An Empirical Analysis using Private Investments Cross Analyses Method (PICAM) and Monte Carlo Simulation to Evaluate Economic Sector Performance

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Abstract: - Empirical studies regarding the elements of private investments in developing countries, including Brazil, have demonstrated the negative impact of high inflation rates on investments, with great impacts on the innovation policies. However, the recent Brazilian experience clearly shows that stabilization, in and of itself, is not capable of recovering the investment rates and innovation strategies. Therefore, the objective of this study is to analyse the elements of the long term private investment in Brazil. The used method was an econometric cross section data model and Monte Carlo simulation, called PICAM (Private Investments Cross Analyses Methodology). This method was developed by the authors in order to contribute for a better business economic analysis. The PICAM was tested to evaluate an economic sector performance in Brazil's economy. The chosen sector was the Plastic Products Manufacturing Industry. The results have shown evidences of crowding-in effect of public investments in infrastructure over private investments stimulating growth. All the signs of the analyzed variables were obtained as presented in the therory, with the exception of the real interest rates variable (r), in which it was observed that the coefficient is positive and insignificant in the estimated equation. The results also indicated that the operating costs impacts negatively the investment decision on the studied industry, as well as a future trend of declining margins with a period of market consolidation.

Key-words: PICAM, Panel Data, Monte Carlo Simulation, Crowding in, Crowding out, Econometrics

1 Introduction

Empirical studies of private investment in developing countries, including Brazil, show the negative impact of high inflation rates, interest rates, exchange rates and international crisis on private investment and innovation policies. However, the recent Brazilian experience shows that stabilization by itself is not enough to recover investment rate and innovation strategies.

Several studies show the necessity of developing econometric models using reliable information in order to obtain further elements related to private investments in Brazil, especially since the period related to the implementation of the Real Plan until now. The econometric model is only possible by taking into account the advances in the theories regarding simulation and the national macroeconomic principles. Consequently, it is observed an interesting combination of information, simulation models and analysis that enable decision making processes, which can be seen in [8]; [18]; [16]; and [10].

This study is divided into five sections: the first is the introduction; the following section describes the literature related to investments models; third section presents the materials and the PICAM which describes the econometric model; Section 4 presents the tests results and the econometric simulation for the period 1996-2011 and Monte Carlo Simulation; lastly, the conclusions.

Thus, the objective of this article is to analyze the elements of the long term private investment in Brazil applying a panel data econometric simulation model and Monte Carlo Method.

2 Literature Review

Due to their crucial aspects, it is necessary to correctly assess the performance of investments as an agent of development and innovation. Commonly known as "determinant of private investments", this economic analyses is responsible for allocating resources for private and public organizations going through financial difficulties, with the proposal of a new conceptual approach for their strategies. It is described, in the following sections, the strategic investments and a few characteristics of Brazilian private investments and its economy.

2.1 Strategic Investments

The economic volatility environment has led to a need for gradual changes in the investments responsibilities. [2], argues that strategic investments (SI) is related to bureaucratic and administrative issues. However, the economic behavior and the constant recessions of recent years have favored the creation of a new model related to fundraising. In this case, it is up to the organizations to develop a deep understanding of the economy and its dynamics, in order to create products and new process. Recent advances in the information technology models and the urge for new financial tools, with greater proximity to organizational reality, are enabling the development of strategic investments [5].

Relating SI to economic performance is something new, especially considering the search for sector assessments focused on indicating the proper innovation products for organizations. Basic responsibilities, such as minimizing financial risks and operational costs, and maximizing innovation elements, should be responsibilities of SI [9], which is the opposite of the current operational models, which are still focused on the evaluation of cash flow, liquidity, risk analysis, payment capacity and associated information technology.

To achieve this, SI must be a department in organizations with extensive responsibilities and with connections with other areas, generating benefits for clients.

2.2 Investment Elements: a theoretic panorama

The previous section shows the importance of economic assessment, as well as the importance of organizational management of SI. Thus, the present section tries to conduct a bibliographical survey, with the objective of extracting the relevant data to execute the econometric study.

Using empirical studies, we will try to identify if there is an inhibiting factor for private investments derived from the macroeconomic instability and from governmental investments, over the course of the timeframe proposed in previous section.

The vital role of capital formation in sustainable economic growth is widely recognized. However, in Brazil and in many other developing countries the investment rates were reduced until the mid 1990's, a fact which was a result mainly of the external debt crises and of lack of inflationary control.

The gross formation of fixed capital in relation to the Brazilian GDP, measured at constant prices, had an average decrease of 23% in the 1970's, of 18.5% in the 1980's and of 15.2% in the 1990-1995 period.

In 1998 Brazil's economy felt the impacts of the so called Asian crises, and in 2008 the great international financial crises happened. Due to the deceleration of the GDP in 2011 it is quite possible that other fiscal measures will be adopted by the government, in an attempt to stimulate the level of economic activity, especially those related to the increase in credit for 2012 and the years ahead.

The econometric results obtained in other studies related to investments themes, and its elements in Brazil and in other countries are presented in Table 1. They summarize the works used as a foundation for the empirical research of this article.

The study of investment behavior, specifically in the private sector, results from the fact that this is a typically endogenous variable and from the observation that the adoption of specific economic actions in the market will increase the relative importance of private investments in the creation of aggregated capital. Particularly important

dimensions of this problem are related to measuring the effects of macroeconomic instability on the levels of investments in the private sector, and the identification of the type of relationship that exists between public investment, private investment and innovation policies.

3 Materials and Methods

A quantitative research was used not only to explain the theoretical model underlying the regression analysis, but also to test the existence of stationary and the co-integration between the used time series data. The proposed econometric model combines the use of a series of data related to economic performance - observing organization's behaviors, productive aspects and growth.

The data comprehends the time period from 1996 to 2011, this timeframe is relevant for the determination of Brazil´s sector analysis, and also to indicate for future studies.

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Table 1 shows a literature review based on the lattes studies on private investments analysis.

Table 1. Comparison of the macroeconomic variables used in Brazil and abroad

Methods and Variables	Luporini & Alves (2010)	Santos & Pires (2007)	Ferreira (2005)	Serven (2002)	Rossiter (2002)	Melo & Rodrigues Júnior (1998)	Rocha & Teixeira (1996)
Sampled country	Brazil	Brazil	Brazil	61 Countries	USA	Brazil	Brazil
OLS	X	-	X	-	-	X	X
Private investment	X	X	X	X	X	X	X
Tributes	-	X	X	-	-	-	-
Util. of Ind. Cap.	X	-	X	-	X	-	-
Credit	X	-	X	X	X	-	-
Public Investment	X	X	X	X	X	X	X
I_pb/Y (--)	-	-	-	X	-	-	-
Relative Prices of Capital Goods	-	X	X	-	-	X	X
Inflation (Uncertainty)	X	-	X	X	-	X	-
GDP	X	X	X	-	X	X	X
Cost of Capital (r)	X	-	X	X	-	X	-
Innovation Investments	-	-	-	-	-	-	-
External Debt	X	-	-	-	-	-	-
R^2	0.92092	-	0.9521	N/D	N/D	0.89	0.85
Log Variables	Yes (Except r)	Yes	Yes (Except r)	Yes (Except r)	Yes	Yes (Except r)	Yes

3.1 Econometric Model: PICAM

To explain the issue of private investments it was chosen the following variables as part of the functional form: GDP, utilization of industrial capacity, public investments in infrastructure, public investments in non-infrastructural areas, public investments in innovation, real interest rates, relative prices of capital goods, inflation, a credit availability proxy, tax burden, external restrictions and exchange rates. [21] used some of the variable to study Region Economic Performance.

The GDP and the utilization of industrial capacity are commonly used factors when specifying equations for level investments, as they reflect the demand conditions of the economy and are used to measure the accelerating effect of investment and possible economic cycles. Typically pro-cyclic economies, such as the ones in developing countries, tend to show a strong correlation between private investments and the variables related to demand [24].

