A framework to evaluate over-costs in natural resources logistics chains

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Abstract
Foreign trade barriers and duties have been significantly reduced by multilateral agreements and integration mechanisms among nations. Logistics costs represent a significant proportion of the final price of the items, especially of the commodities. For this reason, minimizing logistics costs is an important challenge for nations in order to enhance competiveness of foreign trade and in particular to take advantage of natural resources rents. In this article, we propose a holistic framework for estimating logistics costs, focused on determining over costs that result from inefficient procedures and a lack of adequate public policies and regulations of the public entities. These issues have not been considered in the literature, and this article fills this gap. As a case study, we present the application of the framework to estimate over costs in some natural resources logistics chains of Bolivia. A discussion of the results found is presented together with recommendations for further research.

Keywords: Natural Resources; Logistics chains; International trade

Un marco de referencia para evaluar los extra-costos en cadenas logísticas de recursos naturales

Resumen
Las barreras y aranceles al comercio exterior han disminuido significativamente gracias a los acuerdos multilaterales y los mecanismos de integración entre las naciones. Los costos logísticos representan una proporción significativa del precio final de los artículos, especialmente de los commodities. Por esta razón, minimizar los costos logísticos es un desafío importante para las naciones para fomentar la competitividad del comercio exterior y en particular para aprovechar la renta de los recursos naturales. En este artículo, proponemos un marco de referencia integral para la medición de costos logísticos, enfocado en determinar los extra-costos que resultan por procedimientos ineficientes y la falta de políticas públicas y regulaciones de las entidades públicas. Estos elementos no han sido considerados en la literatura, y este artículo aborda esta brecha. Como caso de estudio, presentamos la aplicación del marco de referencia para estimar los extra-costos en algunas cadenas logísticas de recursos naturales en Bolivia. Se presenta una discusión de los resultados encontrados, así como recomendaciones para trabajo futuro.

Palabras clave: Recursos Naturales; Cadenas logísticas; Comercio exterior

1. Introduction

Free trade agreements and the current geographical fragmentation of production worldwide are positioning logistics costs as a key element of the total cost of a product, in particular commodities. Hence, logistics costs present an important challenge for companies and nations in order to compete in the current markets [1].

Foreign trade competitiveness relies on the efficiency and effectiveness of the export and import logistics chains, where a significant number of private and public parties interact. Efficiency at seaports, airports and borders (nodes of the global network) are critical. International experience shows that an adequate coordination of the different parties involved

in the logistics chain, generates important economic, social and environmental benefits, reducing operational costs and enhancing national connectivity and regional integration.

Latin American countries face important challenges in terms of logistic performance with respect to OECD countries and other emerging countries. To reduce this gap, it is necessary to promote public policies that enhance infrastructure development, trade facilitation including customs procedures, an adequate market regulation, supply chain security and the efficiency of logistic services [2].

In the literature, it is possible to find several studies that show the importance of transport costs with respect to trade costs, as well as the importance of a good level of infrastructure. Avelar-Sosa et al. [3] present a study in which the results show that a good degree of the regional infrastructure has a positive impact on logistics services, and as a consequence, on the costs. In [4,5] an analysis of the determinants of transport costs and their impact on foreign trade in Spain is presented. In [6-8] the impact of transport costs for foreign trade is analyzed for intra-trade and containerized trade in Latin America. The impact of port efficiency as a determinant in maritime transport costs is analyzed in [9], and the importance of connectivity measures for maritime transport is discussed in [10].

Integral and sustainable logistics policies have been promoted by the Unit of Infrastructure Services at ECLAC (Economic Commission for Latin American and Caribbean), with the aim to integrate the different stakeholders that participate at the national and international logistics chains [11,12]. This article presents a holistic framework for measuring logistics cost in natural resources logistics chains incorporating ECLAC´s integral vision recommendations. This incorporates the role of the State, taking into account those public entities that directly participate in different links of the global logistics chains (e.g. Customs, Agricultural and Livestock services, among others).

In addition, the proposed framework considers not only the costs incurred under normal operations, but also over costs that are generated as a result of the lack of coordination and inefficiencies in the export and import processes, and the lack of adequate State public policies and regulations. As it will be further described, methodologies that have been proposed in the literature do not incorporate this vision, which is the main contribution of this work.

The manuscript is structured as follows. Section 2 presents a brief literature review where the main contributions on the subject are described. Section 3 presents the methodological proposal. Section 4 presents the case study of Bolivia and section 5 presents some conclusions and recommendations for further research.

