



BULLETIN



FACILITATION OF TRANSPORT AND TRADE IN LATIN AMERICA AND THE CARIBBEAN

Logistics inefficiencies in latin american landlocked countries

Background

Over the past decade, logistics have been one of the main concerns of governments and multilateral development agencies. Progress in trade liberalization and the progressive geographical fragmentation of production mean that logistics costs now account for a larger share of the final price of goods than the average tariff that is paid on them (ECLAC, IDB, World Bank, 2010).

Advanced logistics, a concept proposed by the Economic Commission for Latin America and the Caribbean (ECLAC), seeks to avoid confusion with the traditional logistics of supply, and expands the scope of traditional logistics to include the activities of the private sector and the State in the form of public policies on the design, supply, facilitation and regulation of logistics (ECLAC/CAF/OECD, 2013).

This new approach affords a more comprehensive overview of the logistics sector and is therefore useful in seeking solutions that will lead to better national logistics performance, reduced transaction costs and greater export competitiveness.

Advanced logistics also have a number of positive repercussions for national development, fully justifying State involvement in this area. For example, an adequate logistical infrastructure significantly enhances the accessibility of local and international markets and thus facilitates national connectivity and encourages the diversification of production and the emergence of value chains. Coupled with appropriate facilitation and regulation measures, these factors help improve the quality of employment, drive down the cost of food and other consumer goods, and ultimately enhance the quality of life of the population.

For landlocked countries, efficient logistics are a prerequisite for successful integration into international markets. For this reason, this paper specifically examines the main cost overruns in the logistics chains of South American landlocked countries, identifies inefficiencies in logistical processes and, on this basis, outlines a set of public policy recommendations designed to

This document sets out an initial proposal for measuring costs in logistics chains, and is part of a line of work of the Natural Resources and Infrastructure Division of the Economic Commission for Latin America and the Caribbean (ECLAC) that seeks to identify logistics inefficiencies in Latin America and the Caribbean that are detrimental to the sustainability of national and regional growth.

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Background



I. Review of methodologies for measuring logistics costs



II. Need for a comprehensive approach to analysing logistics costs



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improve the competitiveness and sustainability of these countries and achieve a better regional integration. Section I briefly reviews the state of the art and describes the main contributions to logistics cost measurement; section II outlines the need for a comprehensive approach to logistics cost analysis and sets out an initial methodological proposal for measuring costs within a framework of advanced logistics; section III discusses the practical application of this approach to certain logistics chains in Paraguay and the Plurinational State of Bolivia; and finally, section IV sets forth the main conclusions of the study.

I. Review of methodologies for measuring logistics costs

Logistics costs have a spatial dimension, associated with transport and storage activities, as well as a temporal dimension linked to the period of time that processes take, in which inventory costs, the time involved in administrative processes (facilitation) dead time during loading and unloading, stockout costs, variability in lead times and process safety are some of the most important variables affecting the total logistics cost.

From the literature it is apparent that there are two methodological approaches to calculating logistics costs: one from a macroeconomic perspective (at national level); and another from a microeconomic perspective (at the level of individual enterprises). The main characteristics, advantages and disadvantages of these approaches are described below.

A. Macroeconomic methods for measuring logistics costs

Macroeconomic methods seek to identify the logistical strengths of a country by estimating the overall level of logistical efficiency and its relative importance for that country's productive activity and international competitiveness. Such methodologies are largely based on descriptive tools and econometric methods, using variables that do not necessarily take into account all the logistics costs, but which estimate the logistics costs of a given country on the basis of primary and secondary information.

This approach is often used in the annual logistical reports of some countries. For example, in the United States, three key components are considered: transport costs, inventory costs and administrative costs. In the Republic of Korea, the Korea Transport Institute (KOTI) developed a methodology for estimating logistics costs and the efficiency of the national logistical system, taking into account transport costs, inventory costs, packing costs, cargo handling costs in ports, airports and border crossings, information or

documentary costs, and administrative costs, making the distinction between public and private agents.

