬНИЙ АНАЛІЗ В УМОВАХ МИРНОГО ЧАСУ ТА
ВОЄННОГО СТАНУ**

This article presents a comprehensive and analytically grounded assessment of the customs component of the Logistics Performance Index (LPI) as a key determinant of the efficiency and competitiveness of enterprises' foreign economic activity. The study examines Ukraine's LPI trajectory over the period 2007–2023, revealing a structurally imbalanced evolution of the national logistics system: despite a moderate increase in the composite index from approximately 2.5 to 2.7, the customs dimension persistently underperforms relative to other LPI components, constituting a systemic bottleneck in cross-border trade operations.

A structured comparative analysis of Ukraine's logistics performance against regional benchmarks (Europe and Central Asia), upper-middle-income country peers, and the EU reference point (Poland) identifies persistent structural gaps in customs efficiency, institutional capacity, and digital integration. The study establishes a non-linear relationship between customs digitalization and clearance efficiency: although the share of electronic declarations reached over 99% by 2024, system overload offsets the gains of digital transformation, suggesting that

technology adoption alone is insufficient without complementary governance reforms.

The paper develops a multi-criteria classification of customs risks encompassing six dimensions — customs regime, nature and purpose of violations, type of economic operator, type of goods, and geographical factor — and substantiates a three-level risk management framework (strategic, tactical, and operational) integrating automated digital control instruments.

A comparative analysis of customs logistics under peacetime and martial law conditions demonstrates substantial structural transformations in clearance procedures, tariff regimes, logistics routes, and risk configurations following Russia's full-scale invasion of Ukraine in 2022. Customs revenues declined by 38% in 2022 compared to 2021, reflecting the scale of wartime disruptions, while adaptive policy measures helped sustain foreign trade continuity. The findings confirm that digitalization is a necessary but not sufficient condition for improving customs performance: its effectiveness depends on institutional reform depth, governance quality, system interoperability, and alignment with EU standards.

У статті здійснено комплексну аналітично обґрунтовану оцінку митної складової Індексу ефективності логістики (LPI) як ключового детермінанта конкурентоспроможності зовнішньоекономічної діяльності підприємств. Досліджено траєкторію LPI України за 2007-2023 роки, яка демонструє структурно незбалансований розвиток національної логістичної системи: попри загальне зростання інтегрального показника від 2,5 до 2,7, митна складова стабільно відстає від інших вимірів, виступаючи системним «вузьким місцем» у забезпеченні ефективності зовнішньоторговельних операцій.

Проведено порівняльний аналіз логістичних результатів України із регіональними бенчмарками (Європа та Центральна Азія), групою країн із рівнем доходу вище середнього, а також Польщею як еталоном ЄС. Виявлено суттєві структурні розриви у митній ефективності,

інституційному потенціалі та цифровій інтеграції. Встановлено нелінійну залежність між рівнем цифровізації митних процедур та ефективністю митного оформлення: незважаючи на зростання частки електронних декларацій до понад 99%, надмірне навантаження на систему нівелює переваги цифрової трансформації.

У роботі розроблено багатокритеріальну класифікацію митних ризиків за шістьма ознаками (митний режим, характер і мета порушення, тип суб'єкта зовнішньоекономічної діяльності, вид товару, географічний чинник) та обґрунтовано трирівневу систему управління ними (стратегічний, тактичний та операційний рівні) з інтеграцією автоматизованих цифрових інструментів контролю.

Порівняльний аналіз митної логістики в умовах мирного часу та воєнного стану засвідчив суттєві структурні трансформації в процедурах митного оформлення, тарифних режимах, логістичних маршрутах і конфігурації ризиків після повномасштабного вторгнення Росії в Україну у 2022 році. Зафіксовано падіння митних надходжень у 2022 році на 38% порівняно з 2021 роком, що відображає масштаби воєнних потрясінь, водночас адаптивні політичні заходи сприяли збереженню безперервності зовнішньої торгівлі. Доведено, що цифровізація є необхідною, але недостатньою умовою підвищення митної ефективності без відповідних інституційних реформ та регуляторної гармонізації зі стандартами ЄС.

