Customs management and its modernization: an analysis using structural equations at the Lázaro Cárdenas customs office, Mexico

Gestión aduanera y su modernización: un análisis con ecuaciones estructurales en la aduana Lázaro Cárdenas, México

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Abstract

This research study examines the relationships between best practices in modern customs operations and their effect on customs functions in the case of the Lázaro Cárdenas customs office, Michoacán. The measurable model of customs modernization, with validated observed variables from the case of the Manzanillo customs office by Reyes (2021), is applied. The aim is to determine how much of the improvements in customs functions can be attributed to public service reforms, technological and infrastructure changes, and, consequently, to analyze the effects on the efficiency of customs management related to revenue collection, trade facilitation, and oversight. The method employed is the structural equation modeling technique, as recommended by Coyle et al. (2015), for analyzing customs modernization constructs. The results clearly show positive and significant effects on the core functions of customs management as a result of best modernization practices. This work is expected to contribute to improving customs management by recognizing the relevance of best practices and identifying which dimensions of modernization generate the greatest impact in achieving efficient, transparent, and competitive performance, thus leading to actionable propositions and recommendations for administrators and officials.

Keywords: customs modernization, revenue collection, oversight, trade facilitation.

JEL code: C10, H30, F23

Resumen

En este trabajo de investigación se estudian las relaciones entre las mejores prácticas de la aduana moderna y su efecto en las funciones aduaneras en el caso de la aduana Lázaro Cárdenas, Michoacán. Se aplica el modelo medible de modernización aduanera con variables observadas validado en el caso de la aduana de Manzanillo por Reyes (2021). El objetivo de dilucidar cuánto de las mejoras en las

funciones de la aduana son atribuible a las reformas en la función pública, los cambios tecnológicos y de infraestructura y en consecuencia analizar los efectos en la eficiencia de la gestión aduanera relacionada con la recaudación, facilitación comercial y fiscalización. La técnica empleada es el modelo de ecuaciones estructurales mediante recomendado por Coyle et al. (2015) para el análisis de constructos de modernización aduanera. Los resultados obtenidos dejan de manifiesto los efectos positivos y significativos sobre las funciones sustantivas de la gestión aduanera producto de las mejores prácticas de su modernización. Se considera que este trabajo contribuirá a mejorar la gestión aduanera reconociendo la relevancia que tienen las mejores prácticas y desde cuáles dimensiones de la modernización se producen mayores efectos para lograr una actuación eficiente, trasparente y competitiva y se derivan consecuentemente proposiciones y recomendaciones para administradores y funcionarios.

Palabras Claves: modernización aduanera, recaudación, fiscalización, facilitación comercial.

Código JEL: C10, H30, F23

1. Introduction

The reforms to Mexican customs legislation (Administración General de Aduanas, 2007) and the introduction of mechanisms and systems supported by technological changes and new Information and Communication Technologies (ICTs) have produced significant effects, particularly in trade facilitation and the efficient service to foreign trade. At the same time, customs management has maintained and improved revenue collection levels by combating tax evasion and smuggling, ensuring control over imports and exports. These developments have led to important changes in the auditing and tax collection functions (Reyes, 2021).

Recent studies (Horta, 2006; Trejo, 2007; Reyes, 2021) have shown that Mexico is transitioning toward more effective, transparent, and competitive customs management. Nevertheless, research on modernization has focused on describing reforms by examining customs functions individually, without adopting a comprehensive approach to adapt the theory of the World-Class Customs Model proposed by Coyle et al. (2015).

However, studies such as the one by Reyes (2021), which analyzes customs modernization through a case study of the Manzanillo customs office in Colima, Mexico, have made it possible to determine the extent to which best practices impact auditing, tax collection, and trade facilitation key functions of modern customs. The study also assesses the degree to which these functions respond to public service reforms, technological changes, and infrastructure improvements. To do this, the author used a measurable model of customs modernization with observed variables collected via surveys, employing Structural Equation Modeling (SEM) as outlined by Hair et al. (1999).

Although the most significant advances in customs modernization in Mexico have occurred at the Manzanillo customs office, notable developments have also taken place at the Lázaro Cárdenas customs office, following the implementation of the Customs Modernization Plan 2007–2012 (PMA), which aimed to boost the efficiency and productivity of the national and international logistics chain (Reyes et al., 2020).

This has led to increased capacity at this customs office, solidifying its position as the second most important port in terms of container handling, with connectivity to 138 ports in 41 countries (Administracion Portuaria Integral de Lázaro Cárdenas, 2018) ranking 14th in Latin America and the Caribbean according to the Comisión Económica para América Latina y el Caribe (CEPAL) (Comisión Economica para América Latina y el Caribe, 2018).

t is also important to note that cutting-edge technological systems and mechanisms have been introduced at this customs office, indicating technological advancements. It is even part of the Customs Technological Integration Program (PITA) (Servicio de Administración Tributaria, 2016). It plays a key role as a link between Asia and North America, reaching the main consumer centers. The physical and geographical characteristics of the port make it a viable alternative for cargo movement and a strategic logistics hub to serve this growing market (Administracion Portuaria Integral de Lázaro Cárdenas, 2018).

However, while the relevance of the Lázaro Cárdenas customs office for customs management studies is acknowledged, it is necessary to verify the effect of modernization reforms to determine whether they actively contribute to the efficiency of its management and administration related to the functions of auditing, trade facilitation, and tax collection. Given the importance of foreign trade to Mexico and the key role of this customs office, it is essential to address questions such as:

How much of the improvements in customs functions can be attributed to reforms in public service, technological changes, and infrastructure at the Lázaro Cárdenas customs office? Is there a balance between the role of customs management in facilitating trade and the need for control in the context of increasing reduction of international trade barriers, regional integration mechanisms, and free trade agreements?