Generally speaking, macroeconomic methods may adopt one of three approaches:

- (i) The first approach deals with how logistics costs relate to global indicators, for example, as a share of GDP or of the CIF value of goods. This kind of methodology has been used by authors such as Bowersox and Calantone (1998), Bowersox and others (2003) and Rodrigues and others (2005), whose calculations rely on variables such as the costs of transport, storage, administration and information and communications technologies, as a function of other variables pertaining to socioeconomic factors, infrastructure and geographical area.
- (ii) A second approach relates to the effect of time and its implications for trade. Not only does this method consider the impact of the time needed to transfer goods (lead time) but also the impact of variability in these time frames (reliability) at an aggregate level with regard to bilateral trade. Hummels (2001), Subramanian and others (2005), Djankov and others (2006) and Nordås and others (2006) have all published studies exploring the relationship between the timing of imports and exports, logistical services and international trade, with particular focus on the impact of the time factor (predictability) on foreign trade.
- (iii) The third and final approach refers to global logistical indicators such as those developed by the World Bank, including the Logistics Performance Index (LPI) and the Doing Business report. Such instruments are widespread among the sectoral authorities in Latin America and the Caribbean, mainly because they are readily accessible and they enable international comparisons using the same methodology.

The main advantages of the macroeconomic approach include the relative ease with which it is possible to obtain an assessment of national logistics, which can be useful in the preliminary stages of public policy planning and particularly in identifying priority areas for action. Shortcomings include the fact that working with aggregate data at the national level creates significant distortions in terms of real costs and operating times, since the data do not consider differences between products, seasonal factors or the logistical needs inherent to particular products (for example, bulk, perishable, refrigerated or hazardous goods). For this reason, this kind of analysis is useful as an estimator of

the state of national logistics, but is not valid as a tool for decision-making in the private sector or for monitoring the competitiveness of a logistics chain.

The global indicators developed by multilateral organizations, or by international academic institutions, are often indicators of perception, which rely on the experience of a group of users who are consulted as to the performance of a group of countries. While this keeps the variance of the responses to a minimum by ensuring that the variables are consistent and reliable, performance is measured using averages which, strictly speaking, do not exist for Likert-type variables or latent variables because the distance or intensity between one point and another is not the same for all respondents. To rectify this discrepancy, a special statistical procedure is used to calculate the parameters that characterize these variables and their possible relationships (Jöreskog and Moustaki, 2006). Consequently, as with the previous approaches, these indicators allow a snapshot of the status of national logistics in a regional or global context, but are not suitable for assessing the outcomes of a public policy on logistics.

In this context, there seems to be a need for a microeconomic approach, not only as a way of overcoming the challenges presented by the macroeconomic method, but as a powerful tool for sectoral management, whether at the level of an enterprise, an industry, or an individual logistics chain.

B. Microeconomic methods for measuring logistics costs

Microeconomic methods adopt the logistics cost as the main criterion for addressing the problems facing decision makers at the level of the company, the conglomerate or the national or regional logistics chain. According to Heskett (1973), logistics costs can be projected as the sum of four types of business activity: transportation, inventory, warehousing and order processing.

The literature identifies several approaches for measuring logistics costs from a microeconomic perspective, which differ mainly in how they evaluate and weigh decisions regarding inventory management, modal selection, and the location or extent of the supply chain. In very general terms, it is possible to distinguish between at least three kinds of approach:

- (i) The first is based on the measurement of private logistics costs, rather than on total logistics costs, paying special attention to the time frame and variability of the inventory. We should note here that the "time frame" variable not only depends on the modal configuration of the supply chain,

but also on the characteristics of demand for the product. For example, Zinn and others (1992) study the effect of the pattern of demand over time and how this affects inventory levels, in particular safety inventories and, consequently, inventory costs.

Haartveit and others (2007) propose a method for quantifying logistics costs based on time studies, with special reference to the multi-product chain of a particular company. Vernimmen and others (2007) assess the consequences of unreliability in shipping services on the inland supply chain, while a further study by Evaraert and others (2008) analyses the logistics costs of a wholesaler, which are treated as part of a production function, using activity-based costing (ABC).

