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AN EXPLANATORY MODEL OF STOCK PRICES IN THE BRAZILIAN TRANSPORT SECTOR

UM MODELO EXPLICATIVO DAS COTAÇÕES DE AÇÕES DO SETOR DE TRANSPORTES BRASILEIRO

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Abstract

The aim of this study is to establish an explanatory model of the variation of the prices of shares from the transport sector listed in B3. Methodology: Daily stock prices were collected from companies in the transport sector listed on B3 since its IPO until December 31, 2019. Companies that were not on the floor on this date were discarded. As an analysis tool, simple and multiple linear regressions were used. The dependent variable (annual variation in the share price of the transport sector) was subjected to variables such as exchange rate variation, economic activity, as well as important inputs such as wages and fuel, and the Ibovespa variation. Results and conclusions: a model with less variables (Ibovespa variation and inflation variation) was adopted, where a determination coefficient of 0.5131 was obtained (linear coefficient of 0.716). The model, therefore, is closely linked to the stock index and the variation in the inflation index, giving a much more financial profile to these assets.

Keywords: Transport; Logistics; determinants

Resumo

O objetivo deste trabalho é estabelecer um modelo explicativo da variação dos preços das ações do setor de transporte listadas na B3. Metodologia: Foram coletadas as cotações diárias de empresas do setor de transportes listadas na B3 desde sua abertura de capital até 31 de dezembro de 2019. Empresas que não estavam em pregão nesta data foram descartadas. Como ferramenta de análise utilizou-se regressões lineares simples e múltiplas. A variável dependente (variação anual da cotação das ações do setor de transporte) foi submetida a variáveis como variação cambial, atividade econômica, assim como outros importantes fatores como insumos como salários e combustível, e a variação do Ibovespa. Resultados e conclusões: adotou-se um modelo com menos variáveis (variação de Ibovespa e variação de inflação), onde obteve-se um coeficiente de determinação de 0,5131 (coeficiente linear de 0,716). O modelo, portanto, está intimamente ligado ao índice de ações e a variação de índice de inflação, dando um perfil muito mais financeira a estes ativos.

Palavras-chave: transporte, logística, determinantes

Introduction

The economy depends on the movement of goods and people. In developed countries, the service sector is generally prevalent over both the industrial and natural resource sectors, that is, the tertiary sector overlaps the primary and secondary sectors. It refers to one of the most important factors of human progress, given that the more developed your system of circulation of people and goods, the more developed your economy will be (GRACIANO, 1971 apud SCHMIDT, 2011).

Highways, railways and waterways, in addition to serving to interconnect the different regions of a country, still constitute the means of colonization and integration of different locations with the national community, providing benefits and evolution to the nation, transforming itself into a element of national integration (GRACIANO, 1971 apud SCHMIDT, 2011).

Cargo logistics is fundamental to a country's economy. The management of the flow of goods and services permeates practically all economic activities, influencing the competitiveness of companies. In the last two decades, logistics has assumed greater relevance, due to the competitive pressures resulting from the greater commercial opening. The logistics cost in Brazil, in turn, is estimated at about 11% of the Gross Domestic Product (GDP), denoting its economic relevance (FERREIRA AND MARCHETTI, 2014).

At the international level, two studies are worth highlighting: Connecting to compete, 2010, by the World Bank, and The Global Competitiveness Report 2011-2012 (GCR 2011-2012), by the World Economic Forum. The World Bank study presents the Logistics Performance Index (LPI), an indicator that measures the logistical performance of 155 countries, in which Brazil is in 41st position. According to the study, the main national deficiencies are customs procedures and the unavailability of sea routes, which indicates the existence of bottlenecks in ports. There is also room for advances in infrastructure, an indicator in which Brazil ranks 37th. The diagnosis mentioned is corroborated by the GCR 2011-2012 study, which assesses the main determinants of economic development in 142 countries. Among the various factors analyzed is the quality of the transport infrastructure: railways, highways and ports. According to the study, the national modes are, respectively, in the 91st, 118th and 130th positions in the global ranking.