To measure the impact of public investments on private investments we used public investments in a disaggregated form, separating public investments in infrastructure from the investments in electric energy, telecommunications and transportation. All other public investments are considered as non-infrastructural. It is crucial to verify if there is empirical evidence of the crowding-in theoretical effect of public investments in infrastructure over Brazil's private investments, and if not, does the expected crowding-out effect occur [22].

The possible crowding-in effect of public over private investments in infrastructure is theoretically explained by the fact that such investments increase the productivity of capital for future investments and consequently innovation, and save private investors from additional investments they would otherwise have to make in these areas. As for the crowding-out effects of non-infrastructural public investments, these can be theoretically explained by the competition between them for scarce resources available for investments [23]; [24].

A frequently used variable to explain private investments is the real interest rate, the first theoretic proxy of the cost of capital opportunity. This justifies the choice of this variable as a pre-candidate to compose the final functional form.

The relative price of capital goods is also a key-variable in investment decisions, because it directly affects the cost of capital opportunity. It can assess the effects of low competition in the industry of capital goods that result in increasing the prices of these goods above the prices practiced in the rest of the economy, which would negatively impact investments.

Inflation is a commonly used variable as a proxy for uncertainties in the economies of developing countries.

A proxy variable for the availability of credit in the economy is also commonly used in investment studies, especially in developing countries, in which credit access is very limited. Obtaining credit or not is, in many projects, a key-element for the impact of credit itself. Thus, the availability of credit should also be taken into account as a pre-candidate variable. We considered the volume of annual disbursements of the BNDES as a proxy for credit availability in Brazil.

The total tax burden (as a percentage of the GDP) should be used as a possible explanatory variable for private investments. Very few empirical articles use this variable, but in the Brazilian case it may be quite relevant, especially with the significant increase of taxes over the last few years. The motivation for using this variable is due to the fact that economic agents of the public and private sectors have been complaining about the excessiveness of Brazilian taxes as being one of the major obstacles for private investments.

As for external influences, several indicators were used on the empirical work, such as deviation of products from their long term trends, the volatility of the stock exchange, the variability of inflation rates and/or of the exchange rates in relation to the debt/GDP, with negative results for private investments [3]; [20]; [13]; [11] and [17].

And finally, [3] uses the relationship between external debt and exports to investigate the effects of external conditions on private investments in Brazil, and in other Latin American countries, confirming the negative results already uncovered in other studies. [13] investigated the relationship between exchange rates and private investments. The results indicate that the exchange rates affected negatively and significantly private investments over the analyzed timeframe, which was from 1956 to 1996.

Taking Table 1 into consideration, we propose the following generic Private Investments Cross Analyses Model (PICAM):

$$Invest\_priv = f(Y,UCAP,Invest\_pub\_infra,Invest\_pub\_não\_infra,I,r,P\_rel\_bens\_k,IGP\text{-}DI,\ Emprest\_BNDES,t,EE,E) \quad (1)$$

In which:

Invest_priv = *strictu sensu* gross investment of the private sector (excludes state organizations);
Y = Real Gross Domestic Product;
UCAP = average utilization of the industrial capacity;
Invest_pub_infra = public investments in infrastructure;
Invest_pub_não_infra = non-infrastructural public investments;
I = innovation public investments;
r = real interest rate;
P_rel_bens_k = relative prices of capital goods;
IGP-DI = Inflation
Emprest_BNDES = Real disembursement of the BNDES;
T = Tax burden as a percentage of the GDP;
EE = External restriction, using as a proxy the series Debt Service/GDP (%);
E = Real exchange rate;
Dummy = control variable for times of international crises

Based on this expression, we estimate the following econometric equation for the 1996-2011 timeframe, with expresses variables in natural logarithms (except for the real interest rates variable), in order to directly obtain the elasticity of the variables:

$$LInvest\_priv_t = \beta_0 + \beta_1 LY_t + \beta_2 LUCAP + \beta_3 LInvest\_pub\_infra + \beta_4 LInvest\_pub\_não\_infra + \beta_5 I + \beta_6 r + \beta_7 LP\_rel\_bens\_k + \beta_8 LEmprest\_BNDES + \beta_9 LT + \beta_{10} EE + \beta_{11} LnE + \beta_{12} D1 + \varepsilon_t \quad (2)$$

In which ε_t is a random disturbance.

In conformity with the model of the investment accelerator, we expect that the increased GDP will generate an increase in private investments, because increased production requires more investments and innovation processes. The effect of the interest rate is negative and reflects the adverse impact of the cost of capital utilization over investment decisions. Used as a proxy for uncertainty and instability, we expect that the elevation in the inflation rates will decrease investments in the private sector; here the implicit hypothesis is that instability increases the *waiting price* for new information and increases business risks. The relationship between the Private Investment and Public Investment variables is ambiguous, because both crowding-in and crowding-out can predominate between the two types of investment.
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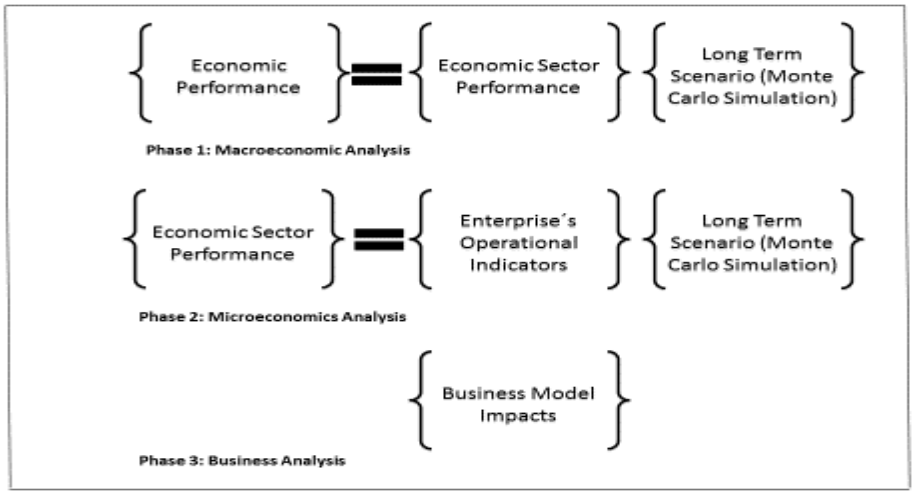
The extended PICAM is presented in the Figure 1, which shows initially an evaluation of macroeconomic analysis based on economic sector performance followed by the long-term scenario analysis using Monte Carlo Simulation. The second phase is to evaluate microeconomic economic variables with economic sector performance followed by long-term scenario analysis using Monte Carlo Simulation. Finally, the third phase analyses the impact on the enterprises' business model.

It is important to observe that there are no other studies to compare results with PICAM due to its inedited and unpublished method of analysis.



The PICAM model was applied on phase 1 and 2 with the objective of testing macro and microeconomic data that affects private investment of plastic industry in Brazil. The used data was

obtained from IBGE (Brazilian Institute of Statistics and Geography) available in the Annual Industrial Research and indicated by sector through CNAE (National Activities Economic Classification) for the period 1996 to 2011. Table 2 represents the observed sectors.

