EVALUATION OF OPERATIONAL STABILITY IN MODERN LOGISTICS: THE SYNERGISTIC IMPACT OF TRANSPORT COMPANIES AND THE CUSTOMS REGIME

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Abstract: *Maintaining operational stability in logistics is of utmost importance in the context of increasingly complex global supply chains. This study assesses the operational stability of modern logistics systems, focusing on the synergistic effects created by the interaction between transport companies and customs authorities. The author uses a combination of quantitative analysis of operational performance data and qualitative insights from new practices to improve customs logistics synergy. The paper studies the link between logistics companies' performance and the efficiency of customs procedures. This analysis examines the extent to which the synergy between transparency and digitalization of the Customs Service and the private sector contributes to a more significant increase in efficiency, beyond their individual positive effects. Conversely, inefficiencies in one area are significantly increased when combined with bottlenecks in another, resulting in increased operational instability, costs, and reduced supply chain flexibility. Key factors driving this coordination include coordinated planning, information exchange protocols, and mutual understanding of operational constraints between transport companies and customs authorities. The more closely the operational processes directly related to logistics are aligned with customs management, the more efficient global trade will be conducted. This study contributes to the literature related to logistics and supply chain management by empirically examining the effects of coordination on the operational efficiency of transport companies and customs regimes.*

Keywords: *operational stability, logistics systems, customs procedures, synergy, efficiency.*
JEL Classification: *O33, F13, C43.*

1. Introduction

Logistics performance indicators, including customs, are directly correlated with economic development. The Logistics Performance Index (LPI) report highlights that no country has achieved successful growth without a well-developed international trade sector, which is closely linked to high-quality logistics services. Customs procedures are a key component of this index. Thus, national economic policies and synergies between customs and logistics have a mutual influence. Proactive government measures can help develop synergies, while high levels of such synergies improve national economic performance, attract investment, and create favorable conditions for further improvement of customs and logistics processes, creating a positive feedback loop. The LPI measures the current state and serves as a tool for informing and shaping policies in this area (Arvis et al., 2007).

The global economy is marked by massive interdependence, with global logistics chains serving as the essential foundation of international trade. However, recent developments have highlighted their increasing susceptibility to various risks, from pandemics and geopolitical tensions to economic crises and environmental problems. Under such circumstances, ensuring the operational integrity of logistics frameworks has evolved into a facet of efficiency, a fundamental component of the competitive stature of national economies and individual enterprises, and a safeguard for sustainable economic advancement.

Logistics stability encompasses the predictability, reliability, and sustainability directly related to transporting goods and information from the origin to the point of sale and final consumption. The interaction between the stakeholders in the given process is essential in

maintaining the functionality of supply chains, namely, transport companies and customs authorities. This imperative determines that transport companies representing the private sector should maximize efficiency, improve delivery speed, and reduce costs in the context of intense competition. Customs authorities assume a multifaceted mission that includes fiscal, economic, and legislative enforcement responsibilities.

Conventional analysis of logistics systems often regards transportation operations and customs procedures in isolation, evaluating their effectiveness independently. However, such an approach proves inadequate for comprehending the intricate dynamics of contemporary supply chain processes (SCPs). Improving a single system component, such as accelerating transport, may fail to yield the expected outcomes and could even exacerbate existing challenges if other elements, such as customs clearance, remain inefficient and act as a "weak link" in the logistics chain. In this analysis, synergy is defined as a phenomenon wherein the outcome of coordinated interactions between transportation companies and customs authorities diverges significantly from the mere aggregation of their efforts.

Positive synergy denotes that coordinated actions result in disproportionately elevated stability, speed, and efficiency levels, surpassing the anticipated outcomes of isolated improvements. Conversely, negative synergy manifests when inefficiencies and a lack of coordination in one domain exacerbate issues in another, culminating in a cascading escalation of instability, costs, and diminished supply chain flexibility—the outcome is inferior to the sum of the individual shortcomings. Grasping the mechanisms through which both positive and negative synergies materialize at the intersection of transportation and customs is essential for formulating effective strategies to enhance operational stability. This study aims to assess the operational stability of modern logistics systems through the prism of the synergistic effect of interaction between transport companies and customs regimes.

2. Literature review

O. Kuchma concludes that the versatility of evaluating criteria when choosing transport connections and cargo transportation schemes will necessitate further clarification for different participants (Kuchma, 2024). P. Guarnieri et al., in their paper, emphasize that compared to traditional regimes, the Special Customs Regime for Industrial Warehouses under Computerized Control (SCRIC) lessens the working capital required for purchasing raw materials and inputs due to the tax suspensions. The need for capital to pay Tax on Industrialized Products (TIP) and Import Tax (if applicable) for domestically sold final products only arises from the point of sale until payment is received. If the product is exported, there is a need for working capital for TIP (and applicable Import Tax) and reducing existing costs (Guarnieri et al., 2008). Australian industry is very effective with the flexibility and workability of the Business Continuity Plan (BCP) and the additional support material available (Thornton, 2008).