- (ii) A second microeconomic approach, as set forth in a significant body of literature, relates to logistics cost as a criterion in decision-making. Under this approach, logistics costs are determined by inventory management, modal selection, spatial location and supply chain management. In the case of inventory management, there are three decisions that are subject to the minimum cost criterion: the size of the order, the number of orders, and the lead time for the next order. These decisions are modelled either theoretically or for specific cases under different assumptions that characterize the supply chain in question.
- (iii) A final approach is related to more integrated supply chain management policies. For example, Roorda and others (2010) propose an integrated model in which logistics costs are represented alongside variables such as the outsourcing of logistics services, the growth of other industries, and the impact of new supply chains available on the market. Taken together, these variables determine the mode of transport and other relevant decisions such as routes, consolidation and even infrastructure decisions.

In summary, microeconomic methods provide greater detail at the level of the product, product group, firm, industry or cluster, while also enabling an integrated overview of most logistics costs by including time-related expenditures (safety stock and stock out) alongside traditional transportation, storage and administration costs. At the conceptual level, the literature focuses on the private or traditional view of logistics costs, namely the costs that a company incurs in moving goods from the point of origin to the destination, and ignores public-sector actions associated with facilitation and the regulation of market failures. It is precisely this oversight that this paper seeks to rectify.



II. Need for a comprehensive approach to analysing logistics costs

As discussed in the previous section, traditional approaches to addressing logistics costs typically exclude important logistical components: at the macroeconomic level, information on specific logistics chains is sacrificed so as to obtain overall management indicators that are useful for international benchmarking; while at the microeconomic level, activities carried out by the public sector (facilitation, regulation and safety) are overlooked in favour of modelling.

For this reason, ECLAC, under its definition of advanced logistics, promotes analysis according to an integrated sequential framework, identifying and costing each of the various inefficiencies that are detected, both in terms of value and time, regardless of the mode of transport used, whether this corresponds to the domestic or international portion of the chain, or whether the stakeholders participating in the process are public or private. This makes it possible to detect and isolate the impact of failures in the provision of infrastructure services or shortcomings in the quality of services provided by the State (process facilitation), while giving due consideration to inefficiencies in private activities and the negative externalities generated for the population and the environment.

It should be stressed that there is no one-size-fits-all methodology; rather, the chosen approach will depend on the particular problem being addressed and on the availability of information. Logistics problems are common in developing countries and particularly in those that are landlocked and relatively undeveloped, and which must overcome considerable difficulties to access and compete in global markets. The logistics of specific chains must therefore be analysed in order to balance the quantity and quality of information, and to properly account for the peculiarities of private logistical services and State activities, and their impacts on particular chains.

The following subsections provide a general overview of the best way to undertake an analysis of logistics costs using a comprehensive approach, and then apply this methodology to two logistical export chains that are representative of landlocked countries in South America.

A. Defining main components and cost determinants

Within a framework of advanced logistics, the costs incurred by private companies in moving goods from one point to another must be considered in conjunction with inefficiencies in the markets underpinning the provision of logistical services, particularly transport and infrastructure, as a result of regulatory failures or shortcomings in facilitation processes. This framework can also be expanded to include the externalities generated by the activity, namely the costs incurred by society as a result of transport services, such as congestion, pollution and road accidents. The purpose of identifying these factors is so that they can be properly included in cost assessments, thus contributing to sustainable logistics.

Logistics costs incurred by private operators as a result of failures in the provision of infrastructure may be due to the fact that the characteristics of the available infrastructure prevent the operation of vehicles or do not allow them to operate at full economic efficiency. For example, this is the case when rural bridges are unable to accommodate the use of heavy duty trucks owing to design or capacity restrictions, which necessitates the use of smaller trucks (with economies of scale consequently being lost) or the transfer of goods (cross-docking) once the bottleneck has been reached, with the attendant delays and possible loss of cargo. Similarly, the down time spent loading or unloading goods, obtaining administrative certification or crossing borders, also has an impact on the final logistics cost.

