EVIDENCE OF PREDICTIVE POWEROF THE MACROECONOMIC VARIABLES REGARDING THE BRAZILIAN STOCK MARKET IN THE PERIOD FROM 2002 TO 2012

Elisa Elaine Moreira Teixeira
Doctor of Business Administration from Federal University of Minas Gerais
Estácio de Sá University, Belo Horizonte – MG, Brasil
E-mail: *elissaem@hotmail.com*

José Guilherme Chaves Alberto (*Corresponding Author***)***
Student of PhD in Business Administration from Fumec University
Fumec University, Belo Horizonte – MG, Brasil
E-mail: *guilhermezaragoza@gmail.com*

Luis Renato Junqueira
Student of PhD in Business Administration from Federal University of Minas Gerais
Federal University of Minas Gerais, Belo Horizonte – MG, Brasil
E-mail: *lrjunq@gmail.com*

Francisco Vidal Barbosa
Post-Doctoral from Harvard University.
Federal University of Minas Gerais, Belo Horizonte – MG, Brasil
E-mail: *fvberlim@gmail.com*

Henrique Cordeiro Martins
Doctor of Business Administration from Federal University of Minas Gerais and Birmingham School
Fumec University, Belo Horizonte – MG, Brasil
E-mail: *henrique.martins@fumec.br*

Antônio Artur de Souza
Doctor in Management Science - The University of Lancaster
Federal University of Minas Gerais, Belo Horizonte – MG, Brasil
E-mail: *antonioartur@uol.com*

*Endereço para Correspondência:
Contato: José Guilherme Chaves Alberto
Rua Yucatan, 77 – apto. 102 – Bairro São Pedro – Belo Horizonte – MG – CEP: 30.330-400

ABSTRACT

In this article, we investigated the relationship between Ibovespa Index points variation (IBOV) and the variation of the following macroeconomic data observed: Agricultural GDP, Industrial GDP, Service GDP, Total GDP, Broad Consumer Price Index, Export Trade Balance, Import Trade Balance, Exchange Rate and Interest Rate. The results show evidence that the variable Service GDP variation was significant to predict quarterly future variation of Ibovespa points in the 2nd, 3rd and 4th quarters; regarding the variables: Broad Consumer Price Index variation, Export Trade Balance variation, Import Trade Balance variation, Selic Rate variation, Exchange Rate variation and Agricultural GDP variation showed no significant results; the variables of the Total GDP variation and the Industrial GDP variation provided significant coefficients, however, Granger causality test shows evidence that the variables don`t cause the variation of the Ibovespa points.

Keywords: *Stockmarket; macroeconomic variables; autoregressive model vector*

1. INTRODUCTION

The issue of asset pricing is fraught with uncertainties and unknowns as to how it should be done. The investors' uncertainty as to the results to be obtained in their investments in the financial market generates strong demand for studies on stock return. Although the literature in this field is evolving, a consensus has already emerged. In some countries, the researches in this field have proliferated, but in Brazil, besides the small investor, also the academic surveys were removed from the capital market. Only in recent years the academy became interested and to investigate the nuances of the national stock market (e.g., TEIXEIRA; BARBOSA; SOUSA, 2012; PIMENTA JR.; HIGUCHI, 2008; GROPPO, 2004; BRUNI, 1998).

The paucity of research may be related to the emerging market condition in which Brazil is. Terra (2007) believes that emerging markets have problems with infrequent trading, limited external financing, poorly drafted legislation, lax enforcement and incomplete institutional structure. The author believes, however, that these facts should not fit as an excuse for not conducting empirical researches. The determination of the factors with greater power to explain the behavior of stock prices in a different market from those already surveyed is important to check for differentiation of the factors or whether these remain unchanged even in a market with distinct characteristics.

There is the ongoing effort of executives and researchers in order to understand the risk of (systematic) market to manage and reduce the risks of investing (e.g., OFFICER, 1973; GESKE; ROLL, 1983). The systematic risk, directly or indirectly, influences the cost of capital of the projects and impacts the expected returns and the ability of investment to create value for the company. Surveys have been undertaken in order to ascertain to what extent the macroeconomic environment determines both the return as the volatility in the stock market (e.g., OFFICER, 1973; ROSS, 1976; ROLL; ROSS, 1980; GOSVAMI; JUNG, 1998; FAMA, 1981). In this direction, this paper advances the study of the relationship between macroeconomic factors and capital markets to investigate whether macroeconomic factors in Brazil are relevant to estimate the variation of the Ibovespa quote.