Technologies like Truckcam are growing in popularity in some parts of the world. Using dashcam footage of accidents is now standard practice to establish liability. It has implications for logistics firms, in other parts of the world, where such practices might not yet be so commonplace, and for drivers and society more broadly (Hopkins & Hawking, 2018).

3. Methodology

The research methodology is based on a mixed-methods approach, combining quantitative and qualitative analysis. Quantitative analysis includes the processing and

interpreting of aggregated data, such as the World Bank Logistics Performance Index (LPI), and consideration of conceptual approaches used in efficiency and synergy studies. Qualitative analysis is based on studying theoretical models, analyzing case studies, examining reports and recommendations of international organizations (in particular, the World Customs Organization - WCO), and interpreting data from expert interviews and literature reviews. Such synthesis allows for a comprehensive and in-depth understanding of the complex interaction problem between transport and customs and the resulting synergistic effects.

4. Theoretical Framework for Interaction

A synergetic theory, or synergetics, is a key theoretical lens for analyzing the joint effect of interaction. Originating in the natural sciences, it studies self-organization processes in complex open systems. Its basic principles are also applicable to socio-economic systems such as logistics. The interaction between transport companies and customs can be viewed as the interaction of two complex subsystems within a larger international trade system. Synergetics argues that under certain conditions (openness of the system, non-linearity of interactions, the presence of control parameters – "order parameters"), coordination between subsystems can lead to the spontaneous emergence of new macroscopic properties, such as increased order, efficiency, and stability. These properties are not inherent in the subsystems individually. Thus, the synergetic approach helps explain why the coordinated actions of transport and customs can produce an effect that exceeds the sum of their efforts.

Understanding the coordination mechanisms requires drawing on inter-organizational interaction and information exchange theories. These include Transaction Cost Economics (TCE), which explains the choice of coordination forms (e.g., market contracts, hierarchy, hybrid forms) in terms of the desire to minimize the costs associated with finding partners, negotiating, concluding, and monitoring agreements. Within the context of transportation and customs, TCE provides a valuable framework for understanding why stakeholders opt for specific information exchange mechanisms and procedural agreements aimed at minimizing interaction costs at the border. Resource-Based View and Resource Dependency Theory focus on how organizations use their unique resources and manage dependencies on external resources to achieve competitive advantage (Guo & Bouwman, 2016). Transport companies rely on customs authorities to gain access to international markets, while customs agencies depend on timely and accurate information from carriers to ensure effective regulatory enforcement.

Listed theories explain the motivation for cooperation to gain access to critical resources (information, faster processing) and reduce dependency (Feng et al., 2024). Customer loyalty is the key to a company's survival and ability to compete with its competitors in fierce competition (Christian, 2024). Relational View and Social Exchange Theory emphasize the importance of trust, reciprocity, reputation, and long-term relationships in interorganizational interactions. Successful coordination between transport and customs often depends on formal procedures and the level of trust and willingness to cooperate based on the positive interaction experience. These theories help to understand why coordination is successful in some cases and not in others, even under similar formal conditions. Finally, the Contingency Theory reminds us that there is no universally "best" way of coordination.

The optimal mechanisms for interaction between transport and customs depend on many contextual factors: the type of goods being transported (e.g., perishable goods require

closer coordination), the level of technological readiness of the partners, the degree of uncertainty and risk in the operating environment, the specifics of national legislation and international agreements. Digital technology optimizes inventory management and achieves supply chain coordination and integration (Yan, 2024).

Commercial organizations strive to maximize profits, reduce operational costs (like fuel consumption, travel time, and idle time), and provide fast, reliable delivery to meet customer expectations and improve service satisfaction. Their activities are limited by market competition, demand volatility, the state of the transport infrastructure, the need to comply with numerous regulatory standards (including customs), and the efficiency of managing their resources (fleet of vehicles, personnel, warehouse capacity).

Customs authorities fulfill three primary functions integral to regulating and facilitating global trade in goods. Fiscal Function pertains to the revenue-generating and control aspects of customs operations. It encompasses the systematic collection of customs duties, taxes, and other applicable fees levied on imported and, in some instances, exported goods. A core component of this Function is the diligent oversight of the accurate calculation and timely remittance of these financial obligations, ensuring compliance with established tariff schedules and taxation policies.

The Regulatory and Economic Policy Implementation Function is that customs authorities execute a nation's trade policy objectives. It involves administering and enforcing various trade measures, such as quotas, licensing requirements, and import/export prohibitions. Furthermore, this Function includes the verification of origin to ascertain the provenance of goods. It is crucial for applying trade agreements and protecting industries from unfair competition or practices that could undermine the national economy.