2. Literature review

Logistics costs are defined as those resources required to perform the activities related to moving, storing and distributing goods from its origin to the point of consumption. Hence, logistics costs involve a spatial dimension associated to transport and warehouse activities, as well as a temporal dimension associated to the process involved, where inventory costs, dead times for loading and unloading operations, stock out costs, and the variability on the lead times are the main variables that represent total logistics costs.

There are two main approaches in the literature to measure logistics costs: macro and micro economic perspectives, of which the contributions to the literature are presented in section 2.1 and 2.2 respectively. Section 2.3 presents some case studies that employ a combination of macro and micro approaches. A more detailed review can be found in [13].

2.1. Macro methodologies for logistics cost estimation

Macroeconomic methodologies aim to determine the logistics performance of a country, based on the global estimation of its logistics systems and its relative importance with respect to the productivity of the country and its competitiveness. Measuring the efficiency of a nation´s logistic system is important for the private and public sector. For the public sector, it supports the design of public policies and investment decisions. For the private sector it also provides information that may be an input for strategic decision making such as investments and others.

Macroeconomic methodologies are mainly based on descriptive tools and econometric methods, where the variables do not necessarily comprise total logistics costs but represent estimations of the country's logistics costs. For this, primary and secondary information sources are employed.

Particularly for the Latin American case, in [14] a study to determine logistics costs is presented and evidence of the impacts on the competitiveness, development and poverty indexes is provided for the economies of the region. The main trade barriers that were identified are the infrastructure, logistics and trade facilitation. A key finding with respect to infrastructure barriers is that simultaneous improvements in road and rail infrastructure imply bigger impacts than investments in road infrastructure itself. This highlighted the need for integral public policies for transport infrastructure that enhances sustainability and efficiency, promoting the complementarity in transport modes (co-modality).

These types of estimations turned out to be critical to the establishment of public policies or projects related to improving the logistics performance of a country. In global terms, macro-economic methodologies can be classified according to four main approaches:

i. The first approach refers to the measurement of global indicators such as the GDP or the CIF value of the cargo. This type of indicator is frequently used in the annual reports related to logistics in United States.

ii. The second approach is related to the effect on time and its implications in foreign trade, specifically in terms of reliability of the supply chain measured as the time variance of the in transit inventories. This type of methodology has been used by [15-17], that consider transport, warehousing, management and information systems costs. In [18], an analysis of the relationship between import and export times, logistics services and foreign trade is presented. The incidence of the time

factor and the probability of a foreign trade transaction between two nations occurring is also analyzed.

iii. The third approach relies on the causes and effects of logistics costs, where the main estimator of logistics costs is the inventories levels. In [19-21], these topics are addressed, with a special focus on the time variable, considering the impact of lead times variability and its reliability. This approach is very commonly employed for the private sector. Tongzon [22] propose a set of determinants for logistics competitiveness, from which operational effectiveness, adaptability to customer demand and cooperation and the fostering of alliances are highlighted.

iv. Finally, the last approach corresponds to the indexes computed by the World Bank such as the Logistics Performance Index (LPI) and Doing Business that are useful tools for benchmarking analysis, given that they are periodic evaluations including a significant sample of countries.

One of the main advantages that the macroeconomic method offers is the availability of indicators that support decisions making in preliminary stages of public policy planning. It also supports the evaluation of different stakeholders and institutions both public and private that participate in the logistics chain. Furthermore, these types of indicators also enhance the implementation of measures and policies required to improve the competitiveness of a nation.

Macroeconomic approaches previously mentioned, deal with aggregated data and, in general, the variable time is not a focus. The first approach does not consider this variable and the second approach, partially analyzes it. The third approach estimates logistics costs based on the levels of inventory, without considering other costs such as transport and management, or the interaction with variables associated to process facilitation and the performance of the public organisms involved in the logistics chain. In the case of global indicators such as the LPI, these are based on perceptions of logistics operations by the people working in a country and do not measure the performance and total cost components of logistics activities. Furthermore, the logistics performance index is estimated based on the average values for the Likert type variables, and hence special statistical treatment of data is required [23].

An important gap for this type of methodology is that results are not product specific and they deal with aggregated data, which can lead to important distortions with respect to the real operation costs and times, due to the lack of differentiation between products and their own requirements (bulk products, perishable items, dangerous cargo, etc.). For this reason, additional information related to logistics costs and its deployment is needed, and this is provided by the microeconomic approaches.