Keywords: *customs logistics, customs efficiency, customs risk management, three-level risk management, foreign economic activity, martial law, enterprise competitiveness, European integration.*

Ключові слова: *митна логістика, митна ефективність, управління митними ризиками, трирівнева система управління, зовнішньоекономічна діяльність, воєнний стан, конкурентоспроможність підприємств, євроінтеграція.*

Problem Statement in a Generalized Form and Its Connection with Important Scientific or Practical Tasks. The transport and logistics sector plays a pivotal role in the global economy, ensuring the efficient cross-border movement of goods in the context of intensifying trade globalization [1]. As international trade volumes continue to expand, the complexity and scale of logistics operations increase accordingly, placing growing demands on regulatory and control systems. According to the Organisation for Economic Co-operation and Development (OECD), illicit trade accounts for approximately 3.3% of global merchandise flows, equivalent to around USD 509 billion annually, thereby requiring substantial efforts from customs authorities to ensure effective control and compliance [2].

Simultaneously, the expansion of legitimate trade significantly increases the operational burden on customs systems, underscoring the necessity for the digital transformation of customs and logistics processes. In this context, the digitalization of customs logistics—understood as the integration of advanced information technologies, automation tools, and data analytics into customs clearance and control procedures—emerges as a critical factor in enhancing the competitiveness of enterprises in international markets.

For Ukraine, which is pursuing a strategic course toward European integration while simultaneously operating under the conditions of a full-scale military invasion, the issue of digital transformation in customs logistics acquires particular importance. Under such conditions, the modernization of customs systems becomes not only an economic priority but also a strategic instrument for ensuring the resilience and efficiency of foreign economic activity.

Despite the considerable body of scientific research devoted to customs logistics [1; 2; 3; 4], the issue of a comprehensive analysis of the customs component's role within the LPI framework, as well as its transformation under wartime conditions, remains insufficiently explored. This research gap determines the relevance and scientific significance of the chosen topic.

Analysis of Recent Research and Publications. The theoretical foundations of customs logistics have been extensively explored in the works of Korobkova O.M. [1], Dziubynskyi A.V. et al. [2], Huzhevska L.A. [3], Trushkina N. and Serbina T. [4], Yaremenko O.F. [5], and Smyrnov I.H. [6]. These studies provide a comprehensive understanding of the conceptual framework and economic significance of customs logistics within international trade systems. Functional aspects and risk-related dimensions of customs logistics have been examined by Kostyunik O.V. and Sivashenko T.V. [7], Kushnir Yu.B. et al. [8], and Reznik N. and Verbivskyi S. [9], who focus on operational challenges, risk management mechanisms, and efficiency constraints in customs processes.

The specific features of customs logistics functioning under martial law conditions have been analyzed in the works of Kryvoviazuk I.V. [10] and Hryniv N.T. and Ravlikovska A.A. [11], highlighting the impact of external shocks on logistics systems and foreign economic activity. International experience in risk management and the digitalization of customs procedures has been investigated in the studies of Bugarčić F. and Stanišić N. [12], as well as Alsharari N.M. [13], providing important insights into best practices and institutional approaches to modernizing customs systems.

However, despite the substantial body of existing research, the issue of the customs component's role within the LPI framework and its transformation under wartime conditions remains insufficiently explored. Recent studies increasingly emphasize that digitalization alone is insufficient without effective governance mechanisms, regulatory harmonization, and system interoperability [14; 15; 16; 17; 18].

Formulation of the Article's Objectives (Problem Setting). The aim of this study is to provide a comprehensive and analytically grounded assessment of the customs dimension as a key determinant of logistics performance, as measured by the Logistics Performance Index (LPI), and to analyze the transformation of customs systems under conditions of European integration and wartime disruptions in Ukraine.

To achieve this aim, the following research objectives are addressed: (1) to analyze the structural components of the LPI, with a particular focus on the customs dimension as a systemic constraint to logistics efficiency; (2) to assess the dynamics of customs efficiency in Ukraine and identify nonlinear relationships between digitalization and performance; (3) to conduct a comparative analysis of Ukraine's logistics performance relative to regional, income group, and EU benchmarks; (4) to classify customs risks and examine their integration with digital risk management tools; and (5) to analyze the transformation of customs logistics under peacetime and martial law conditions.