The aim of this study is to apply the measurable model of customs modernization with observed variables through surveys (Reyes, 2021) at the Lázaro Cárdenas customs office in Michoacán to study the best practices of modernization and their effect on the core functions of its management.

2. Theoretical-conceptual development

Customs modernization and substantive functions of customs management

By their nature, public customs administrations are not exempt from the principles of New Public Management (NPM). On the contrary, the World Trade Organization (WTO) and the World Customs Organization (WCO) regard the management and functions of customs worldwide as a crucial link in the global supply chain due to customs' determining role in foreign policy, economic development, international trade flows, and national security (Reyes, 2021).

The main strategic factors currently influencing customs administrations are related to the increase in international trade volume, trade liberalization, new international standards, the proliferation of regional trade agreements, significant changes in traditional trade patterns, and the rise in the number of participants. Additionally, the emergence of new logistics and supply chain models, the rise of transnational organized crime networks, borderless security threats, and growing concerns about public health and the environment also play a role (Gordhan, 2017).

As a result of these factors, customs administrations have implemented various responses to different degrees ranging from comprehensive reforms to more minor adjustments, as noted by Gordhan (2017).

Indeed, the priorities arising from foreign trade in Mexico have led to a shift from a revenue-oriented auditing approach to a facilitative approach with a stronger focus on the protection of other collective legal goods safeguarded by the state, such as national security, public health, animal and plant health, and the environment.

As stated by Shujie and Shilu (2009), the most important milestones that have driven customs modernization are the Revised Kyoto Convention and the SAFE Framework of Standards to Secure and Facilitate Global Trade from the World Customs Organization (WCO), from which the so-called best customs practices can be identified. These are defined as: "...simple and effective procedures designed to provide the highest level of facilitation for customs operations involving goods and passengers, as well as various special procedures" (Trejo, 2007).

Authors such as Coyle, Cruthirds, Naranjo, and Nobel (2014), Gwardzińska (2012), and the World Bank (2017) conclude that best practices in customs matters can be summarized through six constructs: infrastructure, procedures, technology, time orientation, cost, and mission. These constructs enable the development of a theoretical model for world-class customs, incorporating the best practices that customs administrations should follow in pursuit of modernization to enhance their core functions.

However, based on the research conducted by Reyes (2021) to develop the construct of customs modernization, it is considered that the components of mission, time orientation, and cost, together with simplified, efficient, and risk-based procedures, constitute the "public function" dimension. This dimension is understood, as expressed by Rozas and Hantke-Domas (2013), as:

> ...an essential function of the state, exercised through norms established in the legal system, referring to specific activities related to the legislative process, administration of justice, management of the state apparatus, national defense, law enforcement, fiscal and tax administration, and certification, among other similar essential and mandatory functions (p. 46).

The public function, by ensuring more efficient use of available resources and greater agility in operations, impacts both trade facilitation and auditing functions. Additionally, it significantly affects auditing and revenue collection functions by improving compliance with tax obligations

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related to non-tariff regulations and restrictions and enhancing the capacity to detect acts leading to infractions and crimes committed by traders.

Regarding technological changes, Barahona (2002) states that the most advanced customs administrations have automated the majority of their processes, thus reducing paper usage through the digitalization of operations. The use of the internet to receive declarations and disseminate information enables intense electronic communication among customs offices and the application of computerized data analysis models (p. 305).

On this basis, Reyes (2021) argues that technological changes also have a significant effect on customs functions. By allowing for the processing of larger volumes of information, they enable the effective development of risk management, and consequently, the streamlining and increased efficiency of customs procedures, resulting in better overall management. He also acknowledges a relationship between technological changes and the public function.

Finally, the aforementioned author considers that technological changes, together with the customs public function, will affect both auditing and trade facilitation. He supports this claim by referencing Widdowson (2007), who states that the use of technology and risk management will allow customs administrations to focus on high-risk areas and, as a result, ensure more efficient use of available resources, improve the ability to detect infractions and crimes committed by traders and travelers who fail to comply with their obligations, and provide faster processing for users who comply with tax regulations.

The position assumed by Reyes (2021) is that customs modernization is represented through three interrelated dimensions: public function, technological changes, and infrastructure, which significantly impact the essential functions of the modern customs system: control, revenue collection, and trade facilitation an approach adopted in this study.

In studies on the effects of customs modernization, including those by Barahona (2002), Basaldúa (2007), Trejo (2007), Grainger (2008), Cipoletta, Pérez, and Sánchez (2010), Zake (2011), Coyle et al. (2014), Davaa and Namsrai (2015), Morini (2015), and Reyes (2021), the relationship between

modernization and the substantive functions of customs management reveals several benefits, such as: improved voluntary compliance; increased speed and quality of service; access to new sets of skills, tools, and methods; simplified processes and procedures; enhanced management discipline; measurement and transparency; capital investment instead of spending; increased revenue; greater institutional efficiency; reduced transaction costs; economic growth; and the ability to handle the growing volume of goods, which is also a driver of economic development.

However, it is necessary to distinguish the specific case of customs in Mexico particularly in Lázaro Cárdenas, due to its importance to the country by identifying from which modernization dimension the impact on customs functions originates, and the resulting benefits. This distinction can help in the pursuit of greater efficiency in customs management, which improves as international trade transactions become easier, while maintaining strict fiscal and security controls required by international trade, and facilitating the commercial flow for the benefit of both the country and the global trading community (Cantens, Ireland, and Raballand, 2013).