The governmental strategy is supported by the structural transformation of the modal cargo transport matrix and the deepening of the concession program. It is expected, at the end of the process, to obtain a balanced modal matrix, with a more extensive, better quality transport network and with efficient management (FERREIRA AND MARCHETTI, 2014).

An efficient system and stable national companies, in turn, are significant to generate competitive advantages and greater barter in international negotiations. However, the poor performance of navigation coupled with the low productivity of the rail system and the abandonment of the road, left Brazil helpless in terms of logistics in the global context, given that, with the globalization process, logistics and transport operate as decisive factors. in international exchanges and in the accumulation of value to national production chains (BARAT, 2007b apud SCHMIDT, 2011).

The importance of the transport sector for the country is greater than just serving as a link between the producing and consuming areas. Transport is one of the essential factors of production in the economy and encourages wealth and development (ROCHA, 2015). In addition to generating jobs, it helps to improve income distribution and reduces the distance between rural and urban areas, providing better quality of life for the population. Companies depend on transportation to receive inputs from their suppliers and take their products to consumers. Goods are moved from one region to another, through railways, highways, ports and airports, creating jobs and income. The main mode of transportation for production is still by road, but there is an increase in the choice of other modes such as rail (CNT, 2015).

Due to the greater participation of Brazil in international trade, the demand for products such as iron ore and soybeans has increased in recent years, increasing the use of the road modal, given that the railways move mainly goods with low added value and large quantities. Essentially related to the performance of international trade is also the waterway transport modal. Long-distance shipping has a notable participation in Brazilian foreign trade, of which exports, close to 96%, in volume, are transported by ships. The sector's shortcomings and bottlenecks in the country are manifesting due to pressures on the national port system due to the country's greater participation in the international scenario (CNT, 2015).

A model is nothing more than a simplified representation of reality. When a group of observable phenomena is confirmed, the evidence of a regularity is attempted to establish the corresponding mathematical theory. This theory can be considered as the mathematical model of the set of empirical facts that constitute the data. The role of the model is to display the relationships and interdependence between endogenous and exogenous variables. The models deliberately exclude the details that are not considered important in order to clarify which are the key or fundamental variables and the important relationships to explain the phenomenon in question (BLAUG, 1993).

The model is a simplified and abstract representation of reality. A model is not intended to be identical to reality. On the contrary, it seeks to represent the real world through an abstraction, something that is extracted from reality, from the real world, and that helps us to understand how it works. As long as it is a representation, it differs in several aspects from the original or reality in terms of scale, amount of details or degree of complexity, but at the same time preserves what is important in the original or in reality in its fundamental or more salient aspects and highlighted. Given that an economic model is a concise description of reality, which seeks to describe the observed behavior and results, it omits some information in order to focus on the aspects considered relevant and important by the researcher or theoretician (BLAUG, 1993).

According to Rossetti (2000), over time, economic institutions and political-ideological conceptions change. The complexity of the economic process generally becomes greater. New concerns arise. Consequently, the concept of economics evolves. Models - in physics, biology or economics - simplify reality to improve its understanding (MANKIW 1999, p.23). Likewise, the choice between the classical model and the Keynesian model should not, according to an instrumental criterion, refer to the realism of their respective assumptions, but to the predictive capacity of the theory as a whole. However, the theoretical assumptions convey a world view, or ontology, which cannot be neglected

under the penalty of recurring theoretical failures regarding the understanding and explanation of the world by scientific theory (CAVALCANTE, 2014).

This study seeks to establish an explanatory model of the variation in the prices of the shares of the firms related to transport sector listed in B3. The article is divided as follows: this introduction, followed by a theoretical framework where the study hypotheses are established. The methodology follows, where the data analysis tools are contextualized; the next section shows the results with the discussion about them and ends with the conclusions.

