CORRELATION ANALYSIS OF EXPORTS OF MANUFACTURED PRODUCTS AND BASIC PRODUCTS IN THE STATE OF SÃO PAULO

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ABSTRACT

Participation in international trade has been important for national economy and keeps increasing over the years, and it may be noted by the importation and exportation activities. In this sense this study aims to verify whether there is correlation between exports of manufactured and basic products in the State of São Paulo, as well as between them and time. Therefore it was used data available at *Ministério da Indústria, Comércio Exterior e Serviços* (MDIC) website relating to the amount in US$ of both manufactured products and basic products exported in the State of São Paulo from 2006 to 2016. The analysis was performed by using simple linear regression statistical calculation, aiming to verify whether there is correlation. Findings indicate there is strong correlation between the exports of basic products and time; there is no correlation between the exports of manufactured products and time; there is no correlation between the exports of basic products and the exports of manufactured products. Findings may help practitioners in forecasting demands as well as the understanding about exports behaviors when making-decisions.

Keywords: Exportation, Manufactured Product, Basic Product, State of São Paulo, Correlation.

1. INTRODUCTION

In this globalized scenario international trades have grown more and more and have been shown as one of the most profitable ways for a nation's economy, i.e. participation in international trade takes a nation to increase its capital and its economy.

The rule for a good economic scenario of a country is to export more than import. Brazil is currently in the Emerging countries (E7) group. In general, these countries are those underdeveloped countries who present a picture of prosperous economic growth and socioeconomic characteristics that differentiate them from the other peripheral economies (SCHMIELE, 2012; ALBERT *et al.*, 2014).

Brazil has as predominant source of wealth generation the low value-added products, which are sold and exported in commodities, which can be checked, e.g., in the list published at ADVFN Brazil (2017) website, a financial market website. In order of larger exports (quantity) the sequence is as follows: soybeans whether or not broken (10%); iron ores and concentrates (7.2%); crude oils (5.4%); cane sugar in the rough (4%); and frozen, fresh or chilled chicken meat, including offal (3.2%). This last one was topic of study for Sartin *et al.* (2015) in an analysis of correlation between them and beef exports.

Although Brazil has, as mentioned, its source of income concentrate in low value-added products, it also exports high value-added products, and in this case the largest parcel is for passengers or loads transportation, i.e. passenger cars (2.5%), and airplanes (2.3%) (MDIC, 2017).

The main destinations of Brazil's exportations are China (19%), The United States (12.5%), and Argentina (7.24%), respectively.

According to *Portal Brasil* (BRASIL, 2014) and *Ministério da Indústria, Comércio Exterior e Serviços* (MDIC, 2017), the State of São Paulo has the greatest participation both in the exportation of certain products and in the national GDP. The export destinations of the State of São Paulo has an order of participation little different from Brazil's. In this specific State the sequence is The United States (17%), Argentina (12%), and China (8.4%).

Also according to MDIC (2017) website, which provides, among others, local, regional, and national data of imports and exports in Brazil, the State of São Paulo

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had participation of 24.9% in the exports performed in Brazil in 2016 and of 37.6% in the imports performed in the same period. These values result in the State cash deficit of US$ 5.5 billion (MDIC, 2017), thus highlighting Brazil's inadequate characteristic of importing more than exporting.