This article is divided into five sections. After the introduction, presents the literature review in Section 2; followed by the methodology in Section 3; in Section 4, develops data analysis and the discussion of the results; and in Section 5, the final considerations are exposed.

2. THEORETICAL REFERENCE

The business of the company, the financial conditions and the results of operations may be adversely affected by changes in economic policy, such as tax and exchange variations, or even by problems such as: currency fluctuations, tax policy and other political, diplomatic and social issues within the country or which affects it. As the market risk is possibly related to these variables, the models of macroeconomic factors set out to examine this relationship. In a model of macroeconomic factors, the variables used are the historical returns of the assets and observable macroeconomic variables. The goal is to determine which macroeconomic variables are persistent in explaining the historical return of the asset. The variables that explain the return then become the factors that will be included in the model (FABOZZI; FOCARDI; KOLM, 2006).

The authors who study the relationship between macroeconomic variables and stock market assume that, once the present value of the stocks of a company reflects the expectation concerning its future cash flow, any variable that has influence on this cash flow influences, indirectly, stock prices and defines thus their volatility.

Several studies have tried to show reliable associations between macroeconomic variables and stock price. One of the first works on the relationship between macroeconomic variables and stock market was proposed by Officer (1973). The author studied the period from 1897 to 1969, using the returns of the stocks listed on the NYSE. The study showed that the volatility of stock returns was related to fluctuations in the economy. Later, Roll and Ross (1980) sought to identify the appropriate number of factors to be used in the model and Chen, Roll and Ross (1986) minded the determination of these factors. Since then, several authors have studied the relationship between macroeconomic data and the capital markets, including Brazil (e.g., TEIXEIRA; BARBOSA; SOUSA, 2012; PIMENTA JR .; HIGUCHI, 2008; GROPPO, 2004; BRUNI, 1998).

This article seeks evidence which can help answer such questions through the research of the relationship between the variation in the return of the Ibovespa Index (IBOV) and the variation of the following observed macroeconomic data: Total GDP, Agricultural GDP, Industrial GDP, Service GDP, inflation (IPCA Broad Consumer Price Index), Export Trade Balance, Import Trade Balance, Exchange Rate and Interest Rate through autoregressive vector models - VAR.

According to Medeiros and Ramos (2004), an increase in GDP would increase corporate profits and consequently stock prices. Therefore, the expected impact of macroeconomic performance should be positive. Several empirical studies confirm this hypothesis (LEUNG; DOUK; CHEN, 2000; BLACK; FRASER, 1995; JARVINEN, 2000).

Nishat and Shaheen (2004) studied the relationship between the stock market of Pakistan and the variables industrial production and consumer price index from 1973 to 2004. The results indicated that there is a relationship between the stock market in Pakistan and the economy, indicating that industrial production is positively related to asset prices, while inflation negatively affects asset prices.

Zhang, Yong, Lee and Gan (2006) examined the relationship between a Stock Index in New Zealand and a set of seven macroeconomic variables from January 1990 to January 2003, using cointegration tests. The test results indicated unilateral causality of the following variables on the stock index: interest rates, money supply and real GDP. However, as the authors say, there is no evidence that the New Zealand stock index is explained by changes in macroeconomic variables.

Goswami and Jung (1998), Karamustafa and Kucukkale (2003) and Flannery and Protopapadakis (2002) studied the relationship between trade balance and stock returns. Although Goswami and Jung (1998) hoped that the relationship was positive, it did not show significant. The findings of Karamustafa and Kucukkale (2003) presented negative relationship, as well as the Flannery and Protopapadakis (2002).

It is possible that the currency appreciation strengthen the profitability of domestic producers of tradables (substitutes for exports and imports) in relation to foreign competitors. As a result, the exchange rate positively influences the profits and consequently the stock prices. With respect to the exchange rate, other authors who studied the relationship between it and the stock market: Hondroviannis and Papapetrou (2001), Groppo (2004), Horng and Chen (2010) and Agrawal, Srivastav and Srivastava (2010) who found a negative relationship; Chen, Naylor and Lu (2004) and Maghrebiet et al. (2006), whose results showed that the exchange rate affects the return on the stock according to the sector of the company, that is, if an importer or exporter. The study results of Fang (2002) pointed that the depreciation of the currency adversely affected the stock returns and increased market volatility during the period of the Asian crisis (1997-1999). However, this study covered only the period of crisis, and the results can be different for regular periods. Therefore, it is possible to observe that with regard to the influence of the exchange rate, the results are contradictory.