Theoretical Reference:

CAETANO (2013) states that the increase in the dollar rate impacts the net profit of transport companies, causing instability across the sector. Tadeu (2010) notes an increase in the operating costs of the transport sector, especially for fuels and foreign exchange, due to the equipment purchase processes to be carried out in foreign currency. The cost of fuels stands out, reaching, on average, 30% of the airlines' revenues, for example, followed by foreign exchange and commercial expenses. The sensitivity of the airport modal is evident, due to variations in fuel prices and exchange rates, which is not favorable.

When analyzing the cost structure of companies in the airline industry, it is important to note that, according to data from the National Agency of Petroleum, Natural Gas and Biofuels (ANP), the average price of aviation kerosene (QAV) accumulated a 28.4% increase in 2018, while the Brazilian exchange rate, according to data from the Central Bank, closed 2018 at R$ 3.87 / US$ - an increase of 17.1% in relation to 2017. These conditions put pressure on the operational cost of air transport companies in 2018, since QAV is its main input and a large part of its cost structure is influenced by the dollar, such as aircraft leasing, maintenance and insurance. In the accumulated from January to April 2019, the average price of QAV fell by 5.9%, while the exchange rate reached R$ 3.94 / US$, which corresponds to an increase of 1.8% in the first four months of the year. Therefore, given the fall in the price of QAV and the modest increase in the exchange rate, the scenario in 2019 was of a certain stability in prices that affect the operating cost of airlines, however it is important to continue monitoring these prices (CNT, 2019).

Based on these informations, we formulate our first hypothesis:

Hypothesis 1: the stock prices of the transport companies is related to the exchange rate variation.

Hypothesis 1b: this correlation is negatively related.

According to CNT (2017) the 2015 Annual Services Survey (PAS) showed that the non-financial services sector in Brazil was, in that year, composed of 1.29 million companies that generated R$ 1.4 trillion in net operating revenue, R$ 856.0 billion of gross added value and employed 12.7 million people who received R$ 315.0 billion in salaries and other remuneration. Transport activities, auxiliary transport services and postal services led the sector's net operating revenue in 2015, accounting for 29.3% of the total. The relevance of the transport sector can be seen through the other variables surveyed by PAS.

It was the second in terms of added value (24.0%) and the third in terms of participation in the salaries of employed persons by 20.5% (CNT, 2017).

Table 1 shows the variation of the Brazilian GDP with the variation of the GDP of the transport, storage and mail sector. The correlation between the two is evident (coefficient of determination = 0.96).

Table 1 - Annual change in national GDP and GDP in the transport sector (%)

Year	GDP	GDP Transport, storage and mail
2018	1,1	2,3
2017	1,1	1,2
2016	-3,3	-5,6
2015	-3,5	-4,3
2014	0,5	1,5
2013	3	2,6
2012	1,9	2
2011	4	4,3
2010	7,5	11,2

Source: CNT (2019b)

Based on this information, we formulate our second hypothesis:

Hypothesis 2: the price of transport companies is related to the variation in GDP.

Hypothesis 2b: this correlation is positively related.

The transport sector accounts for approximately 32% of the total energy demand in the country (considering the year 2013), which makes it the second most energy intensive, behind only the industrial sector (NOVO, 2016). Within the sector, it is estimated that the cargo transportation activity accounts for about 42% of this total, predominantly based on the consumption of diesel oil in the road mode (EPE, 2014b).

The transport sector will continue to increase as economic growth drives this activity, as it promotes specialization in production and exchanges (IPCC, 2006). It is estimated that the energy used by global transport will increase by about 75% by 2050 without taking any action (IEA, 2015).

Transport affects the country's productivity by influencing its potential in foreign trade, both via import and export. Thus, if transport costs are too high, they will act as an import or export tax and increase product costs, reducing their commercial competitiveness (CNT, 2017b). It is a consensus among decision makers and scholars that an extensive, dense and good quality infrastructure is a necessary condition for carrying out transport services and, thus, for the economic development of a region or country. In fact, investments in transportation infrastructure help companies to be more productive and create conditions for expanding their production. In addition, the existence of an adequate infrastructure can be fundamental for choosing the location of a productive plant. Despite the finding that the availability of transport infrastructure increases productivity and presents gains related to economic dynamism, Brazil presents an adverse situation with regard to transport infrastructure (CNT, 2017b).