3. Methodology: mesurable model of customs modernization with variables observed through surveys

In the case of the Lázaro Cárdenas customs office, a structural model is applied, following the recommendations of Coyle et al. (2014, p. 13) and Reyes (2021). The essential functions of the modern customs system are assumed as dependent (latent) variables: Oversight of foreign trade operations (FTO), Tax revenue collection from foreign trade (RCET), and Trade facilitation (FTF). The explanatory variables are: Public Function (PF), Technological Changes (TC), and Infrastructure (INF) (Reyes, 2021).

The relationships between dependent and explanatory variables in the model are based on the matrix of relationships between best customs practices and the essential functions of Mexican customs, systematized by Reyes (2021) (Appendix 1).

According to Hair et al. (1999), the development of this technique involves seven fundamental

steps, which are repeated interactively until the model achieves the best fit according to the chosen strategy. These steps are followed in the present study:

I. Develop a theoretically grounded model.

II. Construct a sequence diagram of casual relationships.

III. Convert the sequence diagram into a set of models and structural relationships.

IV. Choose the input matrix and estimate the proposed model.

V. Evaluate model identification.

VI. Evaluate fit quality criteria.

VII. Interpret and make possible modifications to the proposed initial model.

Dependent variables and explanatory or independent variables

Dependent variables refer to the customs functions listed below:

Oversight of foreign trade operations (FA): A function of customs management that includes control of international traffic. It involves activities related to international trade agreements and treaties, such as rules of origin, preferential tariffs, intellectual property rights, and enforcement of tax provisions that trigger contributions other than customs taxes. It also includes intelligent auditing, which requires reliable, accessible, and prudent information for building a data repository useful to all foreign trade actors. This oversight covers not only non-tariff or prohibited issues but also tariff and tax matters (Reyes, 2021).

Tax revenue from foreign trade (RCEA): Not limited to collecting foreign trade taxes, but also includes other state contributions and revenues such as the customs processing fee and compensatory fees (Reyes, 2021).

Trade facilitation (FCEA): Involves actions aimed at easing the flow of goods and reducing the costs of foreign trade operations and customs procedures in general (Reyes, 2021).

Independent or explanatory variables are:

Public Function (PF): Customs administration processes based on a reliable and accessible information system. This includes organizational schemes and anticipatory legal frameworks, new managerial tools and techniques, risk management, and procedures ensuring more effective use of available resources, greater capacity to detect violations and crimes, increased operational agility, and enforcement of tax obligations, regulations, and non-tariff restrictions (Reyes, 2021).

Technological Changes (CTN): Represents a practice of customs modernization involving automation of processes, use of the internet for submitting claims and sharing information, computer-based data analysis models, electronic communication with foreign customs offices, and new information systems to control goods and combat tax evasion. Its implementation in risk management reduces corruption and illegal practices by operators, improves information generation and reception, and rationalizes, simplifies, and enhances the effectiveness of customs administrative procedures (Reyes, 2021).

Infrastructure (INF): Encompasses modernization of buildings for commercial operations, ports, airports, roads, security infrastructure, improved working conditions, communication systems between customs offices, IT infrastructure, telephone and electricity services. Its implementation reduces cargo volume bottlenecks, improves global cargo movement efficiency, organizes infrastructure and equipment, and enhances information transmission capacity interrelated with technological changes (Reyes, 2021).

PF, TC, and INF are the constructs of customs modernization and are represented as latent variables with interdependent relationships among them, as well as varying levels of effect on the dependent variables AFT, FTTC, and TFC.

It is important to note that multiple relationships exist between customs modernization and the essential functions of modern customs (Reyes, 2021), which can be summarized as follows:

1. Oversight of foreign trade depends on administrative procedures, the use of information and communication technologies (ICTs), and infrastructure investments that facilitate management processes.

2. Revenue collection is influenced by the quality of public management and the ability to estimate

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the cost of imported godos even in contexts of tariff reductions as well as technological changes that not only impact the public function but also ease revenue processes and support infrastructure modernization at ports, airports, warehouses, roads, and buildings involved in trade operations.

3. Trade facilitation depends on the public function in terms of compliance with commercial regulations, but this should not hinder technological and infrastructural reforms that allow the flow of goods while minimizing logistics costs.

This model aims to relate the components of the customs modernization construct instead of treating them individually, evaluating them in terms of "best-in-class" performance (Coyle et al., 2015), and studying their impact on the core functions of customs management at Lázaro Cárdenas

through a perception-based analysis that links both theoretical constructs.

Associating essential customs management functions with reforms that led to best modernization practices is not trivial. Attempting to explain these relationships helps not only to understand how much improvement in customs functions can be attributed to best practices, but also to estimate the effect of reforms introduced in order to propose actions that strike a balance between trade facilitation and control and oversight.

Table 1 presents the variables, hypotheses, and sequence diagram of causal relationships for the structural model of customs modernization using latent variables. The hypotheses correspond to the analysis of customs modernization practices in Mexico and the association between modernization constructs and the essential functions of modern customs.

Table 1. Variables, hypotheses and sequence diagram of casual relationships

Variables	Hypotheses	Sequence Diagram of Casual Relationships
Structural model of customs modernization with latent variables		
Explanatory and simultaneously intervening variables: Public function (PF) Technological changes (TC) Infrastructure (INF)	H1: Public function, technological changes, and infrastructure are interrelated factors that have a positive and significant effect on the essential functions of customs management. H2: Public function is a factor that positively and significantly influences the auditing of foreign trade operations, and to a lesser extent, the foreign trade tax collection and trade facilitation by customs.	
Dependent variables: Auditing of foreign trade operations (AFT) Foreign trade tax collection (FTTC) Trade facilitation by customs (TFC)	H3: Technological changes are a factor that positively and significantly influences the auditing of foreign trade operations, and to a lesser extent, foreign trade tax collection and trade facilitation by customs. H4: Infrastructure is a factor that positively and significantly influences trade facilitation, and to a lesser extent, the auditing of foreign trade operations and foreign trade tax collection.	