Given this importance of the State of São Paulo for Brazil's importation and exportation activities as well as for national economy, it was decided to analyze the exportation activity performed in this State, in order to know its behavior and correlations.
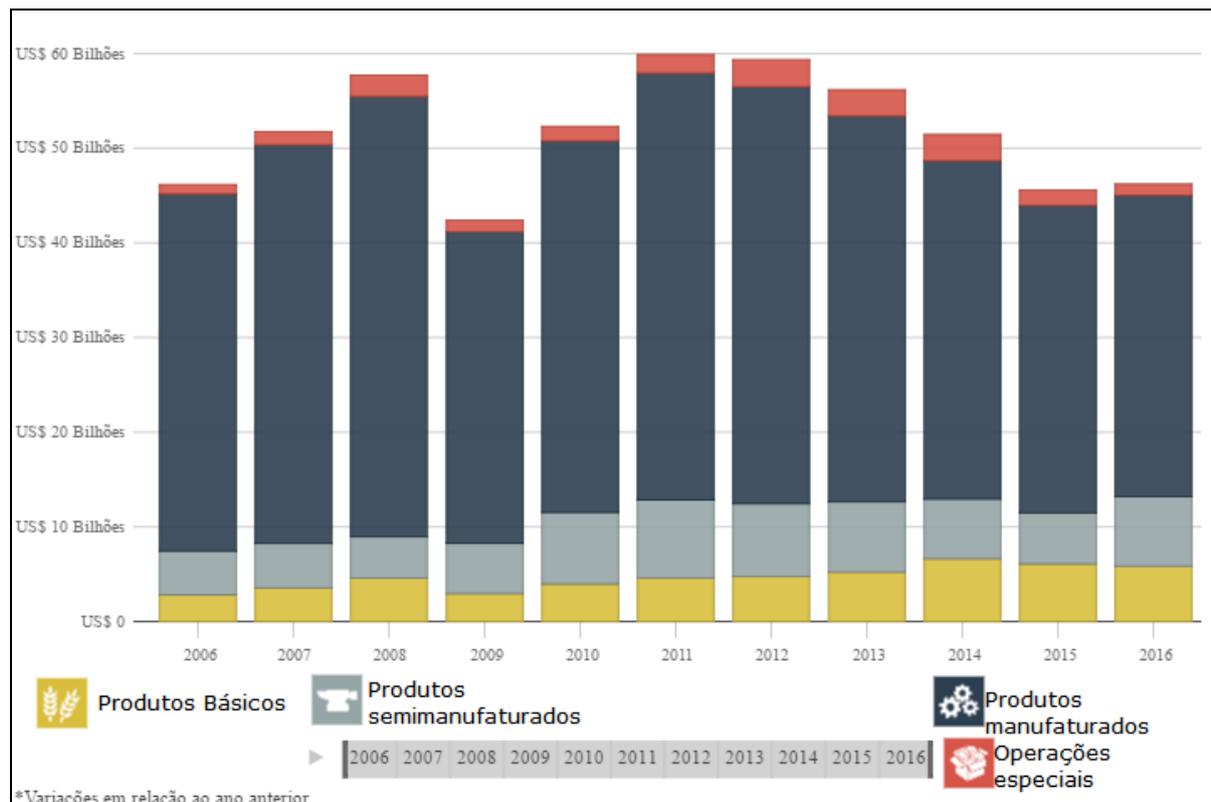

Figure 1: Brazilian exports by aggregate factor - State: São Paulo (2006-2016)
Source: MDIC (2017), adapted.

Data were extracted from MDIC (2017) website for helping this analysis. First of all it notices in Figure 1 the exports history performed in the State of São Paulo over the last eleven years. It is possible to notice the predominant participation of manufactured products in the performed exportation (on average 75%). Figure 2 describes the characteristics of these products classified in main groups. Airplanes (8.4%) and passenger cars (4.8%) stand out among the manufactured products. Soybeans whether or not broken (3.1%) stand out among the basic products.