Law Enforcement and Security Function focuses on safeguarding national security and public safety by ensuring the integrity of international supply chains. Customs authorities are tasked with preventing and interdicting illicit trade activities, including smuggling, the illegal trafficking of narcotics, weapons, and counterfeit products. A critical aspect of this Function is proactively identifying and mitigating potential terrorist threats associated with moving goods across international borders.

Using New Zealand Customs data for 2022, an analysis of seaborne imports from 51 countries, covering 22 vessels and 5,626 full container loads (FCLs). The study revealed significant differences in customs clearance and port processing efficiency. On average across all countries (51), 91.5% of full container loads (FCLs) were cleared before vessel arrival, with a mean lead time of 7 days and 7 hours (Table no. 1).

Table no. 1. Seaborne imports: top 10 overseas countries of loading

Country	Vessels	FCLs	Released before arrival	Arrival to release (mean)	Arrival to Gate-out (mean)
All countries (51)	22	5,626	91.5%	-7d, 7h	5d, 10h
Malaysia	7	1,342	95.1%	-10d, 22h	4d, 17h
Singapore	10	1,261	90.8%	-6d, 13h	5d, 12h
Australia	16	1,207	89.2%	-4d, 19h	5d, 21h
China	8	523	88.5%	-6d, 12h	6d, 15h
USA	8	171	82.5%	-6d, 18h	4d, 21h
Panama	2	130	88.5%	-7d, 22h	8d, 1h
Thailand	3	105	97.1%	-5d, 21h	3d, 19h
Hong Kong (SAR)	3	102	100.0%	-8d, 22h	9d, 6h
Indonesia	4	91	98.9%	-9d, 9h	5d, 12h
Vietnam	4	83	98.8%	-12d, 3h	2d, 22h

Source: (New Zealand Customs Service, 2022).

The average duration from vessel arrival to customs release was 5 days and 10 hours. Statistically significant differences were observed among the top ten countries by FCL volume. Vietnam demonstrated the highest efficiency, with 98.8% of FCLs released an average of 12 days and 3 hours before vessel arrival, and a total gate-out time of just 2 days and 22 hours. Similar high performance was recorded for Thailand, where 97.1% of FCLs were released before vessel arrival (5 days and 21 hours on average), and the arrival to departure time was 3 days and 19 hours. Malaysia, the leading importer of FCLs (1,342), showed a high pre-release rate (95.1%) with a significant lead of 10 days and 22 hours and an average arrival to departure time of 4 days and 17 hours.

Singapore and Australia, also major suppliers by volume, showed 90.8% and 89.2% pre-release, respectively. An interesting observation is the situation of Hong Kong (SAR), which, despite releasing 100% of FCLs before vessel arrival (8 days and 22 hours on average), recorded one of the longest average arrival-to-departure times at 9 days and 6 hours. Similarly, for Panama, the figure was 8 days and 1 hour, indicating potential delays at the port processing stage after the vessel's arrival, despite pre-clearance procedures. Among the top ten, the US has the lowest percentage of pre-releases (82.5%). The results indicate that although pre-clearance is widely implemented, there remains significant potential for optimizing in-port customs documentation procedures and reducing the overall cargo dwell time.

The efficiency of logistics operations varies significantly by country of origin, underscoring the need for a differentiated approach to enhancing supply chain procedures. These findings can serve as a basis for benchmarking and identifying best practices to improve international maritime transport's overall speed and predictability. The data in Table no. 2, representing a selection of the key components of the Logistics Performance Index (LPI) for 2023, serve as a valuable source for analytical frameworks to assess operational stability in logistics and customs regimes. In particular, the indicators of the efficiency of customs services (Customs Score/Rank) and the competence level of logistics operators (Logistics Competence Score/Rank) are direct indicators of the potential reliability and predictability of these systems.

Table no. 2. Logistics Performance Index for 2023

Country	LPI Rank	LPI Score	Customs Rank	Customs Score	Logistics Competence Rank	Logistics Competence Score
Malaysia	26	3,6	31	3,3	28	3,7
Singapore	1	4,3	1	4,2	1	4,4
Australia	19	3,7	14	3,7	14	3,9
China	19	3,7	31	3,3	20	3,8
USA	17	3,8	14	3,7	14	3,9
Panama	57	3,1	47	3	61	3
Thailand	34	3,5	31	3,3	38	3,5
Hong Kong (SAR)	7	4	12	3,8	11	4
Indonesia	61	3	59	2,8	65	2,9
Vietnam	43	3,3	43	3,1	53	3,2

Source: (World Bank, 2023).