2.2. Micro methodologies for logistics cost estimation

Microeconomic approaches support decision making for the enterprises based on logistics costs as criterion. According to [24], logistics costs are a compound of the costs involved in four activities: transport, inventory management,

warehousing and order processing. Some other authors present different classifications, considering warehousing and inventory management as a single component [25], whereas others incorporate other administrative costs. None of these approaches explicitly, consider those involved in the inspections and activities of public organisms as part of the cost (i.e. Customs, Agricultural and Livestock, etc.).

We can find different approaches in the literature regarding those decisions in which logistics cost is the main objective to optimize: inventory policies, transport mode selection (multimodal), location policies and supply chain policies among others. Three main methodologies are identified and further described:

i. The first methodology relies on the estimation of the private logistics costs incurred, with a special focus on the lead times and variability in the inventory levels. It is important to point out that the variable "time" does not only depend on the transport mode configuration of the supply chain, but also on the characteristics of the demand for the product. In this regard, Zinn et al. [26] study the effect of the demand patterns in time, and how these affect security inventories and hence, inventory costs. On the other hand, Haartveit, [27] propose a method for computing logistics costs based on a time study, and Vernimmen et al. [28] address the effects of variability in service times of maritime shipping companies with respect to the inland logistics chain. On the other hand, Evaraert [29] analyzes the particular case of logistics costs for a wholesale distributor where costs are handled as a function of production amounts, using the ABC costing to determine the resources consumption of each activity in the logistics chain that the wholesaler administrates. Haartveit et al. [30] emphasize the variable time to measure logistics costs of a multi-item chain of a particular enterprise. Lamban et al. [31] propose a logistic index to determining the storage costs of a product for a supply chain.

ii. A second approach is related to the relationship between logistics costs for decision making. Under this perspective, logistics costs determine inventory policies, transport mode selection, location policies and supply chain policies. For inventory policies, there exist three types of decisions that are taken such that logistics costs are minimized: order size, number of orders to place and the frequency for the orders. Such decisions are modeled either theoretically or for specific case studies.

iii. The last approach is related to more integral supply chain management policies. Roorda et al. [32] propose an integrated model where logistics costs are combined with other variables such that outsourcing of logistic services, other industrial sectors development, and the impact on new logistics chains in the market.

Microeconomic methods provide more details regarding logistics costs, either for a product level, group of products, firms industry or a cluster. These methods provide a more integral vision of the logistics costs, incorporating the costs associated to the time dimension (safety stock and stock out) traditional transport, warehousing and management costs.

Conceptually, the literature focuses on the private vision, which is the traditional perspective for logistics costs

estimation. It refers to those costs incurred by a private company to transport goods from the point of origin to the point of consumption, without considering those costs in which the public sector is involved. Such costs include those of process facilitation, inspections and regulation. The methodology proposed herein, fills this gap by including these costs in the analysis, with a holistic or integral vision of the global logistics chains.

2.3. Combined macro and micro case studies

In order to illustrate two practical applications, UN-ESCAP [33] presents two case studies: United States and Korea. These two countries were chosen as they present periodic national logistics costs reports. In the United States, the company Cass Logistic Systems Inc. publishes national logistics costs statistics every year, considering three key components: transportation, inventory carrying and administrative costs. The Korea Transport Institute, on the other hand, developed a methodology for estimating logistics costs in order to evaluate the efficiency of the national logistic system.

Several logistics cost factors were considered such as transportation costs, inventory holding costs, packing costs, stevedoring costs, information costs and administration costs. In both cases, public sector activities are not considered directly, and only the costs generated by the operations of the private stakeholders are considered, without including the externalities and over costs caused by the public sector and inefficiencies that occur at different echelons of the global logistics chain. This is the gap that the present document is addressing.

3. Framework for logistics costs estimation

As pointed out in the previous section, traditional approaches for logistics costs assessment found in the literature present important gaps. From a macroeconomic perspective, particular information of the logistics chains is not considered to obtain global performance indicators that are employed for national benchmarking purposes, while from a microeconomic perspective, causes analysis or more detailed computation of logistics costs is not prioritized. Furthermore, the costs related to public entities and the state institutions are not considered.

The following subsections present the integral vision of logistics costs with respect to the traditional vision. Then, the main determinants of logistics costs are analyzed and finally, the proposed reference model is described.

