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ANALYSIS OF THE MOVEMENTS OF CABOTAGE PORT FACILITIES AND A LONG-TERM COURSE BETWEEN THE PERIOD FROM 2015 TO 2017 USING THE LINEAR REGRESSION METHOD

Luiz Rodrigo Bonette
Estácio University Center, Brazil
E-mail: rogobonette@hotmail.com

Dayane Melo Pavan
Estácio University Center, Brazil
E-mail: dayane_pavan@hotmail.com

Larissa Freitas Silva
Estácio University Center, Brazil
E-mail: larifreitasfreitas@outlook.com

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ABSTRACT

The requests for tons movements of the public or private port facilities are conditional and structured in their flows by regulatory frameworks of the port law for the operation in part of this Brazilian port system and for the waterway transport networks, but there is a gap in the literature to which one can test its correlation public/private port based on the port infrastructure operations for the time series from 2015 to 2017. As a consequence, this study aims to identify possible impacts on the behavior of these 36 months (events) using the statistical modeling method using the linear regression technique, concluding strategic analyzes of these facilities of public/private port movements of the ports supporting the maritime transport network in its flow, thus contributing to possible investments in civil construction, in the port industry and in its capacity of the expansion of the port arrangement and the support of its transport network and routes monitored and controlled by the Brazilian port system.

Keywords: Cabotage; long course sea shipping; port legislation; statistical modeling; linear regression.

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1. INTRODUCTION

Maritime freight transport, characterized as an activity that has been going on since ancient times, has always exerted a significant influence on the national and global economies, directly linked to the commercial exchange between peoples and nations. (MENDONÇA; KEEDI, 1997). On the other hand, there is no coherent policy, with a certain degree of stability, for maritime transport in Brazil. Decisions in the sector do not follow a consistent orientation, taking into account cyclical circumstances. (OLIVEIRA, 1999).

According to Laws 8.630 of February 25, 1993 (BRAZIL, 1993) and 12.815 of June 5 2013 (BRAZIL, 2013), the port facilities in Brazil are divided into two types: public port facilities and port facilities for private use. The theme of "port infrastructure" arouses great interest, due to the international exchange of goods that happens preferentially for the port facilities, taking into account the aspects of the public facilities and the stimulation of the increase of the private facilities for the economic growth of the port system. (e.g. TOVAR; FERREIRA, 2006). Ports are characterized by points in which there is a transition from land or water transport, i.e. the cargo will have to be transported by vehicles (SANTOS et al. 2008).

According to Normative Instruction of the Federal Revenue of Brazil – RFB nº 800 of December 27, 2007, the traffic control is made in the cabotage and the long-haul flow used within 200 nautical miles and each port being loaded are conditioned to dock or unmake. Normative Instruction of the Federal Revenue of Brazil – RFB nº 800 of December 27, 2007 (BRAZIL, 2007) regulates the identification of the route and the purpose of the long-haul route, long-haul export, passage, cabotage, foreign cargo transfer and national cargo transfer in maritime stretches (RFB, 2018).

The purpose of this research is to test the correlation based on the operations of public and private coastal and long-haul port facilities with time series from 2015 to 2017, analyzing their temporal behavior of 36 months (events).

The considerable increase in movements in the Brazilian national system of ports entails discussions about its port infrastructure and means of transport, in this case the possible relationship between cabotage and port facilities, or the increase, stabilization or drop in the number of port facilities of public or private use in the Brazilian national system of ports, and on the other hand, also the behavior of the time series of transport movements by cabotage.

In this research the statistical modeling method is applied, contributing to the strategic planning (long-term) of identification of the critical points of operation of the infrastructure of

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the port of the installations that directly impacts the transport planning in the transport engineering on aspects of modal movement, in this case, long-haul coastal shipping.

2. LITERATURE REVIEW

2.1. Port infrastructure

Conceptualizing the seaport is a task that depends on the understanding of waterway transport and the identification of three aspects inherent to this modality of displacement, such as, for example, waterways, port, and land infrastructures (CAMPOS, 2009).

In this case, the research brings the clipping that indicates the relationship between cabotage transport and terminals for public and private use.