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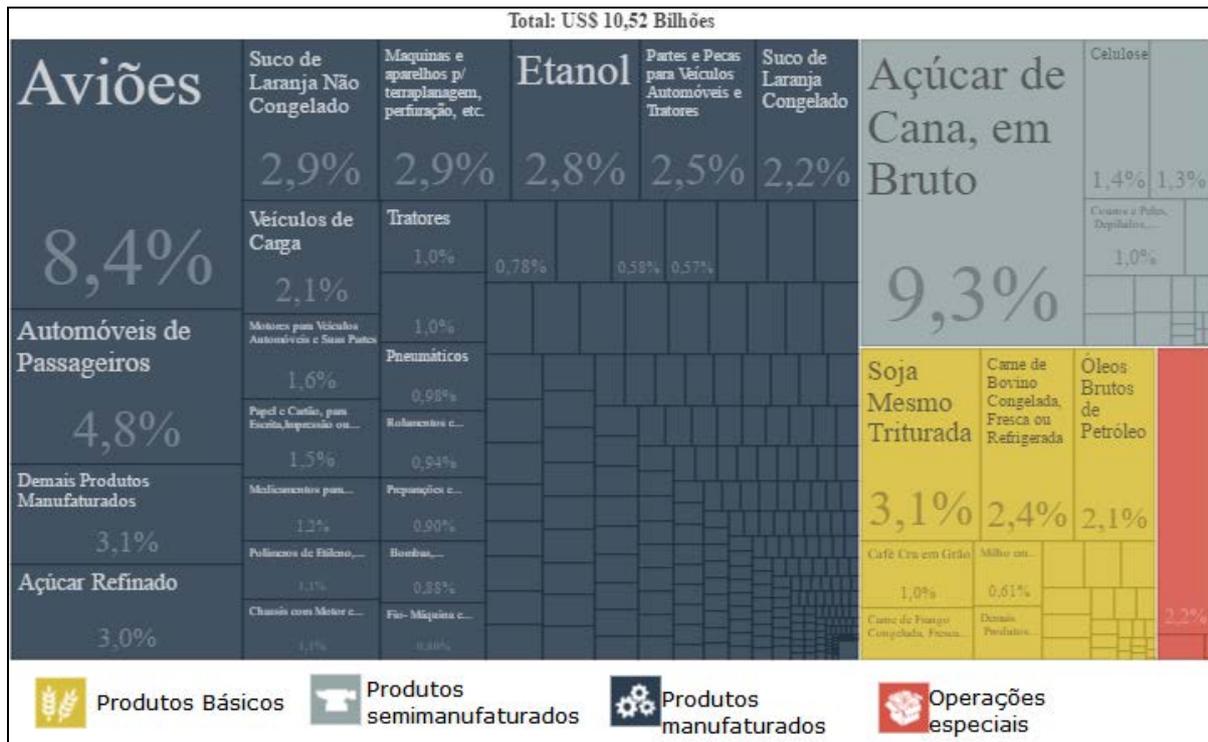
Figure 2: Exported products overview - State: São Paulo (classification: main exported products and value-added)
Source: MDIC (2017), adapted.

Considering the data mentioned above, it is investigated whether there is correlation between the behaviors of the exports of these products based on the assumptions represented in Figure 3.
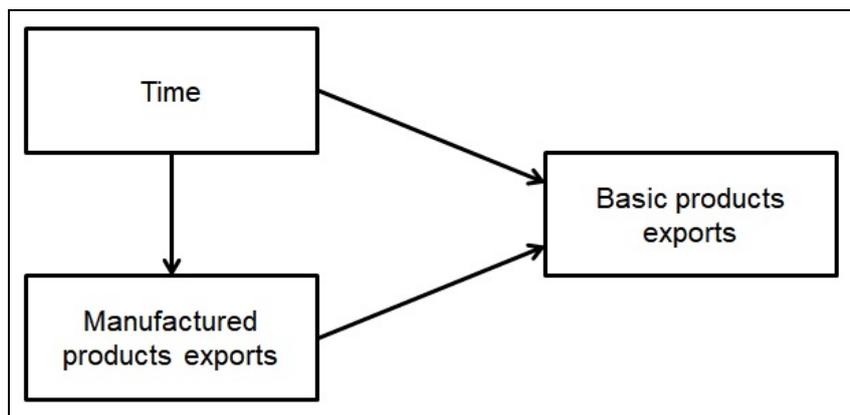
Figure 3: Assumptions
Source: the author.

So, exports of manufactured products, exports of basic products, and time are the variables to be investigated in this study. Then in this way we have as assumptions the following:

- Exports of manufactured products variable is dependent on time variable.

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- Exports of basic products variable is dependent on time variable.

- Exports of basic products variable is dependent on exports of manufactured products variable.

This study is organized as follows: section 2 exposes the theoretical references and the concepts addressed in the study. In section 3 there is the description of the adopted method for the study performing, as well as the study classification as regards to its kind. Section 4 discusses the findings. Section 5 finishes the study with final considerations and suggests issues for further researches.

2. THEORETICAL REFERENCE

2.1. Brazil and international trade

Brazil does part of the E7 countries, which are countries in development and tend to become great world powers. One of the reasons for is linked to both participation in international trade and investment on production and commercialization of high value-added goods.