Diesel, the main input used in the transport sector, has a wide range of applications, which makes this derivative play a prominent role in the economy, being a relevant factor not only in the derivatives sector, but also in others sectors that use it as the main input. In the road cargo transport sector, for example, the percentage of fuel cost over total transport cost was 25.6% in 2012 and this value, although representative, was the lowest in the last 10 years (in 2006, this percentage reached 35.7%). In interregional cargo transportation (also known as long-distance transportation), the cost of diesel is equivalent to 40.1% of the total cost for closed cargo and 18.3% of the total cost for special cargo (LIMA, 2013). Diesel is of great importance for the country not only because of its representativeness in transportation costs, but also because of its representativeness in the production and consumption of derivatives, in volume. The impacts of this derivative are felt at both the micro and macroeconomic levels: at the micro level, there is the example of Petrobras, a Brazilian multinational in the energy sector (mainly derived from fossil fuels), which justified much of the 45% drop in its net profit the third quarter of 2013 compared to the second quarter of the same year with the increase in demand for diesel. According to company reports, production, despite continuing to grow, did not keep up with the growth in demand, causing the need to import diesel oil to increase, since the company is responsible for not allowing fuel shortages throughout the national territory. This increase in the need for imports, combined with an increase in the dollar, impacted the company's net profit, causing instability in the entire sector (CAETANO, 2013).

Hypothesis 3: the quotation of transport companies is related to the variation in fuel prices.

Hypothesis 3b: this correlation is negatively related.

Retail competition requires companies to minimize transportation and distribution costs, so that they do not negate the cost advantages of outsourcing. The net result is the outsourcing of costs, reflected in the working conditions, arrangements and remuneration of logistics workers. Jaffee and Bensman (2016) describe these labor market conditions as forms of “precarious work” or jobs characterized by low wages, unstable labor agreements, temporary employment relationships, underemployment, economic insecurity, absence of employer-provided benefits and lack legal and regulatory protections (KALLEBERG, 2011; STANDING, 2011). Consistent with Standing's analysis of “precariousness”, Jaffee and Bensman (2016) consider these conditions as a direct product of globalization under neoliberal policies that sought to “maximize competition and competitiveness and allow market principles to permeate all aspects of life” (STANDING 2011, p. 1).

More generally, the future prospects of increasing the bargaining power of logistics workers are linked to the fact that supply chains depend not only on low costs, but also on the rapid movement of goods. Once the containerized cargo arrives at the port, it is vital, given the just in time supply chain system, to move it quickly and efficiently. This imperative provides the workforce with a strategic opportunity to exercise energy. As Silver (2003) notes:

> transport workers have and continue to have relatively strong bargaining power in the workplace. This becomes especially clear after we conceptualize the workplace as the entire network in which they are enmeshed. Thus, the source

> of bargaining power in the workplace must be found less in the direct impact of their actions on immediate (usually public) employers and more in the upstream / downstream impact of the failure to deliver goods, services and people to their employees destinations (SILVER 2003, p. 100).

Capital's desire to ensure stability and security in the movement of cargo works for the benefit of labor, capable of exercising "interdependent power" (PIVEN 2006).