Table 2. Brazilian Plastic Industrial Manufacturing Sectors

25.2	Plastic Products Manufacturing
25.21	Flat Laminated and Tubular Plastic Manufacturing
25.22	Plastic packaging manufacturing
25.29	Manufacture of various plastic articles (includes plastic for use in construction)

Taken into consideration Equation 1 we model the following econometric equation:

Invest_priv = f(VBPI, COP, RLV, r, Y, Invest_Pub_infra, Invest_Pub_non_infra, E) (3)

where:

Invest_priv = *strictu sensu* gross investment of the private sector (excludes state organizations);
VBPI=Industrial Gross Product Value
COP = Operational Cost
RLV=Sales Net Revenue
Y = Real Gross Domestic Product;
Invest_pub_infra = public investments in infrastructure;
Invest_pub_non_infra = non-infrastructural public investments;
r = real interest rate;
E = Real Exchange rate;

Based on Equation 3 we propose a logarithm econometric model for private investment for period 1996-2014:

$$LogInvest\_priv_t = \beta_0 + \beta_1 LogVBPI + \beta_2 LogCOP_{it} + \beta_3 LogRLV_{it} + \beta_4 R_{it} + \beta_5 LogPIB_{it} + \beta_6 LogINVPUBINFRA_{it} + \beta_7 LogINVPUBNINFRA_{it} + Log_8 E + \varepsilon_t \quad (3)$$

After testing for Equation 3 the next steps will be:

- Analyze the results of the fixed effects coefficients;

- Analyze the cross-section results of Plastic Products Manufacturing private investment with respect to Flat Laminated and Tubular Plastic Manufacturing, Subsector Plastic packaging manufacturing and subsector Manufacture of various plastic articles (includes plastic for use in construction).

- Analyze the cross-section results of Flat Laminated and Tubular Plastic Manufacturing private investment with respect to Subsector Plastic packaging manufacturing and subsector Manufacture of various plastic articles (includes plastic for use in construction).

- Finally, analyze the future scenarios of private investment for Plastic Products Manufacturing, Flat Laminated and Tubular Plastic Manufacturing, Subsector Plastic packaging manufacturing and subsector Manufacture of various plastic articles (includes plastic for use in construction).

The decision to use the Plastic Industrial Manufacturing Sectors, to test the PICAM, was based on the fact that this sector has a large number of small and medium enterprises. According to [7] SMEs are indispensable in all economies, can be described as a driving force of business, growth, innovation, competitiveness, and are also very important employer.

Table 3 presents a summary of the pre-candidate variables used to explain private investments in Brazil, in annual series since 1996 and what are the theoretic expected signals.

The obtained data was used to simulate the long term macroeconomic perspectives using the Monte

Carlo method for the 2011-2017 annually period with the RiskSim system for the scenarios and risk evaluation. According to [19] the model simulation enables the authors to determine in what production process situations the fulfillment of the goals are threatened for a particular process.

Table 3. Pre-candidate variables for Private Investment

Pre-candidate variable	**Expected signal**
Real GDP	Positive
Average utilization of industrial capacity	Positive
Public investments in infrastructure	Positive
Non-infrastructural investments	Negative
Innovation public investments	Negative
Real interest rates	Negative
Relative prices of capital goods	Negative
Inflation	Negative
Real disbursements of the BNDES	Positive
Tax burden as a percentage of the GDP	Negative
External restrictions	Negative
Real exchange rates	Negative

4 Results

For the econometric analysis all variables, with the exception of the real interest rates variable, were log-linearized using the natural logarithm, and the remaining series were calculated using the fixed prices of 1995. Because the series used in the estimations of the investment equations are temporal series, we presume that these series are random variables ordered over time. The usual methods of estimation and inference presume that these variables are stationary. The non-stationary of a stochastic process is due to the existence of a unit root or a stochastic trend in the auto-regressive process (AR), which generates the presence (or absence) of stationary in the variables used in the estimations.

4.1 Stationary tests

Initially the series were subjected to augmented Dickey and Fuller (ADF) unit root tests [4], in level and in first difference. The ADF test is well known and will be described in this section (see [6]). It should be remembered that the test statistic is similar to the t-student test.

The aim of the tests is to show statistical evidence of the integration order of the variables and are, in fact, pre-tests for co-integration, since theoretically only variables with the same integration order can co-integrate.

According to [12], the null hypothesis is that $\alpha=0$, in which α is the coefficient associated to the first lag range of the series, which enters as a regressor AR(p) for the first difference of the hypothesis. The criterion of rejection indicates rejecting H_0 if $|ADF|>VC$, in which VC is the critical value of the distribution. As in the case of the existence of a unit root, the asymptotic distribution of t is not the same if the series is stationary (in this case the i of student). The correct choice of lags is important, as they can influence the performance of the tests. What we did was choose a number which was sufficient to eliminate any possible serial correlation of residues. The choice was made by minimizing information criteria.

The econometric issues associated with unit root and stationarity tests can be understood by considering a stylized trend-cycle decomposition of a time series y_t:

$y_t = TD_t + z_t$
$TD_t = \kappa + \delta_t$
$z_t = \varphi z_{t-1} + \varepsilon_t, \varepsilon_t \sim WN(0, \sigma^2)$

where TD_t is a deterministic linear trend and z_t is an AR(1) process. If $|\varphi| < 1$ then y_t is I(0) about the deterministic trend TD_t. If $\varphi = 1$, then $z_t = z_{t-1} + \epsilon_t = z_0 + \sum_{j=1}^{t} \varepsilon_j$, a stochastic trend and y_t is I(1) with drift. Autoregressive unit root tests are based on testing the null hypothesis that $\varphi = 1$ (difference stationary) against the alternative hypothesis that $\varphi < 1$ (trend stationary). They are called unit root tests because under the null hypothesis the autoregressive polynomial of z_t, $\varphi(z) = (1 - \varphi z) = 0$, has a root equal to unity. Stationarity tests take the null hypothesis that y_t is trend stationary. If y_t is then first differenced it becomes:

$\Delta y_t = \delta + \Delta z_t$
$\Delta zt = \varphi \Delta z_{t-1} + \varepsilon_t - \varepsilon_{t-1}$

Table 4 bellow summarizes the results of the stationary tests. For the timeframe being analyzed the results of the tests favor the hypothesis of a unit root and also indicate that the series contains a stochastic trend.

The unit root tests for the selected on level variables do not reject the possibility of the existence of a unit root in all cases at a 1% level, the only rejection occurred in the LnIGP-DI variable. In other words, there are no statistical evidences that the variables are I(0). The analyses of the results indicates that the series for private investments (LnInv_Priv), GDP (LnY), utilization of industrial capacity (LnUCAP), public investments (LnInv_Pub_infra and LnInv_Pub_ninfra), innovation public investments (Ln_I), real interest rates (R), relative prices of capital goods (P_rel_bens_k), loans from the BNDES (LnEmp_BNDES) and taxation (LnT), may all be considered stationary.

Based on this, there is statistical evidence that the variables in question can be treated as I(1), and that regressions without their levels (log on level, in the case of the specification used here) are possible and will not present dubious results, as long as the conditions of co-integration are verified. The theory suggests the possibility of a trend, besides the constant, for the formulations of the unit root tests for the GDP and investments, and that was properly considered.

Considering the other level of significances, we observed that there were rejections for the variables: LY for 5% and 10%, LnUCAP for 10%, LnEmp_BNDES for 5 and 10%, and LnIGP-DI for 1%, 5% and 10%. A possible explanation for this fact is that the stationarity tests are susceptible to the specification and the measure unit of the variables, which creates difficulties for the analysis of results. Furthermore, the unreliability of the tests makes it difficult to discriminate stochastic series with high dependencies. The real exchange rate (LnE) can be considered stationary with the ADF of -2.6534 with the rejection of the null hypothesis at a 10% level of significance. For the EE variable we have an ADF, in level, of -2.2719 with an integration order I(1).

Given these characteristics, the investment equations were estimated by means of the Ordinary Least Squares methodology. Some of the studies of investment determinants presented in literature use the co-integration technique by means of a system of auto-regressive vectors (VAR). The estimator of Ordinary Least Squares is one of the few estimators whose properties are solidly established in specialized literature.