The methodological framework of the study is based on a combination of general scientific and empirical approaches, including analysis and synthesis, a systems approach, comparative analysis, and tabular and graphical methods. The study also incorporates elements of empirical modeling, including the use of composite indices, trend analysis, and regression-based interpretation of relationships between digitalization, customs efficiency, and logistics performance.

Presentation of the Main Research Material. The efficiency of customs logistics at the international level is commonly assessed using the Logistics Performance Index (LPI), developed by the World Bank. The LPI serves as a composite indicator that captures the level of development of national logistics systems and reflects the degree of countries' integration into global value chains [2; 12; 19]. Within the LPI framework, the customs component represents one of the six key dimensions and plays a particularly important role in shaping overall logistics performance. Empirical evidence suggests that improvements in customs efficiency have a disproportionately strong impact on the overall LPI score, primarily through reducing trade-related transaction costs, accelerating clearance procedures, and enhancing the predictability of cross-border operations. As a result, the customs dimension is critically important for improving the conditions of foreign economic activity and strengthening the international competitiveness of enterprises [1].

Table 1. Components of the Logistics Performance Index (LPI) and Their Significance for Customs Logistics

LPI Component	Content	Weight for Customs Logistics
Customs	Efficiency of customs clearance and border control agencies (speed, simplicity, predictability of formalities).	High
Infrastructure	Quality of transport and IT infrastructure: roads, railways, ports, and information systems.	High
International Shipments	Ease of arranging competitively priced international shipments.	Medium
Logistics Quality	Competence and quality of local logistics services: freight forwarders, customs brokers.	High
Tracking	Ability to track and trace international shipments and cargo.	Medium
Timeliness	Timely delivery of shipments to the destination within the scheduled time.	High

Source: systematized by the authors based on [1; 2; 12; 19].

A deeper examination of the LPI for Ukraine reveals a structurally imbalanced evolution of the national logistics system, in which improvements in individual components are constrained by persistent inefficiencies in customs procedures. As a composite indicator encompassing six dimensions, the LPI provides a comprehensive analytical framework for evaluating the performance of national logistics systems. Over the period 2007-2023, Ukraine exhibits a non-linear trajectory of logistics performance. Although the overall LPI score increased from approximately 2.5 in 2007 to around 2.7 in 2023, this growth remains moderate and volatile, reflecting the combined influence of structural reforms and external shocks, including geopolitical instability and war-related disruptions. Notably, the customs component persistently underperforms relative to other LPI dimensions, suggesting that inefficiencies in border management constitute a systemic bottleneck that constrains the overall effectiveness of logistics processes.