Transport and logistics companies pay lower wages than companies in many other sectors. This is true worldwide. The Global Wages Report of the International Labor Organization (ILO) lists transport as one of the main sectors in which low-wage employment is concentrated (INTERNATIONAL LABOR ORGANIZATION, GLOBAL WAGE REPORT, 2010/2011). It is very difficult to compare wage levels between countries, as research methodologies differ widely. Still, there is a consistent pattern that, in many countries, wage levels in the sector are far below the list compared to other sectors (TRANSPORTATION & LOGISTICS 2030). In Germany, the transport and storage sector rank the penultimate of twelve sectors, and in the USA the last in the list. An exception is China, where transportation and storage are in sixth place. However, transportation and storage wages are 42% lower than those in the highest paid sector. In transport and logistics, there are significant variations in wage levels between different working groups. In this multifaceted industry, job profiles vary from pilots and seafarers to truck drivers and rail drivers. The necessary skills and working conditions vary enormously, as do the corresponding wages and benefits. Road sector jobs are traditionally lower paid, but this is becoming a point of contention in some countries. In Ireland, unions are lobbying for increases in driver wages. In Bulgaria, unions say that drivers need to work long hours - violating regulations on working hours and rest breaks - just to survive (VERWEIJ *et al*., 2009). Some self-employed drivers in other parts of the EU prefer to work longer shifts to earn more. This is potentially a safety issue, as tired drivers can be more accident prone. The 2009 EU Working Time Directive limits the number of hours that all drivers can stay on the road, including self-employed drivers, essentially reducing salary levels for many (WORKING CONDITIONS).

In some sectors of transport and logistics, companies are already raising wages to combat labor shortages. For example, the average annual salary for a logistics professional in the USA increased by 45% between 1996 and 2004 and another 13% since 2007 after a three-year stagnation period (TRANSPORTATION & LOGISTICS 2030). Wages are not the only form of remuneration that matters. Benefit packages are also important, although the most important benefits vary across the world. Two types of benefits that essentially increase wages - 'variable cash bonuses' and 'reimbursement of expenses' - are the top five worldwide (EURAPHIA CONSULTANT, 2008). Other important benefits include health and pension plans - both areas in which expectations have increased have changed in recent years and where the cost implications for companies are large, especially as the population ages.

Hypothesis 4: the stock prices of transport companies is related to the variation in salary readjustments.

Hypothesis 4b: this correlation is negatively related.

According to Suresh (2018), the Logistics sectors are one of the fastest growing sectors in the Indian stock market. The study carried out by the author was organized to analyze

the risk and return of selected logistic actions listed in the BSE and to compare their performance with the benchmark for the period of 5 years, that is, from January 1, 2013 to December 31, 2017. His article analyzed the performance of the logistics sector that uses BSE Sensex[1] as a reference. The study focused mainly on the price movement of selected stocks in the logistics sector.

Suresh (2018) showed that the shares of Corporate Courier and Cargo Limited gave the highest returns during the study period, while the returns of Skypak Limited's service experts were negative during the same period. The beta of all stocks was greater than one, indicating that all stocks selected for the study present a higher risk.

Hypothesis 5: the stock prices of transportation companies is related to the Ibovespa variation.

Hypothesis 5b: this correlation is positively related.

Methodology

As an analysis tool, simple and multiple linear regressions were used (GUJARATI, 2011), where the multiple regression analysis is conditioned to the fixed values of the regressors and what is obtained is the average value of Y or the average response of Y for the values of the regressors. In multiple regression, in addition, the problem of multicollinearity between the independent variables is worked out.

The R software was used to analyze the data collected under this methodology. A level of statistical significance was set at 0.1. Daily stock prices from transportation companies listed on B3 were collected from their IPO until December 31, 2019[2]. Companies that were not traded on this date were discarded.

The dependent variable (annual variation in the share price of the transport sector) was subjected to simple and multiple linear regressions referring to situations such as exchange rate variation[3], economic activity, as well as important inputs such as wages and fuel, and the Ibovespa variation[4]. As a proxy for wage adjustments, the variation of the Broad Consumer Price Index (IPCA)[5] was used, while for economic activity, the variation of GDP[6] was used. For the variation in fuel cost, the variation in the price of a barrel of oil[7] was adopted. To complete the analysis, the previous year's (t-1) variations of the factors described above were also evaluated.

Results

Seven publicly traded companies linked to the transportation sector, selected in B3, were selected based on the availability of data. Table 2 shows the companies studied and the time period (in years) of coverage, which varied from a minimum of 3 years to a maximum period of 16 years. The total number of observations, in the form of company-years, were 62 companies-year. Table 3 shows the annual percentage variation of the dependent variable (stock price) and of the other independent variables.