The port infrastructure is composed of immobilized components. In other words, moving or using them for other activities is not allowed. This also consists of fixed assets where cargo handling is accomplished between ships and land modalities (LACERDA[1], 2005). Increasing efficiency reduces costs and improves the level of port services, generating positive externalities for the whole economy (TOVAR; FERREIRA, 2006).

Tovar and Ferreira (2006) explains that Brazil's port infrastructure has some deficiencies and limitations that impair its efficiency and even own country's economic development in recent decades.

Lacerda[1] (2005) also explains that the terrestrial infrastructure by means of railways, highways, conveyor belts, patio of the loading and unloading terminals of passengers and patios of the storage areas allows the transport of goods between the ships and the limits of the port area.

The waterway infrastructure is formed by the channels of access to ports, breakwaters, evolution basins, and mooring berths. Within this infrastructure, we have the port superstructure that is mostly operated by private companies. The port superstructure is the equipment for the movement of warehousing of goods such as warehouses, mats, and cranes (LACERDA[1], 2005; ALFREDINI; ARASAKI, 2014).

The ports are sets of terminals close to each other, which share infrastructures such as road and rail access roads and maritime access channels. There are also isolated terminals that share little or no infrastructure with other terminals, which are usually specialized in handling large volume and low-value density cargoes such as fuels and ores (LACERDA[1], 2005).

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In the absence of investments in infrastructure, the current deficiencies of some of the country's main ports tend to aggravate and burden exporters and importers. (LACERDA[1], 2005). The great navigations from the fifteenth century have considerable global economic importance, which makes the ports play a key role in the development of a country's international trade. Ports are considered to be one of the main forces driving the economy. By reducing the costs related to it, the global economy wins (FALCÃO, 2012).

Stopford (2009); Alfredini and Arasaki (2014) interpret and bring the reflection that container terminals are transit facilities to facilitate the process of production flow of goods and commodities, and the container terminals have revolutionized and transformed the marine operations and specialization of ships.

A port can be divided into retroport and retro-area, being respectively an area near the ports where the containers, for example, are stored and the port area itself. In the retro-area, the quantity and size of mooring berths are important for the dynamics of a port, which allows several ships to exchange merchandise at the same time (ALMEIDA, 2015).

The introduction of containers in maritime cargo transport has brought major changes to the operation of port terminals and shipping companies. In the ports, there was a strong reduction in the use of manpower for handling, loading, and unloading operations and the reduction of the time required for these operations. Shipping companies have become increasingly logistic operators, due to the intermodality provided by the containers. Recently there has been an intense process of concentration in this sector.

The pursuit of economies of scale through the use of container ships as large as possible has modified the traditional system in which ships continue to dock at various ports along their routes to a system in which the larger vessels serve fewer ports, from where the containers are distributed to other regional ports (LACERDA[2], 2004).

2.2. Long-course shipping

Chebar (2006) describes that the ports of countries/frontiers are covered more comprehensively and include cabotage by the coast and between the ports of the same country. Similar to the Article 18 of Decree nº 87.648, of September 24, 1982 (BRAZIL, 1982), it describes the composition of the Regulation for Maritime Traffic in Brazil, categorizing long-sea shipping navigation as carried out between the ports of Brazil and foreign ports makes the transport of exports and imports in the international lines (see Article 18 of Decree nº 87.648, of September 24, 1982 (BRAZIL, 1982), Decree nº 87.891 of December 3, 1982 (BRAZIL,

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1982), Decree nº. 97.026 of November 1, 1988 (BRAZIL, 1988), Decree nº. 511 of 27 April 1992 (BRAZIL, 1992), Decree nº 2.117 of January 9, 1997 (BRAZIL, 1997), Decree nº 2.596 of 18 May 1998 (BRAZIL, 1998) and Law nº 9.537 of 11 December 1997 (BRAZIL, 1997)). Also in line with this concept, the Departamento Nacional de Infraestrutura de Transportes - DNIT (2017) states that long-haul shipping is done by merchant ships on the high seas, across the oceans, joining ports of several countries and continents.

According to Lacerda 2004 (2004), the market for long-sea shipping services is segmented into general cargo and bulk cargoes. Cargo transportation is usually done through regular rules and, in general, competition laws are in place, which allows shipping companies to offer price and service conditions.