Source: Own elaboration based on Reyes (2018).

Once the theoretical model was developed and expressed in the form of a diagram, it was formally specified through equations (Hair et al., 1999). The data for the model were obtained from a sample of 254 individuals based on a survey administered to people involved in various foreign trade operations at the Lázaro Cárdenas customs office, following the sampling criteria proposed by Palacios and Vargas (2012).

The sample was determined using the criteria established by Palacios and Vargas (2012), who recommend the use of the tables published by Cohen (1998) and Green (1991). According to these authors, given the number of parameters to be estimated (ranging from 25 to 30), the sample should consist of at least 250 to 300 observations or completed questionnaires.

The survey used was structured, and the instrument consisted of a questionnaire in which the items were rated on a Likert-type scale from 1 to 5 (1 = "very low perceived importance" to 5 = "very high perceived importance"), adapted from the proposal by León (2012).

The subjects comprising the sample were former customs officials at the chief or sub-administrative level involved in customs auditing and merchandise clearance processes at the Lázaro Cárdenas customs office, as well as authorized agents from customs brokerage firms directly involved in the customs operational procedures under study, following the recommendations of Reyes (2021).

Based on the questionnaire responses, the sample was characterized by variables such as gender, age, educational level, employing institution, level of government, and years of experience in the public customs sector.

4. Discussion and argumentation: results of the measurable customs modernization model with observed variables through surveys

In this study, the AMOS (Analysis of Moment Structures) software (Arbuckle, 1994), version 21.0, integrated with SPSS of the same version, was used.

Data entry was conducted using tabulated or properly coded data in a spreadsheet within the SPSS statistical package. When used for this purpose, SPSS generates variance-covariance and correlation matrices for all indicators included in the model.

Since all items in the survey questionnaire were answered, there were no missing data, resulting in a total of 254 valid completed questionnaires.

Because the observed variables are ordinal as in this study, which employed a Likert scale and cannot be treated as continuous variables, the covariance matrix cannot be calculated as a measure of association, as it would not accurately estimate the relationships among the variables. Thus, alternative yet robust methods must be employed (Díez, 1992).

Consequently, the Generalized Least Squares (GLS) estimation method was used in this model, based on Díez's (1992) criteria, as it is appropriate for the analysis of dichotomous or ordinal variables. The variances of the latent variables were fixed at 1.0.

Once the valid questionnaires were entered into the model, and in pursuit of a better model fit given the small effect of the infrastructure construct on Public Function that relationship was removed from the causal relationship sequence diagram presented in Table 1.

Normality was analyzed, and the distributional characteristics of individual variables were assessed (Hair et al., 1999). A fundamental assumption of multivariate analysis is data normality. Thus, skewness and kurtosis analyses were conducted, along with statistical normality tests. The skewness values were below 2 and kurtosis values below 10 (Kline, 2015), indicating that the data are normally distributed.

There were no signs of negative error variances; the variances explained by the observed variables fell within permissible ranges, as did the standardized parameter estimates and their corresponding standard errors. No coefficients close to or exceeding 1 were observed[1].

Simultaneously, model fit criteria were analyzed based on degrees of freedom, which are defined as the difference between the number of correlations or covariances and the effective number of coefficients in the proposed model (Hair et al., 1999).

The model has 24 degrees of freedom. Additionally, the ratio of Chi-square to degrees of freedom ($\chi^2/$

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[1] During the estimation process, illogical results may occur that represent identification problems in the structural model, known as offensive estimates, such as standardized beta coefficients with values very close to or greater than one.

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df), known as the normed chi-square, had a value of 2.76, which falls within the acceptable range according to recommendations ranging from as high as 5.0 (Wheaton et al., 1977) to as low as 2.0 (Hooper et al., 2008). The statistical significance level is 0.00, indicating an adequate model fit.

If there is a good fit, it indicates empirical evidence in favor of the theoretical model. The most commonly used and basic fit indices considered were the Comparative Fit I ndex (CFI), the Goodness of Fit Index (GFI), and the Root Mean Square Error of Approximation (RMSEA).

In practice, an RMSEA value close to 0 indicates an excellent fit; a value between 0.05 and 0.08 indicates a satisfactory fit; and a value above 0.10 indicates a poor fit. For GFI, CFI, and the Adjusted Goodness of Fit Index (AGFI), values close to 1 indicate a good fit, while values below 0.85 indicate a poor fit (Palacios and Vargas, 2012).

In this model, the RMSEA value was 0.08 with a significance level (P-close) of 0.01 (RMSEA values ≤ 0.1 indicate an acceptable fit) (Romero and Babativa, 2016). The Root Mean Square Residual (RMR), used to measure how well the model estimates the covariance matrix, had a value of 0.03, indicating a good fit (Byrne, 1998; Diamantopoulos and Siguaw, 2000).

The index results were: GFI = 0.94 (this goodness-of-fit index, when approaching 1, indicates a perfect fit), and AGFI = 0.90. These results confirm a satisfactory fit, and thus the proposed model is considered acceptable (Kenny, 2015).

Effects among modernization components at the Lázaro Cárdenas customs office

Table 2 presents the standardized direct and total coefficients between the components of customs modernization, obtained from the results using the AMOS software. In all cases, the relationships are significant, with p-values less than 0.05 (Kenny, 2015).