Table 4. Results of the stationarity tests for the pre-candidate variables in the private investments model using annual data from 1996-2011

Variables	t-ADF	Critical value test 1% significance	Critical value test 5% significance	Critical value test 10% significance	p-value
On level variables					
LnInv_Priv	- 1,874	- 4,0579	- 3,1199	- 2,7011	0,332
LnY	- 3,433	- 3,9591	- 3,0810	- 2,6813	0,026
LnUCAP	- 2,342	- 3,9591	- 3,0810	- 2,6813	0,172
LnInv_Pub_infra	- 1,169	- 3,9591	- 3,0810	- 2,6813	0,658
LnInv_Pub_ninfra	- 0,771	- 3,9591	- 3,0810	- 2,6813	0,797
LnI	- 0,684	- 3,9591	- 3,0810	- 2,6813	0,588

R	- 1,842	- 3,9591	- 3,0810	- 2,6813	0,347
LnP_rel_bens_k	- 1,206	- 3,9591	- 3,0810	- 2,6813	0,642
LnIGP-DI	- 5,265	- 4,2000	- 3,1753	- 2,7289	0,002
LnEmp_BNDES	- 3,982	- 4,0044	- 3,0988	- 2,6904	0,010
LnT	- 2,062	- 4,0579	- 3,1199	- 2,7011	0,260
First difference variables					
DLnInv_Priv	- 1,874	- 4,0579	- 3,1199	- 2,7011	0,087
DLY	- 3,433	- 3,9591	- 3,0810	- 2,6813	0,004
DLnUCAP	- 2,342	- 3,9591	- 3,0810	- 2,6813	0,035
DLnInv_Pub_infra	- 1,169	- 3,9591	- 3,0810	- 2,6813	0,263
DLnInv_Pub_ninfra	- 0,771	- 3,9591	- 3,0810	- 2,6813	0,454
DLnI	- 0,631	- 3,9591	- 3,0810	- 2,6813	0,454
Dr	- 1,842	- 3,9591	- 3,0810	- 2,6813	0,088
DP_rel_bens_k	- 1,206	- 3,9591	- 3,0810	- 2,6813	0,249
DLnIGP-DI	- 5,265	- 4,2000	- 3,1753	- 2,7289	0,000
DLnEmp_BNDES	- 3,982	- 4,0044	- 3,0988	- 2,6904	0,001
DLnT	- 2,062	- 4,0579	- 3,1199	- 2,7011	0,069

Source: Elaborated by the authors

For the unit root tests of the selected variables in first difference we observed that the results repeat themselves, as they do not reject the possibility of the existence of a unit root in all of the cases at a level of 1%, the only rejection occurred in the DLnIGP-DI variable. In other words, there are no statistical evidences that the variables are I(0).

4.2 Final functional form for annual data related to 1996-2011

Table 5 bellow shows a summary of the pre-candidate variables used to explain private investments in Brazil, in annual series from 1996 onwards, and the expected signals for the relationship between each one of them and private investments.

Contrary to the study performed by [12], this analysis opted for including the variables that assesses uncertainties (LnIGP-DI), which was also confirmed by the stationarity tests, and also for the total tax burden variable (LnT).

Furthermore, our analysis specified a dynamic model, including the lag in the private investment variable (DLnInv_Priv(-1)), because by using contemporaneous variables the model would present problems with the auto-correlation of residues. The first lag of the private investment variable is commonly used in several studies, due to the fact that some investments cannot be completed in only one year, which explains the use of this variable to assess the inertia effect on investments.

In the first equation estimated we inserted a control variable for times of political instability, represented by a dummy (D1), which assumes unitary values for the years of 1997 (Asian Crises), 1998 (Russian Crises), 1999 (Argentinean Crises and the Brazilian Currency Devaluation) and 2008 (World Financial Crises).

Overall the model presented a satisfactory explanatory rate (R^2 = 0.95), which is a result coherent with the majority of the studies shown in Table 1. One can also observe the importance of the irreversibility of the investment, reflected in the coefficient of the first lag of private investment, which was positive and significant, indicating that current investments depend on their past values.

This evidence indicates the existence of lags in the decision making process and in the implementation of private investments, and suggests that current investments not only reflect partial adjustments of current capital to desired levels, but also tend to happen in an accumulated manner or clustered in time (lumpiness).

Table 5 shows the signs found for the estimated coefficients were positive, statistically significant and are in accordance with the economic theory, which indicates income increase (LnY) and increase in economic activity (LnUCAP), encouraging and increasing private and innovation investments in the country. In the case of the utilization of industrial capacity (LnUCAP) we observed the extremely pro-cyclic characteristic of the Brazilian economy, with a high and positive coefficient (2.86).

This result is compatible with the majority of the existing empirical studies concerning the determinants of investments in Brazil and in other developing countries, where the variables used to assess the conditions of demand were also significant and relevant in the estimated models.

The results show empirical evidence of the crowding-in effect on public investments in infrastructure (LnInv_Pub_infra) over private investments, a positive sign. This means that a stimulus of 1% in public investments for infrastructure will result in a 0.113% increase in private investments.

As for non-infrastructural public investments (LnInv_Pub_ninfra) the sign obtained is also correct (negative), which suggests that the impact of the crowding-out effect dislocates private investments. This means that a stimulus of 1% in non-infrastructural public investments will result in a 0.0741% decrease in private investments.

Table 5. Private investment determinants

Ordinary Least Squares - Dependent Variables: Private Investment (1996-2011)

Explanatory Variables	Coefficients	Expected signal	Obtained signal
Constant	- 9.3598 (-6.0383) [0,0000]	Negative	Negative
DLogInv_Priv(-1)	0.4876 (3.76613) [0.0009]	Positive	Positive
LogY	0.510 (1.8263) [0.0697]	Positive	Positive
LogUCAP	2.866 (9.7258) [0.0000]	Positive	Positive
LogInv_Pub_infra	0.113 (7.3445) [0.0000]	Positive	Positive
LogInv_Pub_ninfra	-0.0741 (-8.0360) [0.0000]	Negative	Negative
LogI	-0.0630 (-0.4739) [0.0000]	Negative	Negative
R	(-8.0360) [0.0000] [0.0527]		
LogP_rel_bens_k	-1.3593 (-9.8211) 0.0000	Negative	Negative
LogIGP-DI	-0.0474 (0.0522) [0.0000]	Negative	Negative
LogEmp_BNES	0.1705 (9.791057) [0.0000]	Positive	Positive
LogT	- 1.1800 (0.008) [0.0000]	Negative	Negative

LogE	-0.09251 (-2.19204) [0.03720]	Negative	Negative
Dummy 1	-6.45 (-3.0061) [0.9951]	Negative	Negative
R^2	0.956458	Log Likelihood	338.5426
Adjusted R^2	0.953631	Statistic F	338.2824
DW	2.59	Prob(F)	0.0000
F Statistics	49.4189	Teste LM(2)	0.18582
Hausman-Wu(3)	0.4360		

Source: Elaborated by the authors

Note: (1) t-statistic in parentheses, corrected for heteroscedasticity and autocorrelation by Newey-West, p-values in brackets; (2) Breusch- Godfrey test for serial correlation. P-values for the null hypothesis of no autocorrelation; (3) endogeneity test of Hausman-Wu. P-values for significance waste obtained by regression auxiliary DlnY against the regressors and instruments. No significant residues indicate consistency of the OLS estimator.

However, the theory suggests that after the initial perverse effect of the competition for resources between private and non-infrastructural public investments, it is reasonable to suppose that these investments can also contribute (even if just a little, when compared to the infrastructural investments) to increase the productivity of private capital to be invested in the future (public investments in education, health, housing, innovation etc.).

In the case of the real interest rates variable (r) we observed that the coefficient is positive and non-significant in the estimated equation. Although the estimated coefficient signal goes against what was theoretically expected, the coefficient is numerically very close to zero (and non-significant), which indicates that this proxy for capital use costs did not contribute to reduce private investments. This evidence was also found by [14] and [10], who also estimated equations using macro-economic data for the 1972-1996 and 1970-2005 timeframes, respectively.

Although capital cost is theoretically important for the determination of the investment, the difficulty to obtain significant coefficients with negative signs for this variable is widely spread in specialized literature. In the Brazilian case, especially, cost capital coefficients so close to zero can be explained, on one hand, by the organizational tradition of not seeking external financing for the company, and on the other hand, by the volatility of the interest rates during periods with high inflation, which made interest rates a negligible reference for calculating the opportunity costs of investments.