As Brazil is in the E7 countries it becomes a target for studies and discussions especially because of those countries whom Brazil has commercial relations with, such as China and The United States. China in turn is very present in studies perhaps because of both its much-criticized production policy and its market share in the global market (e.g. COELHO; MORALES, 2013; DELVAUX, 2016; SALAMA, 2016; IJPDLM[1], 2017).

2.2. Manufactured products: characteristics, economic importance and related studies

Manufactured products are finished products, i.e. products ready to be used by the buyer. This kind of products spares manpower from who acquires it, and because that it has higher cost.

Among the main manufactured products, high technology products stand out in importance, such as electronics and transportation. In this way it is strategically feasible to keep the country economy supported by the production of this kind of goods.

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[1] International Journal of Physical Distribution & Logistics Management.

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Recent studies in Brazil analyze the Brazilian economic performance in relation to the commerce of these products, e.g. Avelar et al. (2015) studied issues related to MERCOSUR, indicating an improvement in Brazilian commercial relations with countries of the bloc; and Ramos Filho and Ferreira (2016), for both statistical purposes and economic analysis, analyzed issues related to the sectors of Brazilian manufacturers in order to detect whether or not there exists the J Curve phenomenon in the relation between commercial balance and exchange rate.

2.3. Basic products: characteristics, economic importance and related studies

Basic products are inputs that passed through little or no preparation and/or treatment work. They are commercialized in commodities.

This kind of products is destined to meet internal or external raw material demands. Its cost is lower and it requires manpower from who acquires it to transform it into finished product.

Brazilian economy is predominantly supported by this kind of products (42.7%, according to MDIC). Soybeans whether or not broken, iron ores and concentrates, and crude oils stand out among them.

As studies addressing basic products topics there are some analysis or discussions about the Real (Brazilian currency) linked to the scheme of commodities (e.g. ALBERT *et al.*, 2014; BRANCO, 2016). Espíndola and Araújo Jr. (2017) discuss about the commercial relations between Brazil and Spain. Regarding the relation between Brazil and China, Salama (2016) points out some aspects of it that negatively impact on Brazilian economic development, also highlighting Brazil's insistence to bet on basic products more than on manufactured products.

2.4. Statistics and correlation analysis and simple linear regression

Statistics is important for providing methods to collect, organize, describe, analyze and interpret data (TIBONI, 2010). Its results help the planning, formulation of decisions, understanding of characteristics and behaviors of some population, or decision-making (TRIOLA, 2005; TIBONI, 2010).

Therefore one of its analysis tools is the investigation of correlation between variables. In linear correlation there is a trend relation in the distribution of points,

which makes possible to notice certain behavior pattern of the variables and between them, in case of dependence between the variables (TRIOLA, 2005; TIBONI, 2010).

Correlation analysis and simple linear regression is done by means of linear correlation coefficient formula. Linear correlation coefficient *r* (Pearson's *r*) is calculated by the formula represented in Equation (1).

$$r = \frac{n \sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{[n \sum x_i^2 - (\sum x_i)^2][n \sum y_i^2 - (\sum y_i)^2]}} \tag{1}$$

Where

n = number of observations of the variables

x_i = independent variable

y_i = dependent variable

R represents the intensity of correlation between the variables. By definition *r* value[2] is $-1 \le r \le +1$, where:

$0 \le r < 0.3$ = inexistent or weak correlation between the variables;

$0.3 \le r < 0.6$ = low to medium correlation between the variables; and

$0.6 \le r \le 1$ = medium to strong correlation between the variables.

Linear regression is the function (mathematical expression) characterized (or represented) by a straight line (first-degree polynomial function) that best fits the points of the variables plotted on the graph. This line is a linear model that associates the independent variable *x* and the dependent variable *y*, it is expressed by means of Equation (2) (TIBONI, 2010).

$$y = ax + b \tag{2}$$

Where

y = dependent variable

x = independent variable

a (constant value) = coefficient of the regression line (or slope of the line)

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[2] The negative value (−1) only defines the slope of the line. It does not define the intensity of the relation, which is explained next.