According to the Logistic Planning Company (2016), it is understood that long-haul navigation is carried out between Brazilian ports and foreign ports, whether maritime, fluvial or lacustrine protected by the legal framework (LAW, 10.893/04).

2.3. Cabotage

Teixeira (2018) argues that cabotage navigation is an intrinsic activity of the country, which has been present since colonization. It has played a relevant role in the transportation of goods for centuries. However, in the last decades, it has lost relative importance compared to other means of freight transport, such as road transport, despite being the most competitive, less polluting and less accident-bearing means of cargo handling.

Cabotage in Brazil according to Article 155 of the Federal Constitution of Brazil (BRAZIL, 1988), caput, reads: Cabotage navigation for the transportation of goods is a national warship, De Miranda Lima (1961), in other words, it is only a flagship that the maritime transport of goods between Brazilian ports is allowed.

De Miranda Lima (1961) describes and establishes the legislator so that cabotage navigation for the transportation of data is effected through foreign events in case of a public declaration. More specifically, Decree nº. 87.648 of September 24, 1982 (BRAZIL, 1982), Article 18 describes the vessel to circulate the Brazilian coast, which does not deviate more than 20 miles from the coast and is at ports that do not exceed 400 miles is supported the concept of cabotage.

According to decree No. 87,648 of September 24, 1982 (BRAZIL, 1982). Small Cabotage Navigation "makes domestic shipping between the country's ports, including distributing long haul cargoes, from large ports to smaller ports, and is of great strategic value

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to countries, so that the main economies of the world, unlike Brazil, reserve this segment for national flag vessels, manned by nationals of the country and operated by national companies, which ensures a continuous service and absolutely national control;

Pinheiro and Oliveira (2016) says that one must invest in the development of ports oriented to cabotage, impelling, consequently, the intermodality of the sector, being of paramount importance for the installation component. For the transport component, the analysis for the development of other transport markets is valid, disseminating and varying the use of modal.

The European Union (EU) currently has the most developed cabotage system in the world for its coastal and river facilities, but in large part by the process of economic integration that has opened the market for all member countries. (MOURA, 2011).

As stated in Moura (2011), the reservation of the flag practiced by Brazil, Chile, and Argentina, prevents the emergence of regional routes that could gain economy of scale when incorporating the transport of goods of other countries of the block and, therefore, to improve the level of service of transport in the region.

Maritime transport is an efficient and low-cost alternative for medium and long distances. The need to purchase vessels for cabotage navigation in local shipyards has been a barrier to increasing the supply of vessels to the general cargo and container segments (LACERDA², 2004).

Lacerda² (2004) describes that cabotage services are made more expensive by the incidence of an additional 10% of the freight values, which are largely passed on to users of cabotage services, while the collection is fully transferred to the shipping companies. Thus, users subsidize the cost of capital of companies.

Therefore, for the viability of the aforementioned points, it is necessary firstly to focus on the bureaucratization of the information component, thus attracting potential customers and facilitating the development of intermodality in the facilities (ports). In order to implement this proposal, the use of the Multimodal Transport Operator should be improved in order to use the unique documentation, streamlining the final process that directly influences the process as a whole (PINHEIRO; OLIVEIRA, 2016).

Maciel (2011) points out that the growth of the Brazilian international trade brings deployment prospects concentrator ports, which would intensify the use of transshipment operations. This means that few national ports would specialize in export and import

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operations, and thus the distribution of these products along the Brazilian coast would be under the responsibility of the Cabotage system.

Stringari (2016) observed that the cabotage modal presented satisfactory results in relation to the road modal, showing a 58% reduction in relation to the cost of freight, due to the conditions of Brazilian roads that increase the cost of this modal.

3. METHODOLOGY OF STATISTICAL MODELING

3.1. Collection and analysis of statistical data

The study is an analysis of the flows of tons that leave the ports of Brazil and are exported, done by cabotage and long course by public and private facilities.

The statistical method used in this work seeks to analyze the data in time series obtained from statistical reports (http://antaq.gov.br/Portal/Estatisticas_BoletimPortuario.asp) in the period from 2015 to 2017 extracted from a set of 234 ports, being 37 public and 197 private.