Günsel and Çukur (2007) investigated the relationship between macroeconomic variables, among them, the exchange rate and stock returns in the London Stock Exchange for the period from 1980 to 1993. The authors discuss that the exchange rate is an important factor in determination of the international competitiveness. A company or industry may be exposed to it if it negotiates freely beyond national borders. For the authors, according to the movement of the exchange rate, the companies can gain or lose in competitive position. However, while the exchange rate appears to be a major factor does not necessarily mean that affect the returns. That is because the company may use tools such as derivatives to reduce risk. So it will not be surprise if it is not found any relation between exchange rate and stock returns. The research results of these authors pointed out that the building materials sector is negatively affected by the exchange rate, while the chemical industry is affected positively.

Tunali (2010) examined the relationship between macroeconomic variables and return of the stock market Turkish (Istanbul), including exchange rate (national currency vs. Dollar), industrial production and imports. The study period was from January 2002 to August 2008. The results showed that increases in industrial production and imports increase the return, while an increase in the exchange rate leads to a decrease in return.

There are several studies in the literature on the relationship between interest rate and return in the stock market. Goswami and Jung (1998) and Fama (1981) found a positive relationship. On the other hand, Chen et al. (1986) found a negative relationship. In Brazil, Schor, Bonomo and Pereira (1998) found a positive relationship. The fact that the result of researches has demonstrated the impact of interest rates on the movement of asset prices may have its explanation in the fact that the increase in interest rates strengthens the remuneration in the fixed income market, which attracts investors to these types of investment over the variable income market (MEDEIROS; RAMOS, 2004). The increase in the interest rate furthermore increases the uncertainty and investors' risk in relation to the return on investments in variable income. According to Brigham and Houston (1999), interest rates influence stock prices because of their impact on corporate profits.

Omran (2003) studied the impact of real interest rates on the performance of the Egyptian stock market, both in terms of market activity and liquidity. The results of the co-integration analysis through error correction mechanisms (ECM) showed significant relations of long-term and short-term between the variables, which means that real interest rates have an impact on the performance of the stock market.

Horobet and Dumitrescu (2008) investigated the relationship between macroeconomic variables GDP, consumer price index, interest rate, exchange rate and money supply and the stock market for countries located in Europe for the period from January 1998 to September 2007. The results showed that the consumer price index is positively related to the stock price, while the exchange rate is negatively related, except in Romania. The variable interest rate in the Czech Republic, Poland and Romania is positively correlated to stock price, which should be interpreted carefully against to lack of liquidity in the stock market in these countries. As for GDP, was not significant.

Pilinkus (2009) examined the relationship between a group of macroeconomic variables and the return of OMX Vilnius Index, stock market index of Lithuania. The study period was from December 1999 to March 2008 and among the variables studied, figured export, import and foreign direct investment (FDI). The results showed that these three variables can be used to predict price fluctuations in the stock market, which confirms the existence of relationship between stock market return and macroeconomic variables in Lithuania.

Frimpong (2009) studied the relationship between exchange rate, consumer price index, inflation and interest rates in the stock market in Ghana. The results indicated that with the exception of the exchange rate, other variables negatively impacting stock prices. For the author, a strong domestic currency reduces the input cost if it enables local producers to be more competitive internationally, generating positive returns in the stock market. As for inflation, this variable has a significant negative impact on the Ghana stock exchange.

Fabozzi, Focardi and Kolm (2006) warn that some factors may have explanatory power for certain periods and although a factor may have worked in the last 20 years, it is important to question how well it has worked in recent years (for example, in the last three years). Persistent factors are often the most desirable.

Thus, it appears that the research carried out for evidence of how the macroeconomic variables influence the return of stock present results still far from a consensus among authors.

3. METHODOLOGY

In this article, macroeconomic variables effectively observed were used, collected on the website of the Central Bank; and Ibovespa points of the site Economática. All data were obtained on a quarterly basis. Table 1 lists the variables used in the study and their respectively abbreviations.

TABLE 1
Variables used in the study and their respectively abbreviations.