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b (constant value) = point of intersection between the line and the vertical axis *y* (it is the value of *y* when *x* is zero)

The values of the constants *a* and *b* are given respectively by Equation (3) and Equation (4) (TRIOLA, 2005).

$$a = \frac{n\sum x^2 \sum y_i - \sum x_i \sum x_i y_i}{n\sum x_i^2 - (\sum x_i)^2} \qquad (3)$$

$$b = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - (\sum x_i)^2} \qquad (4)$$

3. METHOD

This study based on Sartin *et al.*'s (2015) study, which verifies correlation between exports of beef and chicken in Brazil. From it the replica of their logical model was done but by addressing the exportation activity in the State of São Paulo and limiting to manufactured products and basic products.

It is a descriptive study of quantitative nature.

First of all it was collected the data available at MDIC website that refer to values in annual billions US$ of exports performed in the State of São Paulo that comprise the years from 2006 to 2016 and refer to exports of manufactured products and basic products.

Next, it was considered the assumptions of dependency relation between the variables (see Figure 3) and with the data it was made calculations through Equation (1), Equation (2), Equation (3) and Equation (4), according to the need, to verify whether there is correlation between the variables in study and which would be the linear regression line that would represent this correlation.

Finally, findings are discussed in section 4, followed by final considerations and suggestions for further researches in section 5.

4. FINDINGS AND DISCUSSION

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The data collected from MDIC website are organized in Table 1. It describes the amount in billions US$ of exports of manufactured products and basic products in the State of São Paulo from 2006 to 2016.

The exports of manufactured products have average of US$ 38.94 billion per year and standard deviation of 5.25. The exports of basic products have average of US$ 4.64 billion per year and standard deviation of 1.25.

Table 1: Brazilian annual exports of manufactured products and basic products from 2006 to 2016 in billions US$

	2006	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
Manufactured products (in billions US$)	37.7	42.1	46.5	32.91	39.23	45.06	44.04	40.73	35.71	32.45	31.81
Basics products (in billions US$)	2.82	3.55	4.58	2.94	3.97	4.6	4.77	5.22	6.63	6.08	5.85

Source: the author based on data extracted from MDIC (2017).

It notices in Figure 4 that both exportations had similar behaviors over the first five years. It also notices that both kept an increasing over the first three considered years, when they had a decline (in the case of manufactured products, the decline was over than US$ 10 billion), possibly due to the global economic crisis in 2008, the Great Recession, as it became known.

Figure 4: Behavior over the years of exports of manufactured products and basics products in the State of São Paulo
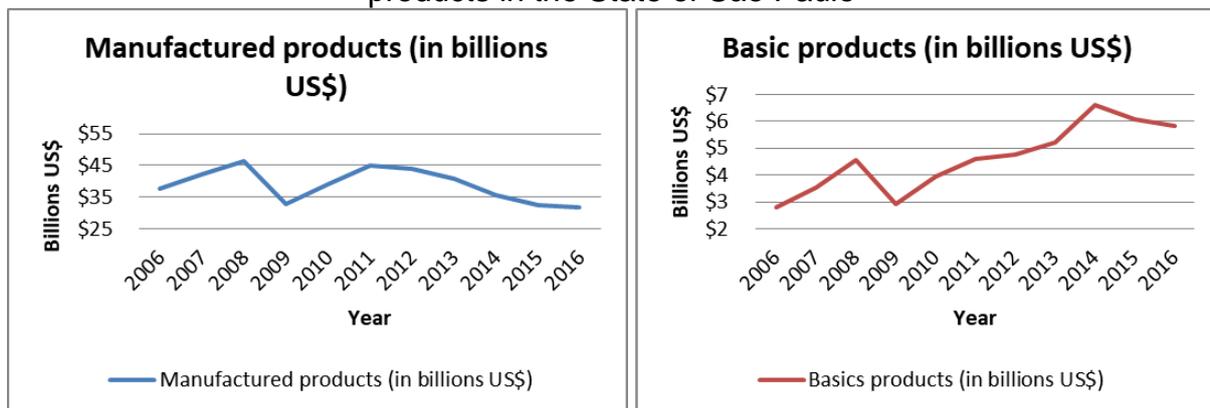

Source: the author.

Another pertinent observation is that from 2011 onwards the exports behaviors become different from each other.