[1] Main index of the Bombay Stock Exchange.
[2] Yahoo Finanças.
[3] Dólar Comercial Oficial - Índice Mensal.
[4] Índice BOVESPA.
[5] Índice Nacional de Preços ao Consumidor Amplo – IPCA.
[6] IBGE.
[7] Indexmundi.

Table 2 - Companies and coverage period

Company (code in B3)	coverage period (years)
azul4	2017-19
goll4	2004-19
logn3	2007-19
rail3	2015-19
rlog3	2014-19
mrsa6b	2014-19
tgma3	2007-19

Table 3 - Descriptive statistics

Variable	minimum	1st quartile	median	average	3rd quartile	Maximum
Δ price (%)	-0,834	-0,1489	0,2464	0,3083	0,6777	2,4728
Δ exchange rate (%)	-0,258	-0,032	0,030	0,07213	0,17847	0,44890
Δ GDP (%)	-3,550	0,185	1,120	1,162	3	7,530
Δ oil price (%)	-0,53	-0,118	0,157	0,083	0,3018	0,811
Δ Ibov (%)	-0,41	-0,08	0,15	0,145	0,315	0,826
Δ IPCA (%)	-1,013	-0,38	-0,013	5,46	0,25	1,91
Δ price $_{t-1}$ (%)	-0,83	-0,31	0,05	0,23	0,599	2,47
Δ exchange rate $_{t-1}$ (%)	-0,25	-0,06	0,09	0,07	0,17	0,448
Δ GDP $_{t-1}$ (%)	-3,550	-0,13	1,12	1,3	3,58	7,530
Δ oil price $_{t-1}$ (%)	-0,53	-0,25	0,08	0,047	0,25	0,81
Δ Ibov $_{t-1}$ (%)	-0,41	-0,13	0,15	0,12	0,27	0,82
Δ IPCA $_{t-1}$ (%)	2,94	3,74	5,90	5,71	6,4	10,67

Δ = variation

Each independent variable was subjected to simple linear regression in relation to the share price of the transportation companies (table 4). In addition, regression was performed with the variables in the previous year (t-1). The following variables were statistically significant: Δexchange rate, ΔIbov, ΔIPCA and ΔGDP t-1, accepting hypotheses 1, 2, 4 and 5, and hypothesis 2 (variation in economic activity is confirmed only when the previous year). Of these, the one with the highest adjusted coefficient of determination (R^2) was the variation of the Ibovespa for the current year (corresponding to a linear coefficient of 0.655).

The exchange rate, oil price, Ibovespa and IPCA variations present coefficients compatible with the respective hypotheses 1b, 3b, 4b and 5b. Exception made to the GDP variation, where the coefficients in both t and t-1 were negative, contrary to hypothesis 2b.

Table 4 - Simple regressions (dependent variable: Δ stock prices)

Independent variable	coeficient	Adjusted determination coeficient
Δ exchange rate ***	-2,23	0,27
Δ GDP	-0,0089	-0,01
Δ oil price	1,21	0,29
Δ Ibov ***	1,79	0,43
Δ IPCA***	-0,216	0,33
Δ stock prices $_{t-1}$	0,13	-0,004
Δ exchange rate $_{t-1}$	0,302	-0,012
Δ GDP $_{t-1}^{\#}$	-0,05	0,03
Δ oil price $_{t-1}$	-0,018	-0,018
Δ Ibov $_{t-1}$	-0,03	-0,01
ΔIPCA $_{t-1}$	-0,045	-0,001

Δ = variation; *** = p < 0,00;1 ** = p < 0,01; * = p < 0,05; $^{\#}$ = p < 0,1

The variables with the highest adjusted R^2 and / or with statistical significance in the simple regression were paired two-by-two and shown in table 5. Depending on the pair evaluated, statistical significance disappeared (case of Δchange and Δ oil when put together and Δ exchange when paired with ΔIbov[8]). The Ibovespa variation maintained its positive coefficient and the IPCA and exchange rates maintained their negative coefficients, while the oil price variation had its positive coefficient when paired with the exchange rate and negative when paired with the Ibovespa variation. In relation to the adjusted R^2, there was an increase in relation to simple regressions. In this case, the biggest was when Ibovespa and inflation were compared, with an adjusted R^2 value of 0.51 (or a linear coefficient of 0.714).