Variables	Abbreviations	Variables	Abbreviations
Broad Consumer Price Index	IPCA	Total GDP	PIBT
Commercial Export Balance	BCEXP	Industrial GDP	PIBIND
Commercial Import Balance	BCIMP	Service GDP	PIBSER
Selic Rate	TXS	Agricultural GDP	PIBAG
Exchange Rate	TXCAM	Ibovespa points	IBOV

Source: authors elaboration.

The calculation of the index variation was performed by the following equations:

$$\Delta IPCA_{t+1} = IPCA_{t+1} - IPCA_t = \ln\left(\frac{IPCA_{t+1}}{IPCA_t}\right) \quad (1)$$

$$\Delta BCEXP_{t+1} = BCEXP_{t+1} - BCEXP_t = \ln\left(\frac{BCEXP_{t+1}}{BCEXP_t}\right) \quad (2)$$

$$\Delta BCIMP_{t+1} = BCIMP_{t+1} - BCIMP_t = \ln\left(\frac{BCIMP_{t+1}}{BCIMP_t}\right) \quad (3)$$

$$\Delta TXS_{t+1} = TXS_{t+1} - TXS_t = \ln\left(\frac{TXS_{t+1}}{TXS_t}\right) \quad (4)$$

$$\Delta TXCAM_{t+1} = TXCAM_{t+1} - TXCAM_t = \ln\left(\frac{TXCAM_{t+1}}{TXCAM_t}\right) \quad (5)$$

$$\Delta PIBT_{t+1} = PIBT_{t+1} - PIBT_t = \ln\left(\frac{PIBT_{t+1}}{PIBT_t}\right) \quad (6)$$

$$\Delta PIBIND_{t+1} = PIBIND_{t+1} - PIBIND_t = \ln\left(\frac{PIBIND_{t+1}}{PIBIND_t}\right) \quad (7)$$

$$\Delta PIBSER_{t+1} = PIBSER_{t+1} - PIBSER_t = \ln\left(\frac{PIBSER_{t+1}}{PIBSER_t}\right) \quad (8)$$

$$\Delta PIBAG_{t+1} = PIBAG_{t+1} - PIBAG_t = \ln\left(\frac{PIBAG_{t+1}}{PIBAG_t}\right) \quad (9)$$

$$\Delta IBOV = IBOV_{t+1} - IBOV_t = \ln\left(\frac{IBOV_{t+1}}{IBOV_t}\right) \quad (10)$$

Where: Δ“Variável”$_{t+1}$= rate of variation of the "Variable" quarterly in period t+1," Variável "$_{t+1}$ = “Variable” in t+1 and " Variável "$_t$ = “Variable” in t.

3.1 Descriptive Statistics and Stationarity Test

Initially, a descriptive analysis of the series with the calculations performed as: average, median, standard deviation, maximum, minimum, kurtosis and skewness. The Anderson-Darling normality test was used to verify if the series is normal; the test has null hypothesis "series has a normal distribution."

The Phillips-Perron test was used to verify the stationarity of the series. The test assumes null hypothesis that the series has a unit root, that is, is not stationary.

3.2 Autoregressive Vectors - VAR

The autoregressive vector model (VAR) provides resources that help you understand the interrelationships between the variables through causalities information, variance decomposition of residues and the impulse response function (BROOKS, 2008).

To determine the number of lags to be used in the estimation of the VAR model it was used the technique known as "Information Criterion" by Akaike's methods (AIC), Schwarz's (SBIC) and Hannan-Quinn (HQIC).

In case of differences between the methods, the SBIC will be used for choosing the number of lags to present best asymptotic properties and the selection of more parsimonious models (e.g. GREENE, 2007; EMILIANO, 2009).

The Granger causality test was used to test the causality between the variables, being null hypothesis the absence of causality between variables. Thereafter, for a better understanding of the VAR model, the impulse response function observed response in the dependent variable due to shock in each variable; and the decomposition of the variance explained the proportion of movement in the dependent variable due to shock itself and other variables.

Finally, Anderson-Darling normality test was carried out in residues and verified by correlogram if the waste is white noise.

4. PRESENTATION AND DATA ANALYSIS

This chapter will present the results of this study from the collected data and the techniques applied, as described in the Methodology.

4.1 Descriptive statistics and Stationarity Test

For better understanding of the variables is shown in Table 2 the descriptive analysis of the series.