The analysis shows significant differentiation among countries in these parameters. Singapore (LPI Score: 4.3; Customs Score: 4.2; Logistics Competence Score: 4.4) and Germany (LPI Score: 4.1; Customs Score: 3.9; Logistics Competence Score: 4.2) demonstrate high scores, which indicate developed customs procedures and high quality of logistics services that contribute to operational stability. Hong Kong (SAR) (LPI Score: 4.0; Customs Score: 3.8; Logistics Skills Score: 4.0) and Austria (LPI Score: 4.0; Customs Score: 3.7; Logistics Skills Score: 4.0) are also among the top performers.

Comparing the key components of the Logistics Performance Index (LPI) in Table no. 2 (Customs Performance and Logistics Competence, 2023) with the operational performance of seaborne imports in Table no. 1 provides an in-depth understanding of the factors that influence operational stability and demonstrates the importance of using multi-dimensional analytical frameworks. The expected correlation is observed between high Customs Performance scores (Table no. 2) and pre-clearance performance (Table no. 1).

Countries with high Customs Performance Scores, such as Singapore (4.2) and Malaysia (3.3), exhibit a high percentage of cargo released before vessel arrival (90.8% and 95.1%, respectively), reflecting the efficiency of their pre-clearance procedures. It confirms that the objective assessment of Customs performance at the macro level (LPI) is often reflected in the actual speed of Customs clearance at the operational level. However, the Logistics Competence Score (Table no. 2) and its relationship with the actual port handling times and the arrival to gate-out from Table no. 1, require a more detailed examination. Hong Kong SAR, with a high Logistics Competence Score (4.0) and Customs (3.8) in Table no. 2, as well as 100% pre-release of cargo (Table no. 1), nevertheless shows the longest time from arrival to gate-out from the terminal (9 days 6 hours). It may indicate that Logistics Competence, as a component of the LPI, reflects the overall quality and availability of services.

5. Mechanisms of positive synergy

The positive synergy cannot arise in a vacuum; it is a consequence of interaction and efforts to build effective coordination. The key mechanisms contributing to this include joint planning of transport operations, arrival/departure schedules, and use of infrastructure such as land border crossing points and ports. It allows you to avoid load peaks, optimize flows, and reduce waiting times. Creation and use of common information platforms and standardized protocols for real-time data exchange between carriers, shippers, customs brokers, and customs authorities will lead to faster customs clearance. Providing advance information about goods and vehicles allows customs authorities to conduct risk assessments before arrival, accelerating the customs clearance process for low-risk shipments. Increased transparency throughout the process for all participants reduces uncertainty and facilitates better planning (Chow et al., 2022).

Developing partnerships between customs and business, particularly through Authorised Economic Operator (AEO) programmes, based on mutual trust and understanding of each other's operational realities and objectives. It promotes a more open exchange of information and collaborative problem-solving. Standardisation and harmonisation: The use of internationally recognised standards in the field of data, like the WTO Data Model, procedures (revised Kyoto Convention), and technologies, promotes the compatibility of systems and the simplification of cross-border transactions. Methodologies for measuring synergy: The assessment of the synergy effect requires using specific methods that allow for the quantitative or qualitative measurement of the benefits of coordination.

Performance-based models: Methods such as data envelope analysis (DEA) can be used to assess a logistics system's technical and overall scale performance. Comparing efficiency at different levels of coordination or analyzing changes in efficiency over time allows us to identify synergistic effects. Cost/benefit models: This approach measures synergies as total cost savings for all supply chain participants when moving from an uncoordinated state to an optimal, coordinated interaction structure. Such models also allow us to assess the distribution of synergies (benefits) between different participants (goods owner, carrier, forwarder, customs).

Indexing methods: Building integral synergy indices based on a system of indicators characterizing the state of key subsystems (e.g., infrastructure and equipment, organizational management, commercial operations, information interaction) and their level of consistency. To determine the weights of the indicators, expert methods like Analytical Hierarchy Process – AHP, or objective methods based on the statistical properties of the data (Lu et al., 2019). Qualitative methods: Analysis of case studies of successful examples of cooperation, conducting surveys and interviews among experts to identify factors contributing to synergy and describe its manifestations in practice.

6. Conclusions

Data such as the Logistics Performance Index (LPI) and seaborne import statistics reveal significant differences between countries in customs clearance and port handling efficiency. Although the practice of pre-declaration is common, there is considerable scope for optimization of port handling processes. Countries with high customs efficiency scores tend to perform better in the pre-release of goods. However, high levels of logistics competence do not always guarantee minimum port handling times, indicating that the issue is multifactorial.

Various methodologies can be used to measure synergies, including performance-based models, cost-benefit analysis, index methods, and qualitative approaches such as case studies and expert surveys. The study, therefore, highlights the need to deliberately develop and strengthen synergies between the transport sector and customs authorities using modern approaches to planning, information sharing, and performance measurement to improve operational stability in modern logistics.

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