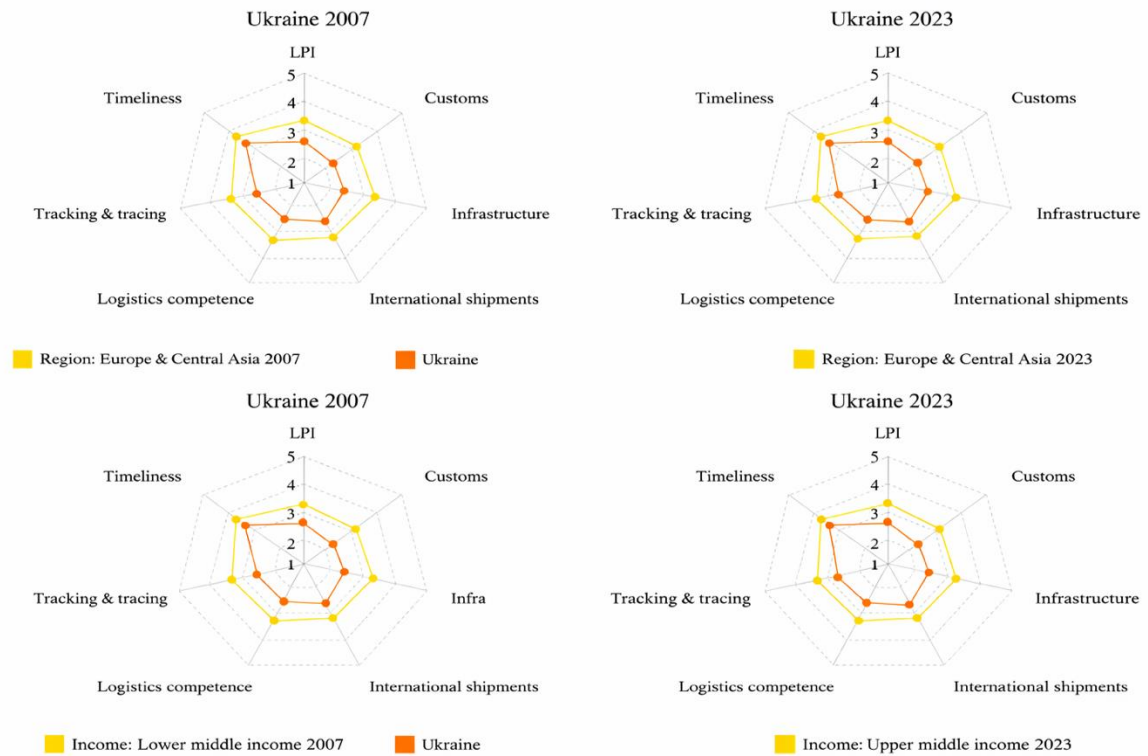


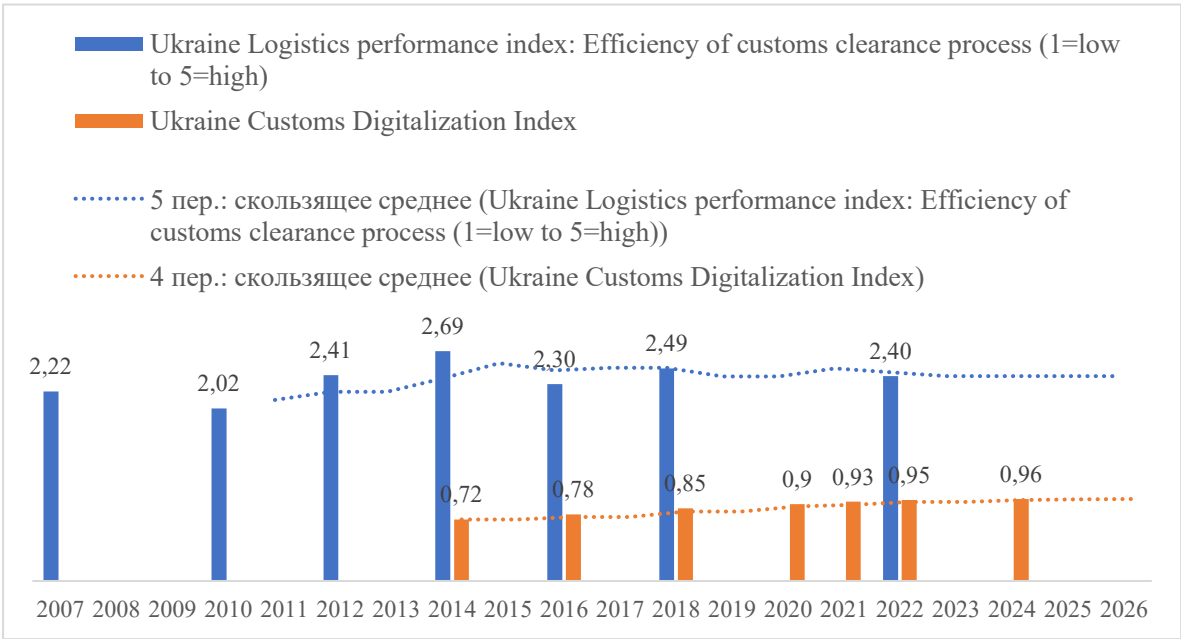
Fig. 1. Structural Comparison of Logistics Performance Index Dimensions: Ukraine vs Regional and Income Benchmarks (2007–2023)

Source: systematized by the authors based on [20; 21; 22].