TABLE 2
Descriptive statistics data from 2002 to 2012.
ΔIPCA - Broad Consumer Price Index variation, ΔBCEXP –Export Trade Balance variation, ΔBCIMP - Import Trade Balance variation, ΔTXS –Selic Rate variation, ΔTXCAM - Exchange Rate variation, ΔPIBT - Total GDP variation, ΔPIBIND – Industrial GDP variation, ΔPIBSER - Service GDP variation, ΔPIBAG - Agricultural GDP variation, ΔIBOV – Ibovespa points variation. Percentage data.

Variable	Average	Median	Standard-deviation	Minimum	Maximum	Kurtoses	Skewness	P-value**
ΔIPCA	-1.030	1.874	70.240	-266.900	151.000	6.673	-0.882	0.026*
ΔBCEXP	3.537	2.524	15.459	-41.220	33.870	3.215	-0.346	0.763
ΔBCIMP	3.441	5.700	11.835	-39.640	21.610	5.559	-1.231	0.070
ΔTXS	-1.911	-2.467	9.383	-24.390	16.380	2.646	-0.170	0.934
ΔTXCAM	-0.310	-1.190	9.792	-17.370	31.460	4.791	1.236	< 0.005*
ΔPIBT	0.905	0.843	3.153	-5.378	6.190	2.277	-0.149	0.525
ΔPIBIND	0.769	2.521	7.474	-16.150	9.870	2.207	-0.591	< 0.005*
ΔPIBSER	0.856	2.031	2.493	-5.619	3.430	2.727	-1.065	< 0.005*
ΔPIBAG	1.378	14.973	26.150	-41.620	38.800	1.383	-0.042	< 0.005*
ΔIBOV	3.424	5.504	14.441	-27.710	32.850	2.737	-0.370	0.447

Notes: * Significant at 5% ** normality test Anderson-Darling.
Source: Authors elaboration from data analyzed using Stata and Minitab software.

Ibovespa average variation in the period was 3.424%, 5.504% median and standard deviation of 14.441%. There has been a great dispersion of the variables, especially the IPCA with standard deviation of 70.240%; amplitude of the series corroborates evidence of high data dispersion (minimum of 266.9% and maximum of 151.0%).

There is the significant difference between the value of the average and the median in the series analyzed, highlighting the variation of Agricultural GDP series (average of 1.378% and a median of 14.973%).

The variation series of Commercial Export Balance, Balance of Trade Import, Selic Rate, Total GDP and Ibovespa points did not reject the null hypothesis at 5% significance, that is, there is evidence that follow a normal distribution; on the other hand, the variation series of Inflation, Exchange Rate, Industrial GDP, Service GDP and Agricultural GDP were significant at 5%, that is, there is evidence of non-normality in the series.

Table 3 shows the Phillips-Perron Stationarity test.

TABLE 3
Phillips-Perron Stationarity test.
ΔIPCA - Broad Consumer Price Index variation, ΔBCEXP - Export Trade Balance variation, ΔBCIMP - Import Trade Balance variation, ΔTXS - Selic Rate variation, ΔTXCAM - Exchange Rate variation, ΔPIBT - Total GDP variation, ΔPIBIND - Industrial GDP variation, ΔPIBSER - Service GDP variation, ΔPIBAG - Agricultural GDP variation, ΔIBOV - Ibovespa points variation,

Variable	Stationary test - z(rho)	Stationary test - z(t)	P-value**
ΔIPCA	-35.519	-8.846	0.000*
ΔBCEXP	-31.233	-7.843	0.000*
ΔBCIMP	-26.892	-5.336	0.000*
ΔTXS	-20.341	-3.510	0.008*
ΔTXCAM	-29.320	-5.028	0.000*
ΔPIBT	-38.430	-10.395	0.000*
ΔPIBIND	-30.621	-10.541	0.000*
ΔPIBSER	-37.793	-11.717	0.000*
ΔPIBAG	-21.824	-19.440	0.000*
ΔIBOV	-32.524	-5.334	0.000*

Notes: * Significant at 5%. ** Critical values for Phillips-Perron test z(t) -3.702 (1%) -2.980 (5%) -2.662 (10%). z (rho) -18.356 (1%), -13.044 (5%), -10.540 (10%).
Source: Authors elaboration from data analyzed using Stata software.

It was found by the Phillips-Perron test that all series are significant at 5%, in other words, there is evidence that the series are stationary.

4.2 Estimates of autoregressive vector models - VAR

4.2.1 Estimation of number of lags

The estimation of VAR models begins by determining the number of lags to be used in the models. Table 4 provides the results of Akaike's tests (AIC), Schwarz's (SBIC) and Hannan-Quinn (HQIC).