Literature also indicates that if interest rates rise and if competition for limited resources increases this will result in the dominance of the crowding-out effect over the crowding-in effect. This can be partially explained by the progressive deterioration of the Brazilian's government capacity to invest in infrastructure and innovation effectively, because it is the type of public spending that presents the most evident complementarities with private inversions.

Results indicate that an increase in the offer of credit (LnEmp_BNES), by means of elevating credit operations aimed at the private sector, will increase private investment in the subsequent years, which confirms the hypothesis that Brazilian organizations face credit restrictions. The results obtained are consistent with the studies performed by [1], [19] and [13], which include financial variables in their empirical studies and indicate that credit availability is one of the relevant variables for private investments in developing countries.

The uncertainties caused by international crisis (assessed by the Dummy 1 "International Crisis" variable) were also relevant in the determination of investments in Brazil, and the negative coefficient obtained indicates that in times of international economic crisis private investments decrease. Thus, the implementation of responsible and consistent policies over the course of time is crucial to minimize economic uncertainties and to encourage private investments in the country.

We investigated the impact of external conditions on private investments in Brazil, using the External restriction variable (EE), having as a proxy the series Debts of Service/GDP (%). As for external conditions, we suggest that external debts

of service did not affect private investments in a significant way during the analyzed timeframe. In fact, the effect of this variable was insignificant in the model and thus, was not included in the final model. One possible explanation for this result is the participation of the public sector in obtaining resources during periods of external crisis, acting as a guarantor for loans contracted by the private sector, and financing investments during periods of external restrictions, and even encouraging the improvement of conditions for external financing.

Finally, the estimated coefficient for exchange rates (LnE), in Table 5, was significant and presented a negative sign, indicating that increased (or devalued) exchange rates do not encourage imports of capital goods, and consequently reduces economic investments. This result is confirmed by [13], who obtained results indicating that the first difference of exchange rates has a significant and negative effect over private investments in Brazil.

This session also analyzes the long-term scenarios for the Brazilian economy using the Monte Carlo Simulation method for 2011-2017 period, as shown by Table 6. It is important to notice that no other paper has published a Monte Carlo long-term analysis in the way that this paper has done. Therefore, we are unable to compare with previous methods. Table 6 summarizes such results in which the method evaluates the variable behavior as well the probability to happen the event, according to a 95% confidence interval. The results have shown that the variable credit has a maximum possible value of R$ 61 billions with a risk of R$ 510,000.00. The minimum possible value is R$ 20 billions with a risk of R$ 25,000.00. The analysis comprehends the rest of the variables.

Variable IGP-DI represents the inflation rate, which can go up to 3.19% a year. As for private investments the amount can go up to R$ 212,977.04 and with a minimum of R$ 135,191.27. In terms of public investment, it is observed a possibility of a small amount of money if compared to the private sector. That is private sector can take public investment's place.

Table 6. Monte Carlo Simulation (2012 – 2017)

Variables	Max	Risk	Min	Risk
Credit (R$ Billions)	61,622.47	0.51	20,161.70	0.3
IGP-DI	3.19	0.29	0.31	0.25
Private Investments (R$ Billions)	212,977.04	0.41	135,191.27	0.4
Public Investments in Infrastructure (R$ Billions)	57,192.54	0.33	17,985.20	0.28
Relative prices of capital goods	1.06	0.25	0.38	0.31
GDP (R$Trillions)	3,548704.97	0.33	1,378306.27	0.63
Real Interest Rate	33.51	0.92	9.29	0.74
UCAP	87.48	0.27	80.20	0.57
External Restriction	14.10	0.39	0	0
Real Exchange Rate	3.95	0.39	1.71	0.37

Because of changes in economic scenarios, organizational services may need considerable transformations from product commerce to creation of new products to attend customer satisfaction needs. It seems that in the period of 2011-2017 many businesses will have to adapt to a SI more agile with innovation.

As so, there are considered the following aspects: (a) Changes in economic environment: various changes in financial regulation, fiscal, and social demands for lower interest rates have created a distinctive business environment if compared to previous decades. These variables are imposing a new place for the SI with optimization in given services and an operational long term strategy; (b) New business model: The organizations will need to formulate new financial policies given the market instability and increasing risk investment decision making; (c) Connectivity: Financial services will need to be more connected and integrated to financial institutions, with more economic information access, market data and its operational sectors; (d) Technology: New media mechanisms are proportioning changes in the consumer behavior and businesses. It is necessary an increase in research findings creating a rethinking about businesses structure and its performance.

4.3 Macroeconomic and Microeconomic Analysis using Cross Section Model.

It is important to observe that from sections 4.3 to 4.7 show results originated from a method in which, due to be inedited and unpublished, there isn´t another study to compare results.

The results in Table 7 indicated that variables LnVBPI, LnCOP and LnRLV were relevant to explain private investment. The real interest rate (R) showed a negative signal and is expected by the general economic theory.

The importance of the relationship between LnVBPI, LnCOP and LnRLV on private investment is confirmed in the Equation 1.

The results show that increases in LnVBPI increase investments in the following periods. In the case of operational costs results indicate a negative relationship which states that if there is a 1% increase in operational costs lead to a reduction in private investment of 0.80%.

The importance of the relationship between LnVBPI, LnCOP and LnRLV on private investment is confirmed in the Equation 1.

This behavior is maintained throughout the tested equations. For the variable net sales revenue, it is observed a positive relationship for all the tested equations. The analyzed model showed an overall satisfactory degree of explicability with $R^2 = 0.99$.

The impact of interest rate (LnR) is tested in Equation 2. The results have shown a negative coefficient. This indicates the negative effect of interest rates on Plastics Product Manufacturing investment volume, despite the low statistical significance. The interest rate negative impact appears along the other analyzed equations. Equation 3 shows a positive relationship of GDP on private investment. Equations 2 and 3 had an overall satisfactory degree of explicability with $R^2 = 0.99$.

Table 7: Sectorial Investment Equations

Variáveis Explicativas(1)	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7
C	1.1367	-2.9826	-5.1585	2.1306	4.4944	13.003	29.78
	[1.3262]	[-3.572]	[-1.256]	[0.5639]	[0.5871]	[3.5914]	3.2543
	(0.1898)	(0.0007)	(0.2139)	(0.5750)	(0.5594)	(0.0007)	0.002
LogVBPI	3.9304	1.7735	2.0158	0.4446	0.8701	2.6069	2.8445
	[1.5213]	[0.6742]	[0.7112]	[0.1781]	[0.3236]	[1.0717]	[1.1709]
	(0.1334)	(0.5028)	(0.4798)	(0.8593)	(0.7474)	(0.2885)	(0.2467)
LogRLV	2.2634	0.5546	0.7758	0.6462	1.0524	2.8681	3.1070
	[0.9027]	[0.2168]	[0.2809]	[0.2694]	[0.4075]	[1.2188]	[1.3212]
	(0.3703)	(0.8291)	(0.7797)	(0.7886)	(0.6852)	(0.2281)	(0.1920)
LogCOP	-0.8017	-0.2407	-0.2676	-0.8081	-0.8288	-0.7510	-0.7517
	[-2.593]	[-0.724]	[-0.787]	[-2.112]	[-2.1073]	[-2.157]	[-2.179]
	(0.0119)	(0.4716)	(0.4342)	(0.0390)	(0.0396)	(0.0353)	(0.0337)
R		-0.0294	-0.0326	-0.0264	-0.0256	-0.0194	-0.0185
		[-5.233]	[-4.238]	[-4.014]	[-3.6027]	[-3.131]	-2.9809
		(0.0000)	(0.0001)	(0.0002)	(0.0007)	(0.0028)	0.0043
LogPIB			0.1624	0.5853	0.7768	8.8016	8.5580
			[0.5368]	[1.9599]	[1.2763]	[4.1285]	4.0281
			(0.5934)	(0.0549)	(0.2071)	(0.0001)	0.0002
LogInvpubinfra				0.3783	0.3873	0.0722	0.06598
				[4.8710]	[4.8037]	[0.6933]	0.64064
				(0.0000)	(0.0000)	(0.4910)	0.5245
LogInvpubninfra					0.0191	0.1139	0.0825
					[0.3497]	[2.1782]	1.3959
					(0.7278)	(0.0337)	0.1684.
LogT						-6.2561	-6.281
						[-3.924]	-3.9812
						(0.0002)	0.0002
Loge							-0.0981
							[-1.083]
							(0.2832)
R^2	0.9982	0.99803	0.9979	0.9988	0.9988	0.9994	0.9994
Adjusted R^2	0.9981	0.99789	0.9977	0.9987	0.9986	0.9993	0.9994
S.E.R.	0.3446	0.3069	0.9979	0.2623	0.2629	0.2486	0.2496
DW stat	0.8779	1.0199	1.0592	1.4624	1.4560	1.4668	1.5795
F Statistics	50.461	49.871	41.688	41.657	55.4933	48.082	52.222
Teste LM(2)	0.1758	0.1389	0.1733	0.1723	0.1273	0.1403	0.0167
Hausman-Wu(3)	0.38991	0.89120	0.40605	0.40440	0.23480	0.44195	0.78440