Through Equation (1), Equation (2), Equation (3) and Equation (4), the findings are as follows:

Time and exports of manufactured products:

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Representative line: $y = -0.727x + 1500.9$; and r = 0.2113 (inexistent correlation). See Figure 5.

Figure 5: Manufactured products x time
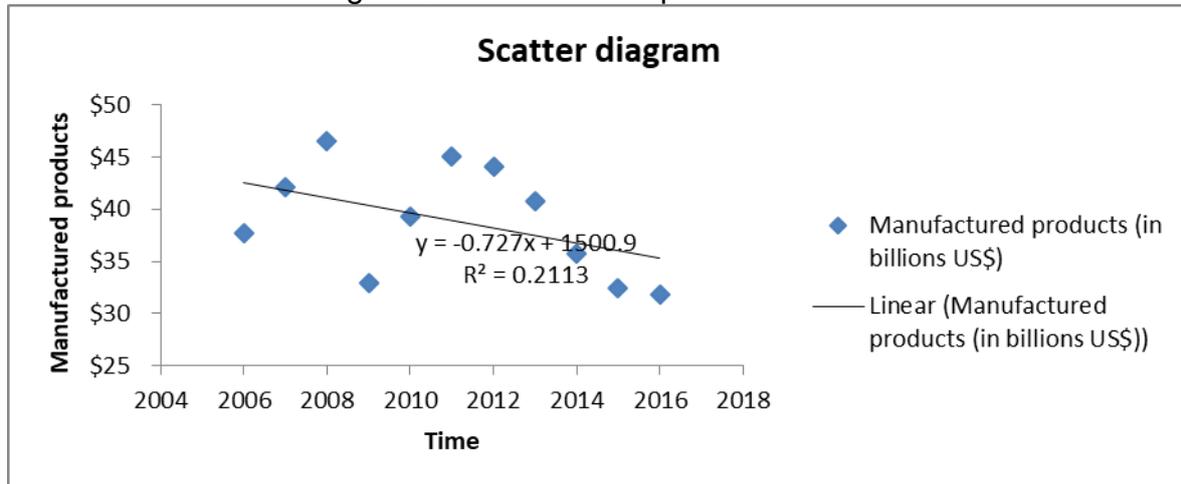
Source: the author.

Time and exports of basic products:

Representative line: $y = 0.3344x + 667.77$; and r = 0.7835 (strong correlation). See Figure 6.

Figure 6: Basics products x time
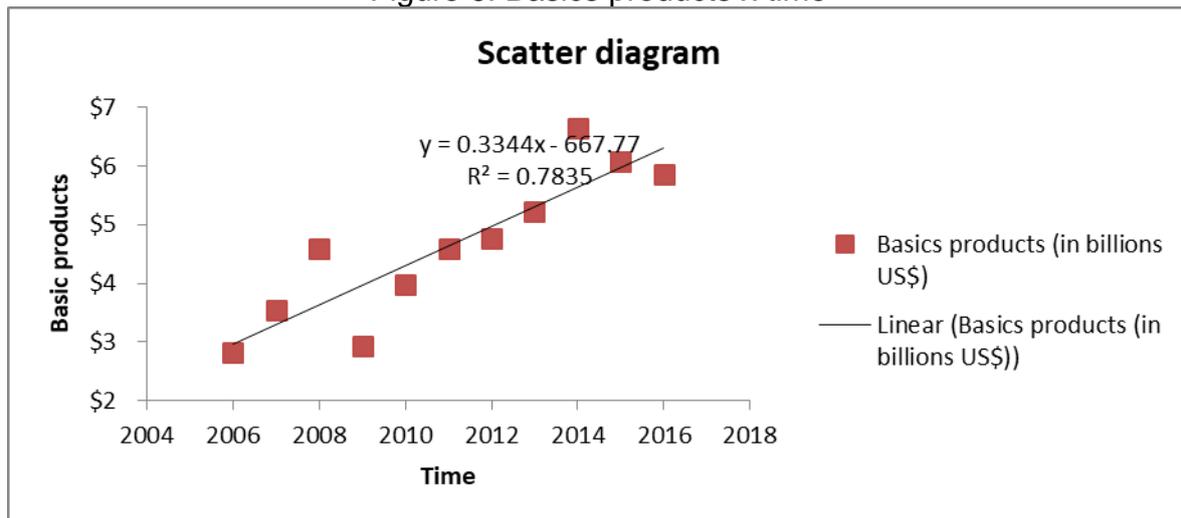
Source: the author.