3.1. Traditional and integral vision of logistics costs

Traditional approaches for logistics costs assessment do not consider those costs related to inefficiencies brought about by inadequate provision of infrastructure services by the State, (e.g. inspections, trade facilitation) as well as those related to the externalities that are generated by the community and the environment. For this reason, ECLAC promotes an integral framework for the analysis of each of
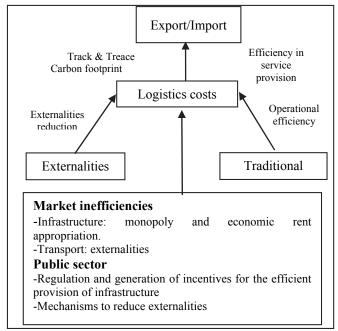

Figure 1. Integral Vision of Logistics costs.
Source: The authors.

the trade processes, identifying the potential inefficiencies, in terms of time and costs involved, independently of the transport mode and the stage of the supply chain, considering both public and private stakeholders.

Fig. 1 presents a diagram of the integral vision of logistics costs assessment. The diagram considers both traditional logistics costs, which are those incurred by the private company to move goods from one point to another, as well as those externalities and over costs that resulted from the inefficiencies in the provision of logistic services involving the State and public entities, mainly related to transport and infrastructure.

Logistics over costs could be incurred, for instance, due to the lack of adequate regulations in monopolies and economic rent appropriation. Furthermore, over costs can be generated due to the lack of an efficient service provision at the different echelons of the logistic chain. This can generate additional storage days or fees due to the non-fulfillment of a time window that is required by a certain facility (e.g. a late arrival fee imposed by the port terminal for the reception of cargo). Another example are truck delays and waiting times at the port terminals due to the lack of efficient coordination in terms of landside operations.

Externalities are those impacts that the society has to assume, as a result of logistic activities, such as congestion, pollution and road accidents among others. The aim of identifying and incorporating them when it comes to computing logistics costs is to enhance more sustainable logistics.

The role of the public sector is crucial to identify and correct those market failures by an adequate regulation and facilitation, both in the transport and logistics sector. In terms of infrastructure provision, the State should enhance mechanisms that prevent monopolistic markets but also

ensure an adequate economic rent appropriation by the private operators.

3.2. Determinants of total logistics costs

To identify the relative importance of each component of the total logistics costs is crucial. The components of logistics costs are not necessarily the same or have the same impact on all products. Literature provides a set of factors that may determine logistics costs such as: infrastructure, human resources competences, technology, legal and regulatory aspects, facilitation of administrative procedures, as well as those elements related to the industrial organization or the market structure. Another important factor is related to the institutional and regulatory stability and maturity.

Measuring each of the components of the logistics costs and establishing causal relationships among the components and determinants is important for estimating logistics costs. For this, variables that affect total logistics costs can be classified as endogenous and exogenous. Endogenous variables correspond to those logistic activities such as transport, loading/unloading, management and order processing, warehousing, etc., that are performed by the private operator at the domestic and international stages of the total logistics chain.

Given that these type of costs have a financial and a time dimension, those variables associated to time and its variability should be considered, as well as those related to the costs of service and the cost of inventories incurred by the inspections and regulatory activities of Customs and other governmental agencies (i.e. Agricultural and Livestock Services, Health and Aquiculture services, among others), or those procedures related to health and safety that include administrative and order processing costs, costs for transporting the cargo to be inspected, loading and unloading, packing/unpacking and inventory costs. Such costs are commonly not considered in the approaches found in the literature.

Exogenous variables are those that indirectly affect logistics costs or the efficiency of the logistics chain as a whole. This category includes national institutions, infrastructure, human resources involved in public services, information systems and technology that support public services, legal aspects and the institutionalism of the public sector that can impact any of the endogenous variables both private and public, as well as those costs related to externalities and those resulting from the market failures.

According to [34], exogenous factors that drive logistics costs have not been addressed as extensively as endogenous factors in the literature. Hence, they use a path analysis to examine six institutional constructs on logistics performance and found that all of them have a direct or indirect impact. The methodology proposed herein aims to incorporate both exogenous and endogenous factors.

3.3. Proposed framework for logistics costs estimation

The framework is structured in three steps that are further described.