Note: (1) t-statistic in parentheses, corrected for heteroscedasticity and autocorrelation by Newey-West, p-values in brackets; (2) Breusch- Godfrey test for serial correlation. P-values for the null hypothesis of no autocorrelation; (3) endogeneity test of Hausman-Wu. P-values for significance waste obtained by regression auxiliary DlnY against the regressors and instruments. No significant residues indicate consistency of the OLS estimator.

The impact of public investment on infrastructure (LogINVPUBINFRA) on private investment is tested in Equation 4. The coefficient on public investment in infrastructure was not significant, despite the positive sign, indicating that public investment tends to complement private investment. This happens because the sector invest their own resources in transport and energy infrastructure. Equation 4 shows an overall satisfactory degree of explicability with $R^2 = 0.99$.

The estimated coefficient for taxes (LnT) was negative, suggesting that the increase in taxation discourages investment level in the industry. The model analyzed in EQ. 6 presented a general satisfactory degree of explicability with R2 = 0.99.

Finally, Equation. 7, was inserted the variable exchange rate in which such variable was negative, suggesting that a more depreciated exchange rate discourages the import of capital goods, at least in the short term and increases the financial commitments of indebted companies externally.

4.4 Coefficient Fixed Effects Results

To assess the specificities of each sector, estimated the magnitude of sector's coefficients fixed effects. Each estimated sector coefficient corresponds to the pure effect of each sector, that is, the average investment difference from a given sector, the annual average for the sector, which is not due to changes in the dependent variables. Thus, the coefficient represents the investment that is related to factors specific to each subsector of Plastic Products Manufacture, independent of the variables included in the model.

Table 8 shows the sectorial coefficients found. It is noted that the signs of the coefficients vary according to the sectors, and exhibit different magnitudes between sectors and between models. The sectors with positive coefficients performed relatively higher investments to other sectors in the period in question, regardless of changes in the explanatory variables considered in the model.

Table 8: Sectorial Fixed Effects Coefficients

Sectors	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7
25.21(1)	4.5624	1.4027	6.0307	1.0264	6.0967	35.688	36.190
25.22(2)	5.0690	1.7488	4.8357	2.1562	7.2708	36.704	37.231
25.29(3)	4.9439	1.5540	4.5865	2.6497	7.7824	37.042	37.581

(1) Flat Laminated and Tubular Plastic Manufacturing – 25.21
(2) Plastic packaging manufacturing – 25.22
(3) Manufacture of various plastic articles (includes plastic for use in construction) – 25.29

The results presented in Table 8 indicate that the subsectors with more specificities tend to have higher sectorial coefficients, indicating that invest according to factors other than those provided in empirical models. This situation can be observed by subsector Plastic Packaging Manufacture according to Equations 1 and 2. The Flat Laminated and Tubular Plastic Manufacturing had the best behavior for the EQ. 3. Finally, the subsector Manufacture of various plastic articles (includes plastic for use in construction) showed better behavior in Equations 4, 5, 6 and 7.

It is observed that the intensity varies with the inclusion of variables in the tested econometric equations. In other words, the sector Plastic Products Manufacture of Brazilian industry showed reduced sectorial coefficients, very close to zero, the various models estimated invest relatively more in line with the changes in the explanatory variables, that is, have few specific effects and are relatively well represented by the estimated models.

4.5 Private Investment Cross-Section for Plastic Products Manufacturing, Subsector Flat Laminated and Tubular Plastic Manufacturing, Subsector Plastic packaging manufacturing and subsector Manufacture of various plastic articles (includes plastic for use in construction).

This session aims to evaluate the behavior of private investment between Plastic Product Manufacturing industry, Flat Laminates Manufacturing Subsector and Tubular Plastics, the subsector of Plastic Packaging Manufacturing subsector and Plastics Artifacts. Equations were generated based on the results obtained in Table 9.

In other words, Equation 1 consists of Gross Value Industrial Production, Operational Costs and Net Sales Revenue, better represented the explanatory variables. Thus, there is a need for a better understanding of the explanatory variables behavior and impacts on private investments in the analyzed sectors.

Table 9, below, presents four behavior models, being the first one private investment of Plastic Products Manufacturing sector - CNAE 25.2 (EQ 1). The second model shows the results obtained by the crossing of information between the manufacturing Plastic Products sector and Flat Laminates Manufacturing Subsector and Tubular Plastics – CNAE 25.21 (EQ. 2). The third is represented by EQ. 3 comprising the crossing information between the Plastic Product Manufacturing Industry - CNAE 25.2, with the subsector of Plastic Packaging Manufacturer - CNAE 25.22. The EQ. 4 represents the information crossing between the subsector Plastic Products Manufacture - CNAE 25.2 with the subsector Plastic Artifact Manufacture – CNAE 25.29.

Table 9: Private Investment Cross-Section Equations for Plastic Products Manufacturing, Subsector Flat Laminated and Tubular Plastic Manufacturing, Subsector Plastic packaging manufacturing and subsector Manufacture of various plastic articles (includes plastic for use in construction.

Fixed Effects Estimation - Dependent Variable : Private Investment 1996-2011				
Explanatory variables	EQ1 LogINV_25.2	EQ2 LogINV_25.2	EQ3 LogINV_25.2	EQ4 LogINV_25.2
C	7.5694	X	X	X
LogVBPI_25.2	0.7304	X	X	X
LogRLV_25.2	0.7667	X	X	X
LogCOP_25.2	-1.1833	X	X	X
C	X	10.461	X	X
LogVBPI_25.21	X	5.0966	X	X
LogRLV_25.21	X	4.9843	X	X
LogCOP_25.21	X	-0.3062	X	X
C	X	X	14.030	X
LogVBPI_25.22	X	X	7.2334	X
LogRLV_25.22	X	X	7.3033	X
LogCOP_25.22	X	X	-0.1329	X
C	X	X	X	4.5338
LogVBPI_25.29	X	X	X	6.2063
LogRLV_25.29	X	X	X	4.7942
LogCOP_25.29	X	X	X	-0.8701
R^2	0.6705	0.6672	0.6746	0.6801
Adjusted R^2	0.6265	0.6152	0.6236	0.6244
S.E.R	0.1593	0.1594	0.1512	0.1441
SSR	1.5230	1.5251	1.3725	1.2466
DW stat	1.6836	1.7355	1.6468	1.7826

The results indicate that the variable operating cost showed a negative signal on all tested equations. This fact implies that a 1% increase in operating costs lead to a reduction in private investment of 1.18 % for Equation 1, from 0.30% to Equation 2, 0.13 % to Equation 3 and 0.87% to Equation 4. These results show the behavior of the subsectors within the Plastics Product Manufacturing industry, and show the importance of controlling operating costs.