In this context, the public sector plays a crucial role in identifying and correcting market failures, whether in the transport sector or in the logistical infrastructure sector. For example, the State may implement mechanisms that help provide the economic infrastructure (transport, energy, telecommunications, water and sanitation) needed for logistics activity; it may promote the facilitation and security of trade, customs and transport processes; properly regulate the sector by encouraging healthy competition; and help build national capacities to generate value-added logistical services. States must also seek to minimize the negative externalities for the population and the environment through regulatory, economic and technical instruments so that these additional costs are properly incorporated into logistics costs, thus promoting a sustainable logistics conducive to the development of society as a whole.

Consequently, identifying the various components of the logistics cost of a country or of a particular chain is the first step towards reducing that cost. The literature indicates a set of factors that directly determine the magnitude of logistics costs, albeit to varying degrees depending on the product. These are: infrastructure, technology, human

resource capacity, legal and regulatory aspects, issues pertaining to facilitation of administrative procedures, and elements of industrial organization or market structure. Factors related to the country's stability and the institutional and regulatory maturity are also relevant.

Logistics costs are determined by variables that are classed as either endogenous or exogenous. Endogenous variables refer to actual logistical activities such as transportation, loading and unloading, packaging, administration, processing, value-added services and warehousing at each stage of the supply chain. These activities are carried out by the private operator in the domestic and international sections of the chain. Other endogenous variables are associated with time and reliability, the service and inventory costs arising from customs procedures, phytosanitary or health and safety inspections, and include the administration, processing, loading and unloading, packaging and inventory costs associated with these processes.

Exogenous variables are those that indirectly affect logistics costs or the efficiency of the chain as a whole. This category includes public infrastructure (or public use infrastructure, if leased out under a concession), the human resources involved in public processes, service availability, legal frameworks, the openness of the economy, the public-sector institutions that may have an impact on certain endogenous variables, whether public or private, in addition to the externalities and costs incurred by private operators as a result of market failures.

In keeping with this classification, González and others (2008) analysed the determinants of logistics costs and their impact on competitiveness, growth and poverty indices in the economies of Latin America, and discovered that the main variables affecting this relationship were those of infrastructure, logistics services and trade facilitation.

B. Description and selection of representative logistics chains

Drawing on baseline information on domestic import and export transactions over a number of years, it is possible to determine a set of representative or strategically important logistics chains for inclusion in the study. The main logistics processes and stakeholders must be identified, along with the transportation corridors used and the volume of sales, while the strategic interest in marketing a given product, and the coverage of the modes of transport frequently used, could also be analysed.

In the case of exports, logistics costs must be analysed from the product's point of origin, for example farms or mines, to the first point of arrival in the destination country. For

imports, logistics costs should be analysed from the port of origin to arrival at the importer's warehouse.

Based on this information, a selection is made according to the relative size of each productive sector terms of volume transferred, value of sales and opportunities for innovation or national or regional production linkages, among other aspects. For cost mapping purposes, activities can be grouped into the categories identified in Table 1, although there may be additional or more specific categories depending on the chain, the specific context of the economy, and the availability of information.

Table 1
COST CATEGORIES USED IN THE ANALYSIS
OF LOGISTICAL ACTIVITIES

Pre-shipment	Pre-shipment activities, which include consolidation, packaging and warehousing of products, transport to the exporter, and any other activity that may be necessary or that is carried out prior to the departure of the cargo to its final destination. Also included are costs related to inspections and certifications required by any public authority.
Transfer to port or airport of departure	This item essentially includes domestic ground freight from the exporter's plant to the inland waterway port or airport, and any other logistics costs that arise at this stage of the process.
Port or airport	Costs associated with waiting, entry into and departure from the port or airport.
Customs	Includes all activities related to customs and other verification and monitoring institutions, as well as certifications and inspections that are required by the client or by the importing country. In the case of ground transport, costs related to border crossings are also included.
Transport to destination	Includes freight costs and costs related to insurance, handling and port services in the case of inland waterway, sea or air transport.
Inventory and financing costs	Inventory and financing costs are calculated for the entire export and import process. This heading is intended for the calculation of those costs that arise as a consequence of having the cargo halted, or that prevent the settlement of payments on time and as needed.