Statistical analysis was applied with 36 events/months of balances of these cabotage and long course flows as correlatable variables for tests with the linear regression technique using the @minitab software.

The nature of the research is applied, with the purpose of descriptive research, being this way a quantitative approach, using the method of statistical modeling with the linear regression technique. The techniques of data collection form through an official website (Agência Nacional de Transportes Aquaviários - ANTAQ, 2018) for statistical reports of 36 months/events tabulated by @excel and interpreted in @minitab.

The temporal aspect is classified as longitudinal formed by the 36 events/months between the possible correlations between variables within a methodological process of the research from February 2018 to September 2018 (composition of eight months of research).

In this, the concepts of simple linear regression:

$$E(Y) = a + \beta x_i \quad (1)$$

$$Y = a + \beta X_i + \mu_i \quad (2)$$

And the straight-line adjustment of the simple method:

$$y = ax + b \quad (3)$$

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$$a = \frac{\sum xy - \bar{n}\,\bar{x}\,\bar{y}}{\sum x^2 - n(x)^2} \quad (4)$$

$$b = \bar{y} - \bar{a}x \quad (5)$$

4. RESULTS AND DISCUSSION

4.1. Statistical analysis of the temporary series of public cabotage (public facilities) versus private cabotage (private installations) from 2015 to 2017

In this session, we will analyze the time series of public cabotage versus the private cabotage of the port facilities between the periods of 2015 to 2017 and present the correlations between them. See figure 1.

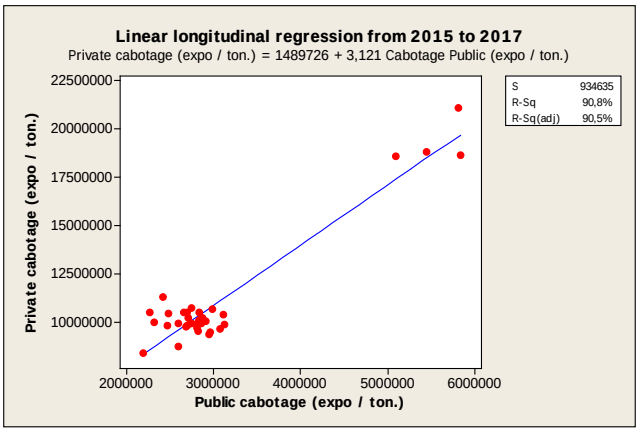

Figure 1: Linear regression of public cabotage (public facilities) versus private cabotage (private facilities) from 2015 to 2017

From Figure 1, it is observed that,

- Apparently, the number of tonnes of public cabotage has a correlation with private cabotage;
- The graph shows that there is a 90% correlation between public cabotage and private cabotage;
- Apparently, the concentration of tonnes exported in public cabotage is 2,700,000, and the private one, 10,000,000;
- Apparently, there are some points that seem to be an *outlier*. The causes of these can be analyzed in future research and;
- Correlations were made between public and private cabotage with dollar, harvests and GDP and the result of all correlations were null, that is, not a correlation between them.

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Through @minitab we did a linear regression and obtained a favorable result for the correlation between private and public cabotage, see table 1 and 2.

Table 1: Analysis of the linear regression of public cabotage (public facilities) versus private cabotage (private facilities) from 2015 to 2017.

Predictor	Coef	SE Coef	T	P
Constant	-81.866	207.341	-0,29	0,7
Mês	-3.304	4.622	-0,71	0,48
Private cabotage (expo/ton.)	0,29	0,02	18,07	0
S = 287361	S = 287361		R-Sq(adj) = 90,4%	

Table 2: Analysis of variances of public cabotage (public facilities) versus private cabotage (private facilities) from 2015 to 2017

Source	DF	SS	MS	F	P
Regression	2	2,72827	1,36414	165,2	0
Residual Error	33	2,72501	82576153109		
Total	35	3,00077			

From Table 1 and 2, it is observed that,

- In these results, the p-value for cabotage is zero, which is higher than the significance level of 0.05. These results indicate that there is an association between private and public cabotage, and;
- Apparently, there is a correlation between long public and private courses of 90.4%.