3.3.1. Step 1: Definition of the scope of the study and selection of the logistics chains

a) *Mapping the most relevant logistics chains*
This activity consists in the analysis of the export and import transactions of the country in question in order to determine a set of representative logistics chains to be included in the study. This considers the identification of logistics chains and modeling the main process and stakeholders involved, as well as the main transport corridors used to transport cargo. The basis of the analysis is the historical data of trade volumes and the coverage of the transport modes that are most frequently used for each logistics chain.

For the export transaction, the analysis should consider those logistics costs from the origin of the product (i.e. at the farm) to the point of consumption in the country of destination. For import transactions, the analysis should consider the costs from the moment the product arrives at the point of origin until it reaches the warehouse of the importer.

b) *Selection of logistics chains*
This consists in the identification and selection of the main logistics chains based on a multicriteria analysis. For this, a pre-selection of the most relevant logistics chains is performed as a first step. Then, criteria to select a set of logistics chains are defined. Criteria to be considered could be the relative importance of each productive sector with respect to trade volumes, value of the cargo, innovation opportunities, among other criterion that may be important to consider. Finally, based on the relative importance of each criterion, the pre-selected logistics chains are evaluated and those with a higher score are selected.

Table 1.
Cost categories by transport mode and trade.

Cost Category	Description
Pre-shipment	Costs related to the activities performed for cargo handling prior to its shipment to its final destination such as: packing, labeling, consolidation of cargo and storage of products, transport of cargo among facilities. This also includes the cost of those activities related to cargo inspection and certifications required by any public organism.
Shipment to the port of origin	Costs of the land transport from the warehouse of the exporter to the port terminal where it will be transferred.
Port/ Airport/ Border entry	Costs for cargo handling at the port/airport terminal where the cargo will be loaded to a ship. It also includes all the related costs for delays at the gate and within the terminal.
Customs and control agencies	Costs incurred for Customs and other control agencies for the inspection, control and clearance procedures. It also includes those costs incurred for certifications and inspections required by the customer or the country of destination. For the case of road transport, it also includes those costs incurred at the borders.
Shipment to destination	Costs related to the freight shipment that could be either by road, air or maritime mode. It also considers any other handling costs as well as insurances.
Inventory and Finance	Costs such as in-transit inventory costs as well as those incurred due to waiting times. Also, additional costs that resulted because of delays or variability in the lead times are considered in this category.

Source: The authors.

c) Definition of costs categories

Costs have to be categorized in order to be measured. Table 1 presents a general categorization of costs that may be used and should be adapted to the specific considerations of each case study.

d) Identification of the sources of information

This consists in the identification of the main sources of information both primary and secondary for data gathering. Primary sources of information consider those relevant stakeholders involved in the process either of export or import of each logistics chain. An agenda should be planned, with the dates for interviews and focus group.

3.3.2. Step 2: Costs, over costs and processes analysis

a) Development of logistics processes mapping

This activity consists in the analysis of the export and import processes of each logistics chain under study, with the aim of determining potential impacts that these factors and their regulation have with respect to the efficiency of the logistics chains. For this, in-depth interviews should be performed with those stakeholders previously selected form each logistics chain. With the information gathered during the interviews and the secondary information obtained, a logistic processes map should be designed, such that the main physical and information flows are identified with their corresponding costs. Other techniques such as Business Process Analysis (BPA) to model the process could also be used.

b) Costs and over costs analysis

A diagnostic of the current situation of each logistics chain may be elaborated, based on the logistic process mapping. The costs and over costs incurred at each stage of each logistics chain must be identified. For this, a base scenario is determined first, whereby the costs of the logistics chain are identified under "normal" operation.

Then, the over costs are determined considering other scenarios that can occur (based on in-field observations and interviews) in which inefficient operations occur that result in additional costs (i.e. a late arrival of export cargo for the stacking period at a port that result in an additional fee for the exporter), as well as costs associated to waiting times or delays in each of the stages of the logistics chain (i.e. waiting times at the gate of the port or at an empty container park). This estimation may be computed according to average observations or occurrence probabilities.

c) Logistic inefficiencies analysis, its sectorial impact and national competitiveness

This activity aims to provide a general analysis of the most relevant inefficiencies observed for the logistics chains under study, and current gaps with respect to other economies and best practices. Impacts on the competitiveness of foreign trade at a macro level of those gaps and potential benefits obtained by the reduction or elimination of those over costs observed should be estimated.

Recommendations to reduce those gaps identified should be provided and analyzed with the stakeholders involved in the processes in order to prioritize them and generate a roadmap of the specific actions required to significantly reduce those over costs per product and corridor. This process is not proportional to the scale economies of the potential solutions recommended, and is actually a complex process in which political and social variables may also be considered.