Table 2. Total standardized coefficients among components of customs modernization

Customs modernization components	Total effects	
	PF	INF
Technological changes	0.42	0.58

Source: Own elaboration based on AMOS results.

The first result observed is that the direct effect of Technological Changes on Infrastructure and Public Function is positive. In the first case, the standardized coefficient of 0.42 (p < 0.05) indicates a medium positive effect of Technological Changes on Public Function. In contrast, the total effect (0.58, p-value 0.00) of Technological Changes on the Infrastructure construct is classified as large (Kline, 2015).

The results show that the innovative and modernization drive in customs management, together with technological changes, despite structural adjustments in both systems and procedures, tends to impact infrastructure.

To explain this behavior from a theoretical perspective, it is important to consider that technological changes represent a practice of customs modernization that integrates into the public function of customs through process automation, the use of the internet to receive claims and disseminate information, the application of computerized data analysis models, among others factors which in turn affect IT, technological, transport, and operational equipment infrastructure.

Despite the absence of a theoretical stance regarding which relationship produces a greater effect in the cases mentioned above, the study conducted at the Manzanillo customs office reported coefficients of 0.37 and 0.73, respectively (Reyes, 2021), which shows a behavior similar to that obtained in Table 2 for the customs office under study.

One argument to explain this behavior at the Lázaro Cárdenas customs office is that the technological changes implemented during the period 2003–2021, although they have contributed to the streamlining and simplification of management procedures, have had a significant effect on infrastructure optimization through the Comprehensive Model Customs Infrastructure project applied as part of the Customs Modernization Plan (General Customs Administration, 2008).

In this same vein, the adoption of foreign trade information systems and mechanisms introduced at the customs office through the[2] employed technologies that offer ease of operation, data integrity, and information security. In this way, they

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[2] Currently, the Proyecto de Integración Tecnología Aduanera (PITA) is being implemented, which integrates the Sistema Automatizado Aduanero Integral (SAAI) and the Módulo de Administración Tributaria del Comercio Exterior (MATCE).

influence Public Function as mediated by reforms in security infrastructure, information technology, and communications, progressively increasing the capacity for information transmission and reception, as well as the streamlining and simplification of procedures.

These effects highlight the transparency of customs operations, expressed in the maximum amount of information available to all users and intermediaries regarding current tariffs and duties, valuation procedures, tariff classification criteria, restrictions and prohibitions applicable to the import and export of goods, potential sanctions, and available remedies, among others.

Effects of modernization on the functions of customs management at the Lázaro Cárdenas

The second result is related to the effects of best modernization practices at the Lázaro Cárdenas Customs Office on its core functions, as shown through the standardized total coefficients presented in Table 3.

The results show the following effects:

1. Reforms in the Public Function positively influence the three core functions of customs. This is expressed in standardized regression coefficients that, being greater than 0.5, indicate large effects.

The Public Function influences the auditing function through a more professional organization that makes intensive use of information technology, new procedures and management tools, agile, modern and flat structures, intensive use and distribution of information and international exchanges, automation of customs declaration processes, and strengthening of human capital.

An analysis from the perspective of management carried out by the Lázaro Cárdenas customs and port, as part of modernization and with the aim of adapting to the needs of international trade without neglecting its auditing authority, shows important actions and results, as detailed below.

First, the introduction of more effective procedures, increased capacity to detect violations and crimes committed by traders, more skilled human resources with appropriate profiles, improvements in risk management to focus inspections on potentially

non-compliant operations (and thus violating the legal framework), among others.

Table 3. Standardized total coefficients between components of customs modernization and functions.

Indicators	Total effects	Total effects on customs functions mediated by other modernization components		
		TC	INF	PF
As an effect of Public Function reforms (PF)				
Customs operations auditing (COA1)	0.64	0.27	0.077	
Tax collection from foreign trade (RCET)	0.66	0.27	0.077	
Trade facilitation by customs (TFC1)	0.65	0.26	0.075	
As an effect of Technological Reforms (TC)				
Customs operations auditing (COA2)	0.70		0.00	0.00
Tax collection from foreign trade (RCET2)	0.68		0.00	0.00
Trade facilitation by customs (TFC2)	0.73		0.00	0.00
As an effect of Infrastructure Reforms (TC)				
Customs operations auditing (COA3)	0.75	0.43		0.00
Tax collection from foreign trade (RCET)	0.85	0.49		0.00
Trade facilitation by customs (TFC3)	0.65	0.37		0.00

Source: Own elaboration based on AMOS results.

According to the Ministry of Communications and Transport (Secretaría de Comunicaciones y Transportes, 2018), the customs modernization project carried out between 2014 and 2018 enabled the auditing, monitoring, and control of the entry and exit of goods, as well as the means of their transportation, ensuring compliance with

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foreign trade regulations. It featured the following additional characteristics:

- Docks to achieve 90 inspection positions for foreign trade cargo.

- A maneuvering yard with a 11,033.00 m² hydraulic concrete area.

- A forklift platform with a 2,245 m² area.

- Hydro-sanitary and electrical installations.

- Emergency stations.

- A 2,245.00 m² metal structure supported by 24 round hydraulic concrete columns, 60 cm in diameter.

- Installation of gamma-ray inspection equipment.

The most significant results were that with the new inspection positions for foreign trade cargo, 1,115,452 TEUs[3] were processed in 2016 and 1,149,079 in 2017. Additionally, a capacity was created to handle up to four million TEUs.

As a result of these measures, the port recorded a 31% growth in automotive cargo handling, managing 460,959 units by December 2021, surpassing the 351,993 units handled during the same period in 2020. Of the total handled, 49% were export vehicles, 48% were import vehicles, and 3% were transshipment vehicles.