[8] In the case of the regression in which foreign exchange and oil variables are placed as independent variables, their coefficients practically cancel each other out, also demonstrating the close correlation between both.

Table 5 - Multiple regressions I (dependent variable: Δ stock prices)

Independent variable	coeficient	Adjusted determination coeficient
Δ exchange rate, Δ Ibov***	Δ exchange rate: -0,046 Δ Ibov: 1,77	0,42
Δ Ibov***, ΔIPCA**	Δ Ibov: 1,34 ΔIPCA: -0,126	0,5131
Δ exchange rate *, ΔIPCA**	Δ exchange rate: -1,25 ΔIPCA: -0,15	0,38
Δ exchange rate, Δ oil price	Δ exchange rate: -0,81 Δ oil price: 0,82	0,28
Δ exchange rate $^{\#}$, Δ GDP	Δ exchange rate: -3,19 Δ GDP: 0,12	0,48
Δ oil price, Δ Ibov***	Δ oil price: -0,029 Δ Ibov: 1,82	0,42

Δ = variation; *** = p < 0,00;1 ** = p < 0,01; * = p < 0,05; $^{\#}$ = p < 0,1

Table 6 shows the multiple regressions with more than 2 independent variables, both with variables that did not previously show statistical significance and merging the different periods of time addressed. Surprisingly, when all variables were placed in a multiple linear regression model, only the variation in oil prices remained statistically significant, making evident the multicollinearities between the variables.

The highest adjusted R^2 in the group in table 6 was only slightly higher than the highest adjusted R^2 in the regressions in table 5. In other words, it was decided to adopt a model with fewer variables (Ibovespa variation and inflation variation), where a value of 0.5131 (linear coefficient of 0.716) was found. Thus, a simple linear model for the variation of the stock prices of transport companies would be: Δ price = 1.34ΔIbov -0.126ΔIPCA. The ΔIbov coefficient greater than 1 is compatible with a high beta value, according to Suresh (2018), that is, for each increase of one percentage point of the Ibovespa, there is an increase of 1.34% in the transport sector.

However, another model, with a similar determination coefficient (0.5319), as shown in table 6, could be used: Δ price = 0.733Δ exchange rate + 1.672ΔIbov -0.14ΔIPCA. We applied both models to the sample and found the sum of the square of errors in 18.6 of the model with two variables and 29.5 for the model with 3 variables. The t test showed that both groups are statistically different from each other (p <0.001). Thus, the model with two variables, as it has a smaller error, proved to be more suitable for determining the share price. The most appropriate model, therefore, is closely linked to the stock index and the variation in the inflation index, giving a much more financial profile to these assets.