TABLE 4
AIC, SBIC and HQIC Test.
ΔIPCA - Broad Consumer Price Index variation, ΔBCEXP - Export Trade Balance variation, ΔBCIMP – Import Trade Balance variation, ΔTXS - Selic Rate variation, ΔTXCAM - Exchange Rate variation, ΔPIBT - Total GDP variation, ΔPIBIND – Industrial GDP variation, ΔPIBSER – Service GDP variation, ΔPIBAG - Agricultural GDP variation.

Variable	Akaike's - AIC	Schwarz's - SBIC	Hannan-Quinn - HQIC
ΔIPCA	11.113 (2)	11.242 (2)	11.160 (2)
ΔBCEXP	7.757 (4)	7.970 (4)	7.833 (4)
ΔBCIMP	7.523 (2)	7.651 (2)	7.569 (2)
ΔTXS	7.016 (3)	7.175 (2)	7.077 (3)
ΔTXCAM	7.033 (0)	7.076 (0)	7.049 (0)
ΔPIBT	4.296 (4)	4.372 (4)	4.510 (4)
ΔPIBIND	5.735 (4)	5.948 (4)	5.811 (4)
ΔPIBSER	3.459 (4)	3.672 (4)	3.535 (4)
ΔPIBAG	5.988 (3)	6.156 (3)	6.049 (3)

Note: ( ) The values in parentheses represent the number of lags to be used in the VAR model.
Source: Authors elaboration from data analyzed in Stata 10 software.

The criterion of AIC, SBIC and HQIC information, the number of lags in the VAR model will be:

- ✓ The Broad Consumer Price Index variation and Import Trade Balance variation series with two lags;
- ✓ The Agricultural PIB variation series with three lags;
- ✓ The Export Trade Balance variation, Total GDP variation, Industrial GDP variation, Service GDP variation series with four lags;

- ✓ The Selic Rate variation series presented divergence between the information criteria. As the SBIC criterion provides more parsimonious models was used two lags (GREENE, 2007) ;
- ✓ The Exchange Rates variation series was not estimated for not presenting lags by the information criterion

4.2.2 Extimation of the VAR models

This topic has been divided into eight parts in which each presents estimation of each VAR model proposed in this study.

4.2.2.1 Estimation of the VAR model with two lags, with the variables: IPCA (ΔIPCA) variation and Ibovespa points variation (ΔIBOV).

Table 5
VAR model of the IPCA.
ΔIPCA - Broad Consumer Price Index variation, ΔIBOV – Ibovespa points variation.

Independent a. Panel	ΔIPCA	ΔIBOV
ΔIPCA (-1)	-0.241	-0.005
	(0.068)	(0.857)
ΔIPCA (-2)	-0.517*	-0.053
	(0.000)	(0.075)
ΔIBOV (-1)	-0.054	0.179
	(0.933)	(0.225)
ΔIBOV (-2)	-0.640	-0.102
	(0.330)	(0.500)
Constante	1.658	3.764
	(0.864)	(0.089)

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

The variable "IPCA variation" does not predict the future variation of Ibovespa points in any lag.

4.2.2.2 Estimation of the VAR model with four lags, with the variables variation: Export Trade Balance variation (ΔBCEXP) and Ibovespa points variation (ΔIBOV).

Table 6
VAR model of Export Trade Balance variation.
ΔBCEXP - Export Trade Balance variation, ΔIBOV - IBovespa points variation.

Independent a. Panel	ΔBCEXP	ΔIBOV
ΔBCEXP (-1)	-0.232	-0.208
	(0.056)	(0.275)
ΔBCEXP (-2)	-0.329*	-0.350
	(0.004)	(0.053)
ΔBCEXP (-3)	-0.167	-0.238
	(0.136)	(0.176)
ΔBCEXP (-4)	0.491*	-0.319
	(0.000)	(0.071)
ΔIBOV (-1)	0.193*	0.122
	(0.042)	(0.412)
ΔIBOV (-2)	0.308*	-0.117
	(0.001)	(0.426)
ΔIBOV (-3)	0.107	0.018
	(0.263)	(0.904)
ΔIBOV (-4)	0.314*	0.041
	(0.001)	(0.785)
Constante	0.204	8.315*
	(0.915)	(0.006)

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

The variable "Export Trade Balance variation " does not predict the future variation of Ibovespa points in any lag. Only the constant 5% is significant (p-value 0.6%).