In the same report, the National Port System Administration reported that exports increased by 23% and imports exceeded 35%. The port became the first specialized terminal for vehicle handling in Mexico and achieved a 96% share of total new vehicle operations in Mexican Pacific ports, maintaining global competitiveness.

In this line of analysis, the effect on trade facilitation is attributed, according to the theoretical arguments of Reyes (2021), to changes in fraud risk analysis, random and selective inspections, post-clearance audits that do not hinder trade flows, clear and transparent procedures made available to all, a drastic reduction in inspections, a harmonized classification system, and simplification of declarations all of which are part of current customs practices.

This is confirmed in practice by the fact that in 2021, the port opened a fourth service module to expedite container transportation. This measure represents a 33% increase in inspection capacity with the aim of facilitating ground freight transport operations within the port facilities, simplifying the reception and dispatch of goods, promoting space availability at the terminals, and ensuring a constant flow of freight transportation for dispatch (Administración del Sistema Portuario Nacional Lázaro Cárdenas, 2022).

The effect of Public Function on revenue collection stems from new methods of collecting non-customs taxes due to the gradual reduction of tariffs and the implementation of administrative regulations in favor of importers and exporters for goods clearance procedures, which reduce import and export costs.

These methods have simplified the payment of tariffs, taxes, and fees and customs operations at the Lázaro Cárdenas customs office. This explains the effect of the Public Function on revenue collection, which is evidenced by the trend in the revenue flow shown in Graph 2 of this study.

I. The direct and positive effects of technological reforms, mainly resulting from advances in digital technologies and the reduced cost of communications, have a favorable influence greater than that of changes in the Public Function and with no significant differences across the three core customs functions. Regression coefficients of 0.70, 0.68, and 0.73 for auditing, revenue collection, and trade facilitation, respectively, indicate that technology has significantly contributed to the effective administration of customs and its operations, as it has been widely integrated into modernization efforts.

From a theoretical perspective, Reyes (2021) links technological changes to the auditing of foreign trade operations through electronic systems and mechanisms such as the SAAI (Automated Customs System), the Electronic Customs System (SEA), the Single Window for Foreign Trade (VUCE)[4], the MATCE, the Single Customs Clearance Document (DUNIC), the FAST and Express lanes, process reengineering, and the paperless customs system due to automation processes. These changes, in turn, have created new customs facilities, resumption of activities, partnerships for secure

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[3] A twenty-foot equivalent unit, meaning this unit represents the length of a container which is equivalent to 6 meters, and it is the unit used internationally for cross-border trade.

[4] They began in 2012 at all customs offices in Mexico.

trade, harmonization of criteria, and extended service hours.

The main technological changes at the Lázaro Cárdenas customs office to audit and facilitate foreign trade include:

- MATCE was launched in 2016 with the purpose of providing and maintaining IT solutions to help reduce taxpayer service times, ensure the operational continuity of systems supporting tax collection, foreign trade, and internal operations; evolve operational continuity services to increase productivity and handle more services at lower costs and in less time; and implement quality assurance in internal and provider services.

- The PITA program is an expression of the technological changes aimed at trade facilitation and, consequently, revenue collection (Reyes, 2021). In the case of the Lázaro Cárdenas customs office, a pilot program was launched considering that it was not only about introducing technology into the customs process, but also about conducting a deep review of it to automate and make it transparent, thereby facilitating trade. In this regard, DODA-PITA tests began in 2020 (Gomsa Logística, 2020). Combined with the previously mentioned technological changes, these tests have significantly increased import and export operations, as shown in Graph 1 analyzing the indicators.

In summary, the technological reforms implemented have produced changes in the information system to control goods and combat tax evasion, with a consequent effect on auditing and trade facilitation through (Servicio de Administración Tributaria, 2020):

- Automated procedures for on-site and post-clearance control.

- Use of non-intrusive inspection mechanisms.

- Automation of tax obligation procedures.

II. Lastly, reforms in technological, communication, and physical infrastructure have a direct and positive effect first on revenue collection, second on auditing, and finally, although still significant, on trade facilitation. This is reflected in the high observed regression coefficients of 0.85, 0.75, and 0.65, respectively. The indirect influence of technological changes on these functions occurs in the same order, as a medium effect (0.49, 0.43, 0.37).

From a theoretical standpoint, the relationship between infrastructure as one of the best modernization practices and the main customs functions is discussed from a broad perspective by Reyes (2021). First, the link with auditing is evident in management infrastructure, such as equipment, operational buildings, service and administrative infrastructure, and IT systems. Second, the connection with trade facilitation includes, in general, IT and technological infrastructure. Lastly, transportation infrastructure aimed at increasing the volume of international cargo and reducing operational costs including ports, airports, warehouses, road systems, among others is directly related to the revenue collection function.

This is evidenced in the case of the Lázaro Cárdenas customs office and port, where significant changes in infrastructure have taken place. On this matter, the General Customs Administration, through its Central Administration for Customs Equipment and Infrastructure, reported that for the period 2007–2012, modernization efforts related to infrastructure produced the following outcomes (Servicio de Administración Tributaria, 2020):

- The customs office was equipped with an infrastructure project located in the northern area of the Lázaro Cárdenas port, which has been completed.

- During the period, new customs facilities were inaugurated, including operational and administrative areas, inspection facilities, and inspection equipment for foreign trade goods, allowing foreign trade companies to carry out import and export procedures at a single location. Among the improvements:

    - The capacity of the inspection platform was expanded,

    - new operational and administrative facilities were built,

    - new control booths, as well as access and exit lanes for road transportation and inspection equipment, were installed,

    - the customs office was enabled to carry out foreign trade clearance procedures more efficiently,

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- due to its location (entry and exit point of the Lázaro Cárdenas port), it allows foreign trade companies to conduct import and export procedures at a single site.