The results presented in Table 9 indicate the positive sign and significant for the variables gross industrial production value and net sales revenue for all the tested equations. As for the four estimated models we have that the R^2 showed a high degree of explicability.

4.6 Private Investment *Cross-Section* for Flat Laminates Manufacturing Subsector and Tubular Plastics, Plastic Packaging Manufacturing Subsector and Plastic Artifacts Subsector.

Table 10 presents the results for the croos-section data for the subsector of Plastic Products Manufacture. In this regard, it is noted that for Equation 1 private investment on Flat Laminates Manufacturing and Tubular Plastics is negatively impacted by operating costs, having the biggest impact among the analyzed subsectors.

Table 10: Investment equations between subsectors of Plastic Products Manufacture.

Fixed Effects Estimation - Dependent Variable : Private Investment 1996-2011			
Explanatory variables	EQ1 LogINV_25.21	EQ2 LogINV_25.22	EQ3 LogINV_25.29
C	5.4556	X	X
LogVBPI_25.21	13.564	X	X
LogRLV_25.21	13.165	X	X
LogCOP_25.21	-0.8139	X	X
C	X	0.8047	X
LogVBPI_25.22	X	0.6584	X
LogRLV_25.22	X	2.0737	X
LogCOP_25.22	X	-0.6769	X
C	X	X	7.5118
LogVBPI_25.29	X	X	6.5048
LogRLV_25.29	X	X	5.7340
LogCOP_25.29	X	X	-0.4632
R^2	0.6548	0.7390	0.6203
Adjusted R^2	0.6187	0.7260	0.6163
S.E.R	0.5734	0.0895	0.1478
SSR	8.0710	0.4814	1.3113
DW stat	7.1261	1.6745	1.8061

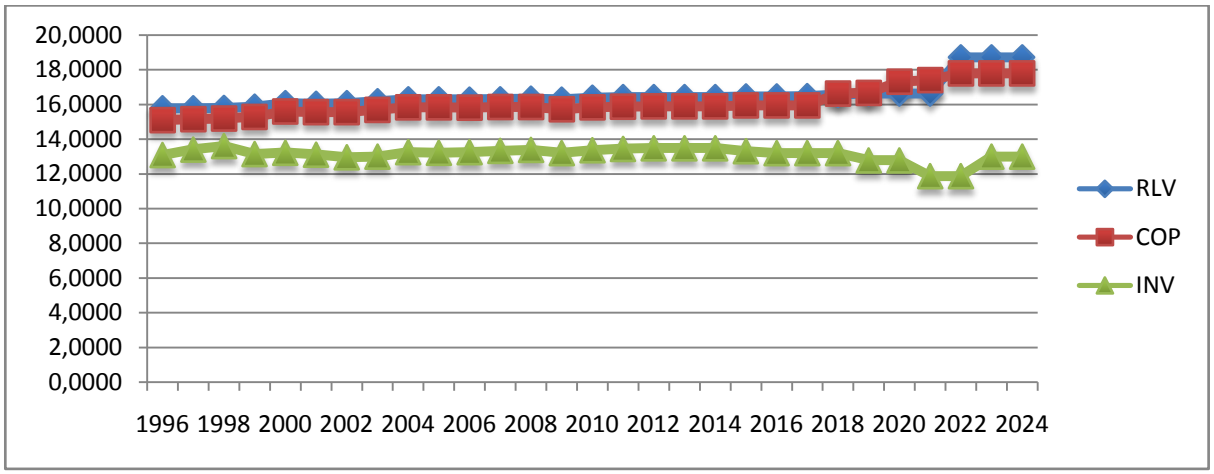
Equation 10 shows the negative impact of operating costs on Plastic Packaging Manufacturing Industry. In this case, an increase of 1 % in operating costs reduces the sub-sector investments by 0.67 %. The equation also indicates the lowest value for the net revenues if compared with other subsectors.

Finally, it is observed by Equation 3, the negative impacts of operating cost on subsector of Plastic Artifacts Manufacturing. The results indicate the lowest impact among the three analyzed subsectors. Net sales variable has a positive sign, despite having the second largest impact. For the three estimated models we have that the R^2 showed high degree of explicability.

4.7 Private Investment Future Analysis for the Plastic Products Manufacturing Sector, Flat Laminates Manufacturing and Tubular Plastics Subsector, Plastic Packaging Manufacturing Subsector and Various Plastic Artifacts using the Monte Carlo Method up to 2024 simulation.

Graph 1, shows the future trend for the subsector Plastic Products Manufacture evaluating the Net Sales Revenue versus Operating Cost in a 2024 projection. The variables for the period study show a certain concern since that profit margin will decline along the time due to the closeness approach of operating costs with relation to net revenues.

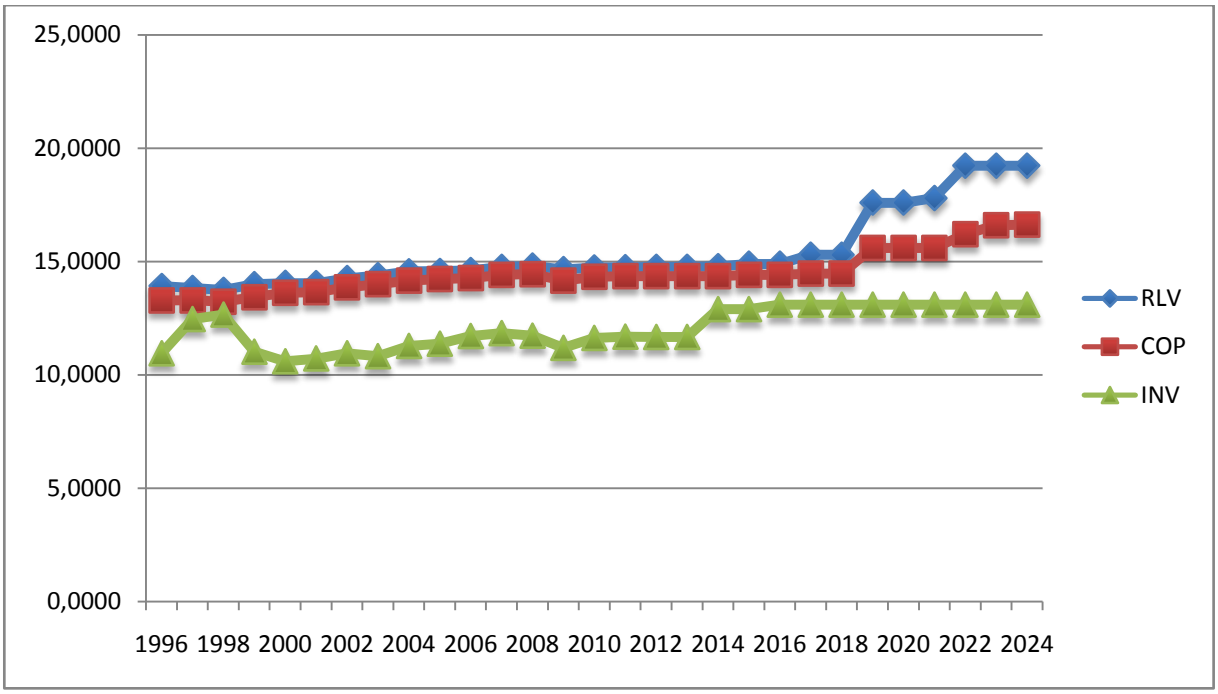
Graph 1: Future Trend for Plastic Products Manufacturing Sector.



From 2019 the operating cost exceeds the net revenue generating a loss situation up to the year 2022. Such behavior indicates a consolidation in the industry, in other words, there will be bankruptcy, acquisition and merger of several companies, micro and small business that may not invested in innovation in management, technology and did not reach the production economic scale. The sector to restore its profits from 2023. It is also observed that during the consolidation period there will be a drop in sector investments which further slow the recovery process.