4.2.2.3 Estimation of the VAR model with two lags, with the variables: Import Trade Balance variation (ΔBCIMP) and Ibovespa points variation (ΔIBOV).

Table 7
VAR model of the Import Trade Balance variation.
ΔBCIMP - Import Trade Balance variation, ΔIBOV - Bovespa points variation.

Independent a. Panel	ΔBCIMP	ΔIBOV
ΔBCIMP (-1)	0.231	-0.061
	(0.070)	(0.760)
ΔBCIMP (-2)	-0.455*	-0.225
	(0.000)	(0.223)
ΔIBOV (-1)	0.206*	0.146
	(0.032)	(0.332)
ΔIBOV (-2)	0.216*	-0.111
	(0.036)	(0.492)
Constante	2.917	5.029*
	(0.057)	(0.037)

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

The variable "Import Trade Balance variation" does not predict the future variation of Ibovespa points in any lag. Only constant 5% is significant (p-value 3.7%).

4.2.2.4 Estimation of the VAR model with two lags, with the variables: Selic Rate variation (ΔTXS) and Ibovespa points variation (ΔIBOV).

Table 8
VAR model of Selic Rate variation.
ΔTXS - Selic Rate variation, ΔIBOV – Ibovespa points variation.

Independent a. Panel	ΔTXS	ΔIBOV
ΔTXS (-1)	0.655*	-0.393
	(0.000)	(0.163)
ΔTXS (-2)	-0.268	0.255
	(0.092)	(0.375)
ΔIBOV (-1)	-0.085	0.100
	(0.330)	(0.525)
ΔIBOV (-2)	0.061	-0.128
	(0.512)	(0.447)
Constante	-1.157	3.904
	(0.351)	(0.081)

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

The variable "Selic Rate variation" does not predict the future variation of Ibovespa points in any lag.

4.2.2.5 Estimation of the VAR model with four lags, with the variables: Total GDP variation (ΔPIBT) and Ibovespa points variation (ΔIBOV).

Table 9
VAR model of Total GDP variation and causality test.
ΔPIBT – Total GDP variation, ΔIBOV – Ibovespa points variation.

Independent a. Panel	ΔPIBT	ΔIBOV
ΔPIBT (-1)	-0.375*	-1.979
	(0.001)	(0.067)
ΔPIBT (-2)	-0.399*	-2.536*
	(0.000)	(0.012)
ΔPIBT (-3)	-0.373*	-2.528*
	(0.000)	(0.007)
ΔPIBT (-4)	0.492*	-2.383*
	(0.000)	(0.018)
ΔIBOV (-1)	0.047*	0.103
	(0.002)	(0.476)
ΔIBOV (-2)	0.066*	-0.049

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	(0.000)	(0.721)
ΔIBOV (-3)	0.040*	0.072
	(0.011)	(0.630)
ΔIBOV (-4)	0.030	0.162
	(0.072)	(0.307)
Constante	0.649	11.814*
	(0.090)	(0.001)

b. Panel	**Granger test**		
Equation	**Excluded**	**χ2**	**P-value**
ΔIBOV	ΔPIBT	8.924	0.063
ΔPIBT	ΔIBOV	43.855	0.000*

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

It is observed from Table 9 that the variable "Total GDP variation" is significant in the 2nd, 3rd and 4th lags (p-value of 0.012, 0.007 and 0.018, respectively). However, Granger causality test did not reject the null hypothesis, that is, there is evidence of lack of causality of ΔPIBT variable with respect to ΔIBOV.

Gujarati (2004) states that if the null hypothesis is not rejected there is no evidence of causation between the variables, in other words, PIBT variation does not cause variation of Ibovespa points.

4.2.2.6 Estimation of the VAR model with four lags, with the variables: Industrial GDP variation (ΔPIBIND) and Ibovespa points variation (ΔIBOV).

Table 10
VAR model of Industrial GDP variation and causality test.
ΔPIBIND - Industrial GDP variation, ΔIBOV – Ibovespa points variation.