For the years 2018 and 2019, there are records of public works investments in the customs office and the port in real estate, infrastructure, and ongoing construction projects, amounting to 236,668,733 and 421,323,673 pesos, respectively (Administración Portuaria Integral de Lázaro Cárdenas, 2019).

In 2021, the customs office opened a fourth service module to streamline the transportation of full import containers. This measure represented a 33% increase in inspection capacity and was implemented to facilitate ground freight operations within the port facilities. It aimed to simplify the reception and dispatch of goods, improve the availability of space at the terminals and customs office, and ensure a constant flow of cargo transportation for clearance.

From the perspective of the performance of the indicators related to the customs trade facilitation function (FCEA) and foreign trade tax revenue collection function (RCEA) proposed by Reyes (2021), there is evidence of real improvements as a result of the reforms and the set of best customs practices analyzed.

Data regarding the total value of operations for the period 2012–2021 which includes both imports and exports are presented in Graph 1. This represents one of the main indicators of FCEA.

The graph shows growth in the total value of operations over the period; however, due to the economic crisis resulting from the health emergency caused by COVID-19, there was a significant decrease in December 2020, mainly due to the decline in export value.

In 2021, a renewed increase in this indicator can already be observed.

Regarding the cash flow revenue from foreign trade at customs, which represents the main indicator of RCEA, its behavior is shown in Graph 2.

Graph 1. Total value of operations at the Lázaro Cárdenas customs office, 2012–2021 (monthly) (Millions of pesos).
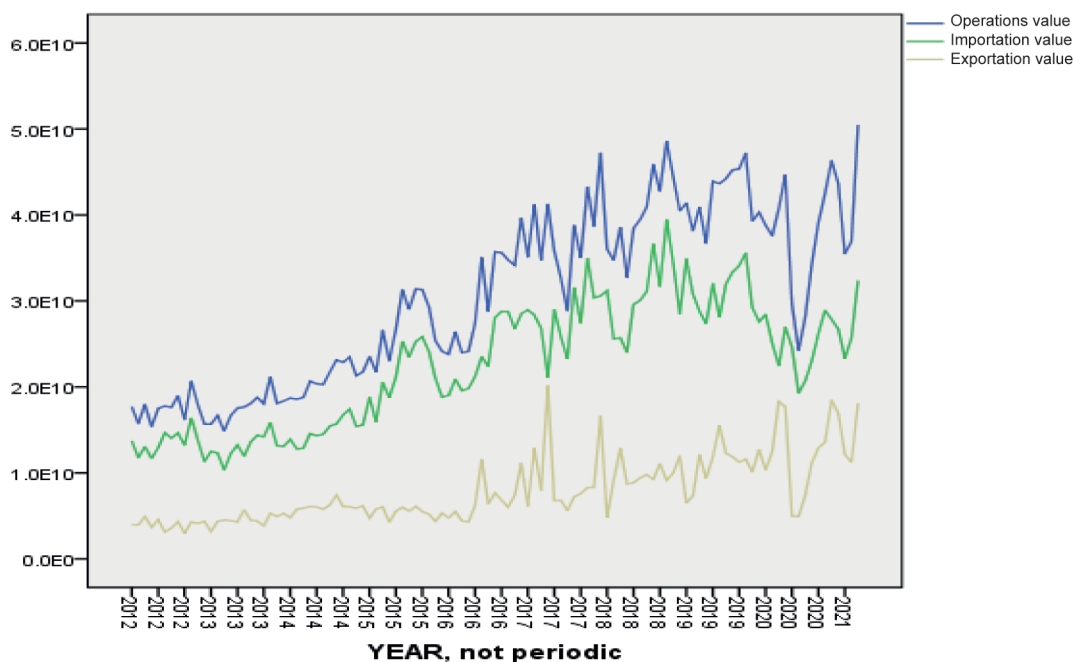
Source: SPSS v. 22 output based on data from the Ministry of Finance and Public Credit (2022).
Note: The value of imports refers to the customs value of the goods, whereas the value of exports corresponds to the commercial value of the goods.

Graph 2. Cash flow revenue at Lázaro Cárdenas Customs Office, 2006–2021 (monthly, in millions of pesos).
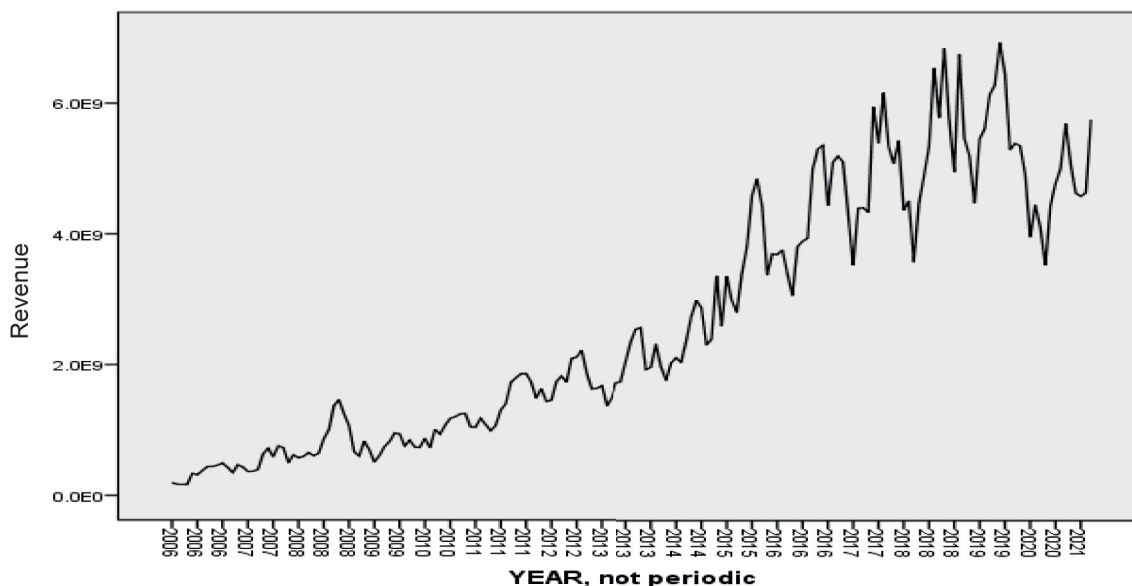
Source: SPSS v. 22 output based on data from the Ministry of Finance and Public Credit (2022).