Graph 1 indicates the future trend for Tubular Plastics Manufacturing Subsector assessing the variables Net Sales Revenue versus Operating Cost in a 2024 projection. The variables for the studied period, and the results presented in Graph 2, raises concern, since the margins will shrink with time due to the approach of operating costs in relation to net revenues.

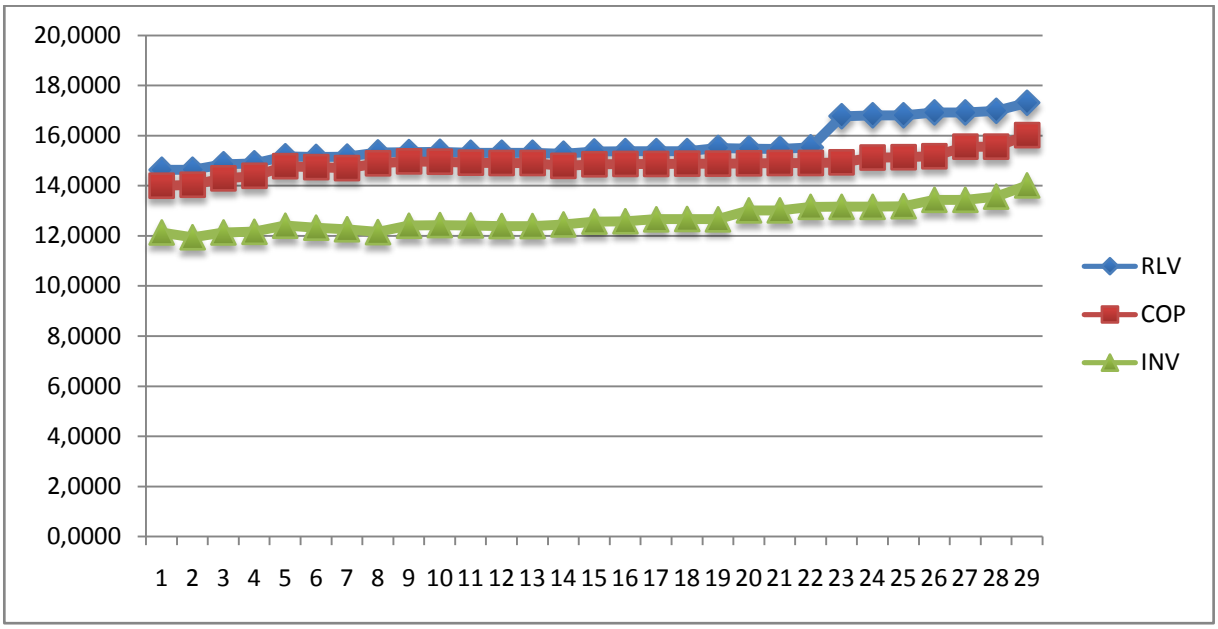
Graph 2: Future Trend for Tubular Plastics Manufacturing Subsector.



The results suggest that by the year 2018 there will be a reduction in the margins led to the exit of those companies that have not invested adequately in innovation management, process and technology. During this period, the operating cost will equal the net revenues creating a situation of possible loss by the year 2019. Such behavior indicates a consolidation in the industry. The sector restore its activities from 2019 onwards. It is also noticed that during the consolidation period there will be a drop in investments, but from 2014 until 2024 the levels of investment will stabilize consequently will boost the industry's recovery and rising margins.

Graph 3 shows the future trend for the Plastic Packaging Manufacturing sector assessing the Net Sales Revenue versus Operating Cost in a projection to 2029. The variables for the study period, and the results presented in Graph 3, raises concern, since the margins will shrink with time due to closeness approach of operating costs in relation to net revenues.

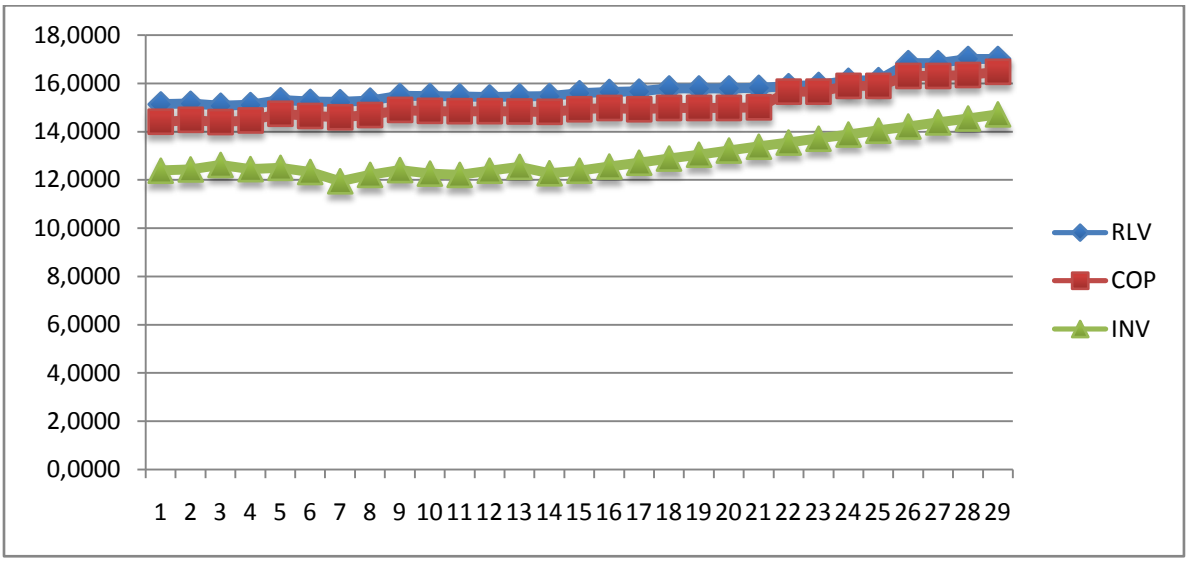
Graph 3: Future Trend for the Plastic Products Packaging Subsector.



The results suggest that by the year 2023 there will be a reduction in the margins led to the exit of those companies that have not invested adequately in innovation management, process and technology. During this period the operating cost practically will equal to net revenue generating a potentially loss situation. Such behavior indicates a consolidation in the industry. The sector restore its margins from 2023 onwards. It is also noticed that, unlike Tubular Plastics Manufacturing sector during the consolidation period there will be a continuity in investment, rising from the end of the consolidation period.

Figure 4 shows the future trend for Several Plastic Artifacts Manufacturing Subsector evaluating the Net Sales Revenue versus Operating Cost in a 2024 projection. The results show the same path as it was observed in other graphs, which is the reduction of margins, but with a longer consolidation period.

Graph 4: Future Trend for the Various Artefacts Plastics Products Manufacturing Subsector



Various Plastic Artifacts Manufacturing Subsector has some different characteristics if compared with other sectors. The results have shown an investments increase during the consolidation process accentuated in recent years with an increase in the margins.

5 Conclusion

This article proposed the elaboration of a econometric simulation model, focused on private investments connected to the real possibilities of economic growth for the coming years. The empirical evidence obtained in the tested models indicates that increases in income and economic activity encouraged private investments in Brazil. Besides credit, external factors and exchange devaluations caused, in general, adverse effects on the gross formation of fixed capital in the private sector of Brazil. These reults indicate the existence of credit restrictions for Brazilian organizations and also indicate the importance of macroeconomic stability and the execution of public policies as an encouraging factor for private investment.

As a result of these analysis, we suggest for future studies, the use of the introduced method to conduct macroeconomic impacts on private investments, by regions and by productive sectors in other nations, using the Monte Carlo simulation models, in an attempt to obtain long term estimates. And finally, we hope that this article encourages new studies, with strategic biases and long term vision, as well as sector analysis, in order to propose innovation strategies for the economic development.

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