Table 6 - Multiple regressions II (dependent variable: Δ stock prices)		
Independent variable	coeficient	Adjusted determination coeficiente
Δ exchange rate, Δ oil price, Δ Ibov **	Δ exchange rate: -0,18 Δ oil price: -0,107 Δ Ibov: 1,81	0,41
Δ exchange rate, Δ Ibov***, ΔIPCA**	Δ exchange rate: 0,733 Δ Ibov: 1,672 ΔIPCA: -0,14	0,5139
Δ GDP#, Δ oil price, Δ Ibov***	Δ GDP: 0,058 Δ oil price: -0,39 Δ Ibov: 2,39	0,45
Δ exchange rate, Δ PIB*, Δ oil price, Δ Ibov ***	Δ exchange rate: 1,09 Δ GDP: 0,07 Δ oil price: -0,027 Δ Ibov: 2,63	0,45
Δ exchange rate, Δ GDP, Δ oil price, Δ Ibov *, ΔIPCA*	Δ exchange rate: 1,73 Δ GDP: 0,01 Δ oil price: 0,61 Δ Ibov: 1,56 ΔIPCA: -0,149	0,50
Δ stock prices $_{t-1}$, Δ exchange rate $_{t-1}$, Δ GDP $_{t-1}$, Δ oil price $_{t-1}$	Δ stock prices $_{t-1}$: 0,20 Δ exchange rate $_{t-1}$: 0,94 Δ GDP $_{t-1}$: -0,04 Δ oil price $_{t-1}$: 0,21	-0,01
Δ stock prices $_{t-1}$, Δ exchange rate $_{t-1}$, Δ GDP $_{t-1}$, Δ oil price $_{t-1}$, Δ Ibov $_{t-1}$	Δ stock prices $_{t-1}$: 0,30 Δ exchange rate $_{t-1}$: 0,09 Δ GDP $_{t-1}$: -0,07 Δ oil price $_{t-1}$: 0,37 Δ Ibov $_{t-1}$: -1,06	-0,01
Δ stock prices $_{t-1}$, Δ exchange rate $_{t-1}$, Δ GDP $_{t-1}$, Δ oil price $_{t-1}$, Δ Ibov $_{t-1}$, ΔIPCA $_{t-1}$	Δ stock prices $_{t-1}$: 0,107 Δ exchange rate $_{t-1}$: 1,80 Δ GDP $_{t-1}$: -0,15 Δ oil price $_{t-1}$: 1,589 Δ Ibov $_{t-1}$: -2,14 ΔIPCA $_{t-1}$: -0,24	0,13
Δ câmbio, Δ GDP, Δ oil price, Δ Ibov**, Δ stock prices $_{t-1}$, Δ exchange rate t-1, Δ GDP t-1, Δ oil price $_{t-1}$, Δ Ibov t-1	Δ exchange rate: 3,03 Δ GDP: 0,018 Δ oil price: 1,092 Δ Ibov: 2,69 Δ stock prices $_{t-1}$: 0,26 Δ exchange rate $_{t-1}$: 0,30 Δ GDP $_{t-1}$: -0,04 Δ oil price $_{t-1}$: 1,67 Δ Ibov $_{t-1}$: -1,46	0,45
Δ exchange rate, Δ GDP, Δ oil price #, Δ Ibov, ΔIPCA, Δ stock prices $_{t-1}$, Δ exchange rate $_{t-1}$, Δ GDP $_{t-1}$, Δ oil price $_{t-1}$, Δ Ibov $_{t-1}$, ΔIPCA $_{t-1}$	Δ exchange rate: -0,609; Δ GDP: -0,163; Δ oil price: 1,412; Δ Ibov: 0,244; ΔIPCA: -0,235; Δ stock prices $_{t-1}$: 0,17; Δ exchange rate $_{t-1}$: -0,109; Δ GDP $_{t-1}$: -0,068; Δ oil price $_{t-1}$: 1,922; Δ Ibov $_{t-1}$: -1,958; ΔIPCA $_{t-1}$: -0,0059	0,485

Δ = variation; *** = p < 0,00;1 ** = p < 0,01; * = p < 0,05; # = p < 0,1

Conclusions

As there is no index of companies in the transport sector, it was necessary to collect within the companies listed in B3 a set of companies that, despite being classified as a transport sector, were a heterogeneous group. From aviation companies to firms related to sea and rail transport to airline companies; from passenger transport companies to the transport of millions of tons of low added value commodities.

Comparing them to each other required the creation of a model that would abstract these differences and bring them together around common needs, such as their inputs. The use of models as a means to better understand the dynamics of asset price variation occurs as a means to support the theories made from the literature review and data observation. Through the use of simple and multivariate linear regression instruments, correlations were established between the share price of the transport sector listed in B3 and aspects such as foreign exchange, inflation and Ibovespa variation indexes. It was also possible to establish a simple model to explain much of the share price of the transport sector.

It was not the objective of this work to establish a predictive model, but to seek the ontology of the phenomenon, when trying to explain the formation of price. As a perspective for new work, the same methodology will be applied to other sectors.

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