4.2. Statistical analysis of the temporary series of a longer public course (public facilities) versus long private course (private facilities) from 2015 to 2017

It was analyzed the time series of long public course versus the long private course of the port facilities between the periods of 2015 to 2017 and to present the correlations between them. See figure 2.

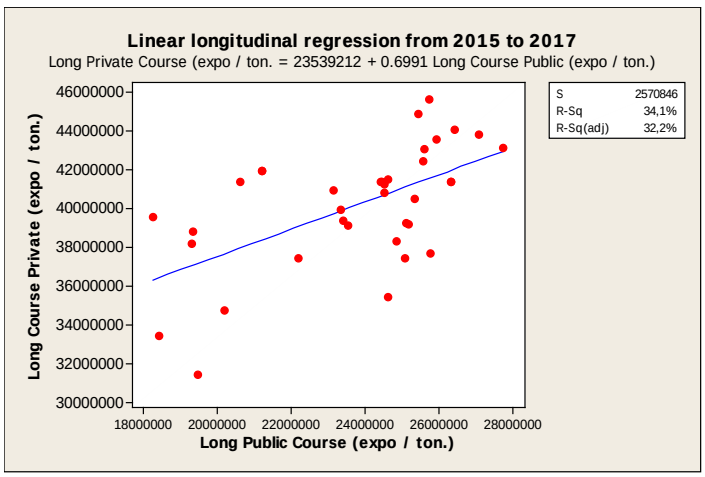

Figure 2: Long-term linear regression (public facilities) versus long private course (private facilities) from 2015 to 2017

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From Figure 1, it is observed that,

- Apparently, the number of tons in the public long course has a small correlation with the long private course;
- Assumption that the long public and private courses are randomly distributed and have constant variance, with no recognizable patterns in, and;
- Correlations were made between public and private long courses with dollar, harvests and GDP and the result of all correlations were zero, that is, there is not a correlation between them.

Through @minitab, we did a linear regression and obtained a result unfavorable to the correlation between long private and public courses, see tables 2 and 3.

Table 3: Linear regression analysis of public long course (public facilities) versus long private course (private facilities) from 2015 to 2017

Predictor	Coef	SE Coef	T	P
Constant	545.337	5.217.721	0,1	0,917
Mês	-60.811	41.402	-1,47	0,151
Private cabotage (expo/ton.)	0,6059	0,1397	4,34	0
S = 2112424	R-Sq=38,2%		R-Sq(adj) = 34,4%	

Table 4: Linear regression analysis of public long course (public facilities) versus long private course (private facilities) from 2015 to 2017

Source	DF	SS	MS	F	P
Regression	2	9,08704	4,54352	10,18	0
Residual Error	33	1,47257	4,46234		
Total	35	2,38128			

From Table 1, it is observed that,

- In these results, the value of p for a long distance is 0, which is greater than the 0.05 significance level. These results indicate that the association between long private and public, and;
- Apparently, there is a correlation between long public and private courses of 34.4%.

5. CONCLUSIONS

From the linear regression analyses on public cabotage (public facilities) versus private cabotage (private facilities) from 2015 to 2017, it is perceived that there are high levels of correlation because the legislation is characterized by the legal flow of the port is initially in the public Brazilian port system for reasons of inspection and parameterization. Therefore, in order to move in private cabotage facilities, it is necessary to legally transfer the flow of the movements of public cabotage facilities, such as customs monitoring and cargo release.

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On the other hand, there is no correlation at satisfactory levels in linear regression when analyzed for long-term linear regression (public facilities) versus long private course (private facilities) from 2015 to 2017, due to long-haul shipping being influenced by speculative variables of the international economy.

6. FUTURE CONTRIBUTION

For future research contributions to the cabotage sector, this work suggests exploring the operational impacts of the legislation of Decree no. 2,596 of May 18, 1998 (BRAZIL, 1998) and Law nº 9.537 of December 11, 1997 (BRAZIL, 1997) in the operationalization of ports public and private sectors associated with Law nº 12,815, of June 5, 2013, with the movement of port terminals in the Brazilian port system in the national context. For the international context, it suggests the relation of port infrastructure with a South American port or a grouping of specific ports of South America by types of goods handled by the port terminals, in the case of the long-haul sector exploring questions of comparison between international ports in Latin America. South.

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