A comparative analysis of Ukraine's LPI in 2007 and 2023, relative to its regional (Europe and Central Asia) and income group benchmarks, reveals persistent structural disparities and uneven convergence. In 2007, Ukraine significantly lagged behind both groups, particularly in customs efficiency and infrastructure, indicating systemic weaknesses in its logistics system. By 2023, partial convergence is observed, with improvements in overall LPI and in components such as tracking and tracing and timeliness, largely driven by digitalization and the development of logistics services. However, a substantial gap remains in customs efficiency and, to a lesser extent, infrastructure.

This divergence suggests that while digitalizable and market-driven components of logistics are improving, institutional dimensions-particularly customs administration - are evolving more slowly, resulting in a structurally imbalanced system. Consequently, convergence with international benchmarks

requires not only technological modernization but also comprehensive institutional reforms, regulatory harmonization with EU standards, and deeper integration into digital customs systems.



Note: The Customs Digitalization Index in this study is constructed as a composite indicator reflecting the level of implementation of digital technologies in customs clearance processes. It comprises three key components: (1) the share of electronic customs declarations in the total number of processed declarations; (2) the intensity of customs clearance (the number of declarations per unit of transport flow); and (3) the reduction of paper-based transit procedures. All variables were normalized to a 0-1 scale using the min-max normalization method. The largest weight (0.5) is assigned to the share of electronic declarations, while the intensity of customs processing and the transit digitalization component are assigned weights of 0.3 and 0.2, respectively.

Fig. 2. Trends in Customs Digitalization and Their Impact on Clearance Efficiency in Ukraine (2007–2024)

Source: constructed by the authors based on [23; 24; 25; 26].

The dynamics of the efficiency of customs clearance process indicator for Ukraine over the period 2007-2023 reveal a non-linear and unstable trajectory, reflecting the complex interaction of institutional reforms, external shocks, and digital transformation processes. The indicator increased from approximately 2.2 in 2007 to a peak of around 2.7 in 2014, followed by a significant decline to about 2.3 in 2016, demonstrating a high sensitivity of customs performance to macroeconomic and institutional factors, including political instability and structural reforms. In the subsequent period, a partial recovery was observed, with

the indicator reaching approximately 2.5 in 2018 and stabilizing at around 2.4 in 2023.

An analysis of Ukraine's customs statistics for 2014-2024 indicates a structural transformation from a volume-driven to a digitally driven operational model. Prior to 2019, the system was characterized by relatively stable and high volumes of transport flows (exceeding 20 million units annually) and increasing cargo flows, accompanied by a proportional rise in the number of processed customs declarations, reflecting an extensive growth model. However, since 2020, the system has experienced a dual shock associated with the COVID-19 pandemic and the full-scale war in 2022, resulting in a sharp decline in transport flows (by more than 50%) and cargo turnover (from over 330 million tons to approximately 150 million tons).

Despite these disruptions, the number of customs declarations demonstrated relative resilience, declining less sharply and recovering more rapidly than physical flows. The share of electronic declarations increased from approximately 86% in 2014 to over 99% by 2024, indicating near-complete digitalization of documentation processes. However, the relationship between digitalization and customs efficiency appears to be nonlinear. While regression analysis indicates a positive effect of digitalization on LPI, processing intensity demonstrates a significant negative effect, suggesting that system overload may offset the benefits of digital transformation. These findings confirm that digitalization is a necessary but not sufficient condition for improving customs efficiency.

A comparative perspective further reinforces this conclusion. While Ukraine's overall LPI score reached approximately 2.7 in 2023, Poland demonstrates consistently higher performance across all dimensions, reflecting a more advanced level of institutional development, digital integration, and alignment with EU customs standards.