During the analyzed period, revenue shows growth despite a decline in 2020 caused by a reduction in operations and their value, as previously mentioned. In March 2021, revenue began to increase again within the context of the country's economic recovery.

5. Conclusions

Customs modernization, conceived as a public function involving technological and infrastructure changes, aims to establish a balance between the customs functions of control and collection of fiscal revenues and the facilitation of foreign trade.

The "model customs" program and the customs modernization plan 2007-2012, along with port development programs and the electronic systems and mechanisms applied in Mexico, have been the main avenues contributing to the facilitation, simplification, and automation of foreign trade, as well as to the efficiency of customs administration control and oversight tasks.

According to the master plan (Secretariat of Communications and Transport, 2018), the

Integral Port Administration of Lázaro Cárdenas has been empowered to promote comprehensive development, aiming to become one of the most important ports in Latin America, both industrially and commercially.

As a result of the program, the necessary conditions were established for a dynamic and efficient flow of cargo handling, which in turn contributes to the high and sustained growth of the regional and national economy. This reflects the changes in customs modernization, particularly in administrative processes, automation, technological changes, and infrastructure.

The study of best practices in the modernization of the Lázaro Cárdenas Customs and their effect on its management functions through SEM corroborates that:

a) Customs is no longer limited to collecting taxes at borders but has become the manager of all state functions related to border crossings, such as trade facilitation, control, and oversight.

b) There is a positive and significant effect of best practices in customs modernization on the three essential functions recognized by the theoretical

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model applied. The behavior of foreign trade operations and revenue indicators during 2006-2021 confirms this.

c) Although there are no significant differences in the effects of customs modernization reforms on its functions, results suggest that the impact on oversight of foreign trade operations mainly comes from infrastructure and technological reforms.

d) Public function reforms act directly on revenue, then on trade facilitation and oversight. In contrast, technological and infrastructure changes have a greater impact on facilitation, oversight, and lastly revenue. Infrastructure's effect is the opposite, impacting revenue collection most strongly, followed by oversight and trade facilitation.

The behavior of the Trade Facilitation and Tax Revenue indicators at Lázaro Cárdenas confirms the changes in modernization and their effects on the essential functions of modern customs in the context of Mexico.

The results express efficiency in customs management, which will continue to make Lázaro Cárdenas a competitive port that generates better services and immediate comprehensive solutions for the economic growth of the sector.

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Appendix

Appendix 1. Relationship between best customs practices and essential customs functions in the context of Mexico

Customs Functions and Practices	Oversight of Foreign Trade Operations	Tax Revenue Collection from Foreign Trade	Customs Trade Facilitate
Public function	• More professional organization that makes intensive use of information technology, new procedures, and managerial tools. • ISO 9002 standard. • High proportion of officials with university education and agile, modern, flat structures. • Intensive use and distribution of information and international exchanges. • Automation of customs declaration processes. • Strengthening of human capital.	• New methods for collecting non-customs taxes due to the gradual reduction of tariffs. • International trade agreements to increase revenue collection. • Administrative regulations favoring importers and exporters in customs clearance procedures, reducing import and export costs.	• Risk analysis of fraud, random and selective inspections, and post-clearance controls that do not hinder trade. • Clear, transparent, and available procedures. • Drastic reduction of inspections (aforos). • Introduction of specific criteria for inspections. • Harmonized classification system. • Simplified declarations. • Facilities for prior inspections. • Clear, transparent, and automated procedures for in situ and post-clearance control. • Use of non-intrusive inspection mechanisms, such as Gamma-ray machines.
Technological changes	• Electronic systems and mechanisms (SAAI, SEA, VUCE, MATCE, DUNIC, automated selection mechanism). • Process reengineering. • Paperless customs. • FAST and Express lanes. • Customs facilitations. • Resumption of activities. • Partnership for Secure Trade. • Harmonization of criteria and extended hours.	• Electronic systems and mechanisms (SAAI, SEA, VUCE, MATCE). • Customs Technological Integration Program (PITA).	• Simplified export Project. • Customs confinement. • Phazir • Secure Wireless communication. • Automated procedures for tax compliance (SAAI, SEA, VUCE, MATCE, DUNIC). • Customs Technological Integration Program (PITA).
Infrastructure	• Management infrastructure: equipment, commercial operations buildings. • Proximity of service and administrative infrastructure. • IT infrastructure.	• IT infrastructure. • Technological infrastructure.	• Infrastructure in transportation means to increase international cargo volume and reduce operational costs. • Improvements in port, airport, warehouse, and road system infrastructure.

Source: own elaboration based on Reyes (2021).