Manufactured products and basic products:

Representative line: $y = -0.0528x + 6.6928$; and r = 0.0489 (inexistent correlation). See Figure 7.

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Figure 7: Basic products x manufactured products
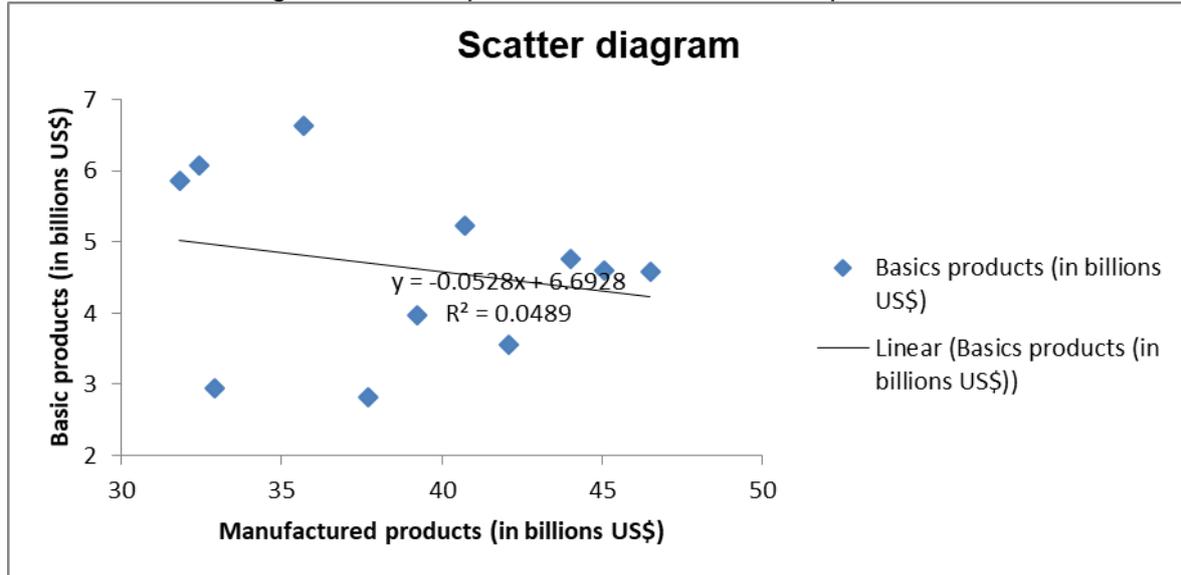
Source: the author.

Findings make possible to understand the behavior of the exportation activities and thus help in formulating decision and planning. For example, the fact of the strong correlation between basic products and time can assist in forecasting demand, and it also indicates that the quantity tends to grow over the years, if we consider the current scenario and practices. In the opposite direction the same can be seen in the others two analyzed relations. As their correlation coefficients r do not point out correlation, these relations should not be considered for formulations or decision-making, among others attitudes; which exclude possible misunderstanding of considering some correlation.

5. FINAL CONSIDERATIONS

This study aimed to verify correlation between time, exports (in billions US$) of manufactured products and basic products in the State of São Paulo, based on the adopted assumptions. As the analysis shows, there is only one strong correlation between the variables, which refers to basic products and time.

One thing to note in this strong correlation is the fact, and not so positive, that Brazil tends to continue and increase, given the growing upward trend in the calculations, its investments on and exports of inputs, still going against the general view that the good business is to product and export more and more products with high value-added.

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As for the exports of manufactured products, it seems it may be linked to economic factors. This assumption is a suggestion topic for further research.

5.1.   Suggestions for further researches

It suggests for further researches to verify whether there is correlation between exports and imports of manufactured products in the State of São Paulo, also considering factors as the economic scenario, since the time variable has shown not having correlation.

6.   ACKNOWLEDGEMENTS

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