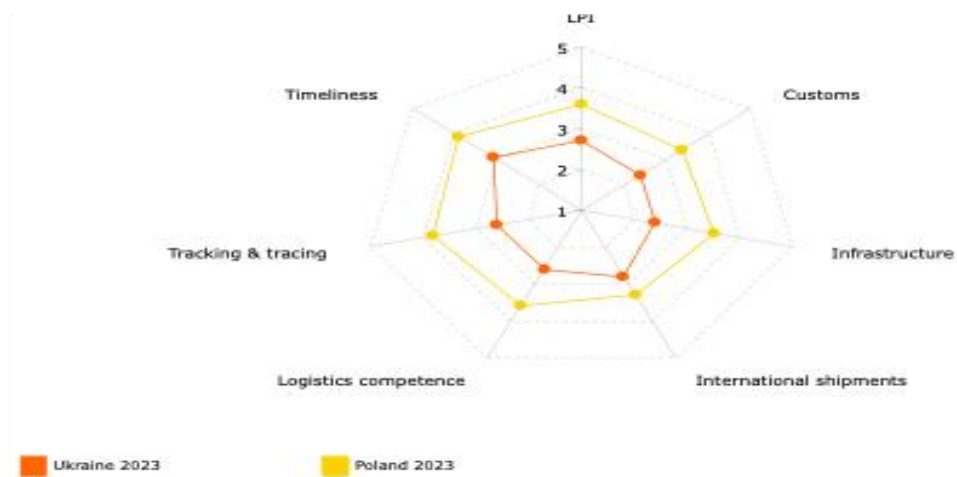


Fig. 3. Performance Gap in Logistics Efficiency: Ukraine and Poland Across LPI Dimensions (2023)

Source: [20].

The performance gap between Ukraine and Poland is particularly pronounced in the customs component, where Poland consistently demonstrates superior results due to higher levels of institutional efficiency, advanced digital integration, and full alignment with EU customs procedures. As a member of the European Union, Poland benefits from fully operational electronic customs systems, harmonized data standards, and seamless interoperability within the EU customs framework, which significantly reduces clearance time and administrative barriers. In contrast, Ukraine's customs performance remains constrained by ongoing transformation processes, despite notable progress in digitalization.

This comparison highlights that substantial improvements in LPI are achieved not solely through technological adoption, but through comprehensive institutional alignment, standardized procedures, and deep integration into international logistics networks. Accordingly, Ukraine's convergence with EU customs systems - particularly through the implementation of MASP-C and regulatory harmonization - can be expected to gradually reduce the performance gap and enhance the competitiveness of its foreign economic activity.

Improving Ukraine's position in the LPI is directly linked to the digital transformation of customs procedures. Within this framework, the classification of customs risks serves as a methodological basis for developing an effective risk

management system. A scientifically grounded classification enables the precise identification of different risk types within the overall system, thereby facilitating the application of appropriate control measures and digital management tools [2; 8]. Based on the conducted analysis, the main types of customs risks can be systematized according to their origin and corresponding control mechanisms (Table 2).

Table 2. Classification of Customs Risks and Corresponding Control Measures

Classification Criterion	Types of Risks	Control Measures
Customs Regime	Import, export, re-import, re-export, transit, temporary admission/export, customs warehousing, duty-free trade.	Compliance with the conditions of the specific customs regime; document verification.
Nature of Violation	Misclassification of goods; smuggling; undervaluation of customs value; non-declaration or false declaration.	Verification of classification codes (HS/UCGFEA); scanning; physical inspection.
Purpose of Violation	Evasion of customs duties and VAT; illegal VAT refund; illegal import of excisable goods.	Cross-checking with tax authorities; analysis of trade patterns.
FEA Entity	New market entrant with no experience; entity with previous violations; unreliable counterparty.	Risk profiling; Authorized Economic Operator (AEO) programs.
Type of Goods	Excisable goods; dual-use goods; prohibited/restricted goods; food products.	Enhanced documentary and physical control; laboratory testing.
Geographical	Countries with a high level of smuggling; conflict zones; offshore jurisdictions.	Increased monitoring; requirement of additional certificates of origin.

Source: systematized by the authors based on [2; 7; 8; 9].

Effective risk management in customs logistics requires a systematic approach to risk identification, including the application of selective inspections, as well as the implementation of a comprehensive set of control and mitigation measures [2]. Given the heterogeneity of risks, each type necessitates an individualized management strategy tailored to its origin and potential impact. In this context, the EU Common Risk Management System, introduced in 2005, represents a benchmark model, ensuring rapid information exchange on risks between operational units and analytical centers across EU Member States. This

system significantly enhances the effectiveness of customs control at the external borders of the European Union by enabling timely and coordinated interventions.