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

Within each of these categories, institutional processes are analysed in order to determine the potential impacts that these factors and their associated regulations have for the efficiency of the selected logistics chains. To this end, through in-depth interviews with stakeholders and the use of secondary sources of information, it is possible to create a map of logistical processes, identifying the physical and documentary flows involved and their respective costs.

Drawing on this information, it is possible to perform a diagnostic assessment of the current situation in each chain, estimating logistics costs and inefficiencies. For this purpose, the baseline scenario consists of the costs incurred in an operation under "normal" conditions and with lag

times that are within an average range calculated on the basis of historical data. Associated cost overruns should also be identified under scenarios that have been observed or reported during interviews with stakeholders in the field, under inefficient operating conditions, which are usually those conditions that generate additional costs such as fines for delays, costs associated with waiting times or average delays in each link of the supply chain (e.g., waiting in the port, at the warehouse, or simply for an empty container to be withdrawn or for consolidation in the exporter's warehouse). This calculation includes any expenses incurred in addition to those generated under normal operating conditions, and an average estimate should be generated for the observations carried out.

Finally, all the information is compiled to infer an aggregate estimate of the inefficiencies' impacts on the competitiveness of foreign and domestic trade, and the savings that could be made by the elimination or reduction of logistics cost overruns, so as to identify and quantify the cost overruns with the greatest impact on business and sectoral competitiveness. In this way, proposals may be drawn up that could help define priorities in public-private efforts to reduce the largest overruns for each product and transport corridor analysed.

III. Case study: inefficiencies in logistics chains in Paraguay and the Plurinational State of Bolivia

Using the approach described above, the Natural Resources and Infrastructure Division of ECLAC recently studied the challenges facing the transport system in South America's landlocked countries (Paraguay and the Plurinational State of Bolivia), with special emphasis on the characteristics and the main logistical inefficiencies detected in some logistics chains. For further background information on this subject, see Status of Implementation of the Almaty Programme of Action in South America (ECLAC, 2014).

reported by landlocked countries are the same as those encountered by transit countries, meaning that efficient solutions would be beneficial to both parties.

A. Plurinational State of Bolivia: analysis of logistics inefficiencies in the supply chain for soybean cake exports

In the case of Bolivian exports of soybean cake, the supply chain includes, on average, a distance of 100 kilometres by road from the point of harvest by the farmer to the processing plant's storage silos and from there, an average of 90 kilometres to the processing plant itself. Once the soybeans are processed, the soybean cake is transported 650 kilometres by rail from Santa Cruz de la Sierra to a Bolivian river port (on the border with Brazil), from where it is shipped by barge along the Paraguay-Paraná Waterway; it is then transferred to ships in Rosario (Argentina). The main destinations are the Bolivarian Republic of Venezuela, Colombia and Ecuador. The analysis found that logistical inefficiencies accounted for cost overruns of 20.9%, broken down as follows:

- Inland water transport was the segment that generated the largest cost overruns, of 11.2%, as a result of the delay of barges crossing the channel at the city of Corumbá (Brazil) and their subsequent formation of a barge convoy. In addition, 72 hours of delays are added to the normal journey time between Puerto Aguirre (Plurinational State of Bolivia) and Rosario (Argentina), a distance of approximately 2,500 kilometres, because of a lack of dredging and navigational beacons in the rivers. An important aspect of the logistical shortcomings associated with river transport involves the underutilization of the capacity of barges, which could carry 1,400 tons but on average carry 1,200 tons owing to the lack of dredging of the waterway.
- The pre-shipment process accounts for cost overruns of 5.5% as a result of losses of goods owing to the poor

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