3.3.3. Step 3: Recommendations and proposals for public policies

a) Analysis and recommendations

A summary of the recommendations to improve current export and import processes as well as public policies recommendations should be reported based on the results obtained with the logistics costs analysis, as well as the priorities defined for the specific projects to be implemented and its impacts on national productivity and competitiveness.

4. The Bolivian, case study of cost logistics estimation

The Natural Resources and Infrastructure Division of ECLAC has recently analyzed the challenges of the transport systems in landlocked South American countries. In this section, we present the results of the analysis related to estimating logistics costs of a number of representative mineral natural resources logistics chains in Bolivia [35].

The logistics chain of zinc concentrate via rail and sea transport in the pre-shipment stage are first sent by road from the mine to the plant (10 km) and from there to the Avaroa railway station (15 km). In the event that the plant has a branch rail line, the road segment runs only from the mine to the plant. Then the concentrate is transported by rail via Ollagüe (on the Bolivian border) to the ports of Mejillones or Antofagasta (Chile), a journey of 650 km. Sea transport then follows from one of these Chilean ports to a port in Japan or the Republic of Korea, lasting between 30 and 35 days. The inefficiencies in shipping operations in this corridor account for 5.3 per cent of the value.

Inefficiencies in customs processing are the most significant contributing factor here, accounting for 2.8 per cent of the total identified; these inefficiencies are the result of delays at border crossings and the significant cost of the certificate of quality issued by the National Service for the Registration and Control of the Sale of Minerals and Metals (SENARECOM), which is equal to 0.5 per cent of the gross value.

The second factor, accounting for 1.5 per cent, is associated with the pre-shipment phase, essentially as a result of the poor condition of secondary roads. The third factor, accounting for 0.6 per cent, involves rail transport and is due to the change of locomotives at the border. The collection process shows cost overruns equal to 0.4 per cent as a result of delays in the settlement of payments (bank transfers) attributable to the time required for the exchange of documents between the seller and the buyer.

In the case of logistics chains that use road transport in combination with sea transport, there is a road segment from the mine to the plant in Potosí and from there to the port of departure (Arica, Chile), covering a distance of 806 km, which takes between 2 and 2.5 days. Sea transport then follows from Arica to a port in Japan or the Republic of

Korea, which is a trip lasting between 30 and 35 days. In this case, the inefficiencies identified account for 19.1 per cent.

Road transport accounts for 13.4 per cent, which is due to delays resulting from the poor road conditions from the plant to the asphalt road. This segment covers a distance of approximately 50 km. There are further delays at the port of Arica because trucks have to wait in line to offload their cargo, due to the lack of proper planning and scheduling of operations at the port, as well as coordination mechanisms. The rest of the links in the chain contribute in a way that is similar to rail transport.

5. Discussion and recommendations

Implementation of systemic approaches for an efficient supply chain management has become one of the main challenges to take advantage of insofar as the business opportunities presented by globalization. In this regard, logistics costs represent the main challenge and play a key role specifically for developing economies, and especially when areas are remotely located, given that distance has historically been one of the main limitations to allowing countries to be integrated into global markets.

Logistics costs currently account for a bigger percentage of the total cost of a product with respect to duties and tariffs. This is influenced by the successful implementation of free trade agreements among countries and more open economic policies.

This document presents a framework for logistics costs assessment based on an integral vision that differs from the traditional approaches found in the literature in that State participation, the resulting costs of an inadequate provision of services, and the public entities involved are also taken into consideration. The framework proposed considers a sequential analysis of the foreign trade processes to identify inefficiencies and over costs. Furthermore, a temporal dimension is also incorporated into the analysis. A systematization of the framework proposed in the long term can be the basis for econometric studies that may be further implemented to validate results.

As further research, we propose the application of the methodology proposed to several case studies and the undertaking of benchmark analysis for different countries in order to provide recommendations that may enhance the competitiveness of foreign trade. For instance, it is possible to consider those supply chains that have been characterized in the literature in detail such as the "Cocoa supply chain" in Colombia [36] or the "Apple supply chain" in Chile [37], extending the preliminary analysis to incorporate the estimation of logistics costs.

Another research avenue is the analysis of logistics costs with respect to trade barriers and duties in order to demonstrate the need to improve current foreign trade processes and take greater advantage of the multilateral and bilateral agreements signed between two or more nations.

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