An important complementary instrument is the Authorized Economic Operator (AEO) program, which provides trusted economic operators with simplified customs procedures and reduced inspection intensity based on their compliance history. The implementation of AEO mechanisms contributes to risk differentiation, optimization of control resources, and increased efficiency of customs operations [10; 11].

The full-scale invasion of Ukraine by Russia in 2022 has fundamentally altered the operational environment of customs logistics, necessitating the rapid adaptation of both the regulatory framework and the operational practices of customs authorities. Under these conditions, the transformation of customs procedures has become a critical factor in maintaining the continuity and efficiency of foreign trade operations. A comparative analysis of the key features of customs logistics under pre-war and wartime conditions is presented in Table 3.

Table 3. Comparative Analysis of Customs Logistics under Peacetime and Martial Law in Ukraine

Aspect	Peacetime	Martial Law
Clearance Procedures	Standard procedures, full set of documents, regular customs queues.	Simplified procedures, reduced documentation, expedited processing of humanitarian cargo.
Customs Payments	Full taxation in accordance with customs tariffs and excise rates.	Deferrals/exemptions for essential goods, military supplies for the Armed Forces, and humanitarian aid.
Logistics Routes	Flexible multimodal routes, including maritime transport.	Reorientation to land and rail routes through western Ukraine; bottlenecks at EU borders.
Risks	Standard commercial and customs risks; fraud.	Additional risks: port blockades, hostilities, seizure of cargo by military administrations, demurrage.
Control Measures	Systematic control based on risk management systems; scheduled inspections.	Enhanced control of humanitarian cargo; prevention of illegal import of commercial goods under the guise of humanitarian aid.
Customs Revenues	2021: UAH 484.9 billion (record level).	2022: UAH 300.8 billion (–38% compared to 2021).

Source: systematized by the authors based on [1; 10; 11].

Among the risks specific to martial law conditions, particularly significant are prolonged storage of containers in ports, resulting in additional demurrage and storage costs; the potential seizure of cargo by military administrations in cases where customs clearance procedures are not initiated; and the illegal importation of commercial goods under the guise of humanitarian aid [10]. At the same time, the reconfiguration of logistics flows and relatively lower congestion at certain border crossing points have created conditions for comparatively faster customs clearance in specific corridors.

Conclusions and Prospects for Further Research in this Area. First, the analysis of the LPI confirms that the customs component constitutes a systemic bottleneck in Ukraine's logistics system and a key limiting factor for the competitiveness of enterprises' foreign economic activity. Over the period 2007-2023, Ukraine's customs efficiency persistently underperformed relative to other LPI dimensions, reflecting structural weaknesses in border management and institutional capacity.

Second, the proposed multi-criteria classification of customs risks (based on customs regime, nature and purpose of violations, type of economic operator, type of goods, and geographical factor) provides a robust methodological basis for the development of differentiated digital risk management tools. The integration of this classification into a three-level risk management system (strategic, tactical, and operational) supported by automated technologies enhances the effectiveness of risk identification, targeting, and mitigation.

Third, the comparative analysis of customs logistics under peacetime and martial law conditions demonstrates substantial structural transformations in procedures, tariff regimes, logistics routes, and risk configurations. The decline in customs revenues in 2022 (by 38% compared to 2021) reflects the scale of wartime disruptions, while adaptive policy measures have mitigated the negative impact on foreign economic activity and ensured system resilience.

Fourth, the comparison with Poland and regional benchmarks highlights that achieving high LPI scores requires not only technological modernization but also

comprehensive institutional alignment, standardized procedures, and deep integration into international logistics networks.

Overall, the study confirms that digitalization is a necessary but not sufficient condition for improving customs efficiency. Its effectiveness depends on the depth of institutional reforms, governance quality, system interoperability, and alignment with EU standards. Future research should focus on the empirical evaluation of digital customs reforms at the firm level, including the analysis of export performance, clearance time, and transaction costs.

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