Independent a. Panel	**ΔPIBIND**	**ΔIBOV**
ΔPIBIND (-1)	-0.517*	-0.860
	(0.000)	(0.131)
ΔPIBIND (-2)	-0.598*	-1.106*
	(0.000)	(0.042)
ΔPIBIND (-3)	-0.498*	-1.178*
	(0,000)	(0.024)
ΔPIBIND (-4)	0.330*	-0.961
	(0.004)	(0.080)
ΔIBOV (-1)	0.094*	0.154
	(0.003)	(0.300)
ΔIBOV (-2)	0.136*	-0.019
	(0.000)	(0.896)
ΔIBOV (-3)	0.106*	0.069
	(0.001)	(0.661)
ΔIBOV (-4)	0.051	0.120
	(0.148)	(0.474)
Constante	-0.123	6.078*
	(0.808)	(0.011)

b. Panel	**Granger test**		
Equation	**Excluded**	**χ2**	**P- value**
ΔIBOV	ΔPIBIND	6.838	0.145
ΔPIBIND	ΔIBOV	47.917	0.000*

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 and Minitab software.

The variable "Industrial GDP variation" is significant in 2nd and 3rd (p-value of 0.042 and 0.024, respectively). However, Granger causality test did not reject the null hypothesis, that is, there is evidence of lack of causality of ΔPIBIND variable with respect to ΔIBOV.

4.2.2.7 Estimation of the VAR model with four lags, with the variables: Service GDP variation (ΔPIBSER) and Ibovespa points variation (ΔIBOV).

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TABLE 11

VAR model f Service GDP variation, causality test and residues normality.
ΔPIBSER – Service GDP variation, ΔIBOV – Ibovespa points variation.

Independent a. Panel	**ΔPIBSER**	**ΔIBOV**
ΔPIBSER (-1)	-0.310*	-2.627
	(0.005)	(0.057)
ΔPIBSER (-2)	-0.307*	-3.856*
	(0.003)	(0.003)
ΔPIBSER (-3)	-0.313*	-3.626*
	(0.002)	(0.004)
ΔPIBSER (-4)	0.591*	-3.008*
	(0.000)	(0.028)
ΔIBOV (-1)	0.029*	0.106
	(0.013)	(0.467)
ΔIBOV (-2)	0.035*	-0.020
	(0.001)	(0.885)
ΔIBOV (-3)	0.024*	0.044
	(0.032)	(0.756)
ΔIBOV (-4)	0.019	0.107
	(0.113)	(0.477)
Constante	0.722*	15.489*
	(0.049)	(0.001)

Panel b.	**Granger test**		
Equation	**Excluded**	**χ2**	**P- value**
ΔIBOV	ΔPIBSER	11.562	0.021*
ΔPIBSER	ΔIBOV	28.673	0.000*

c. Panel	**Residues normality test ***
A^2	**P- value**
0.418	0.314

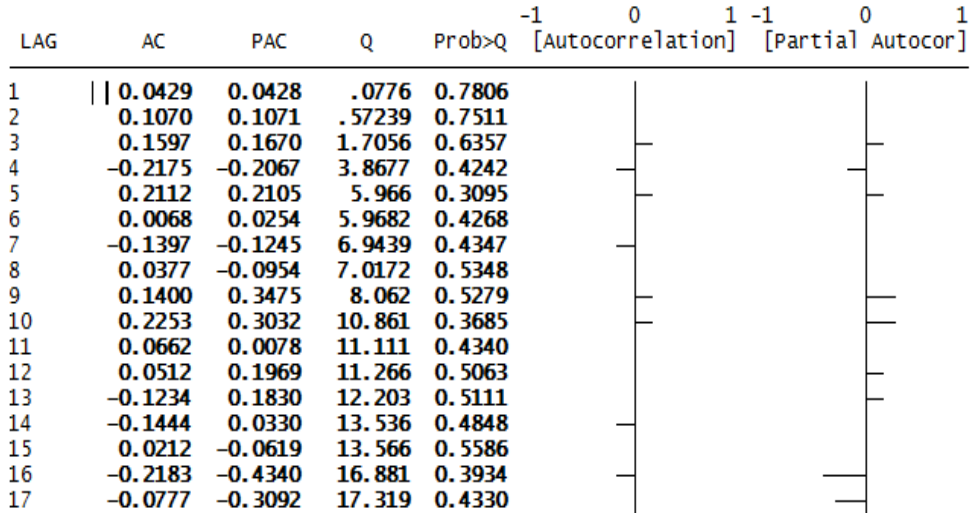
Notes:( ) Figures in brackets represent the p-values of the coefficients.
* Significant at 5%. ** Anderson-Darling normality test.
Source: Authors elaboration from data analyzed in Stata 10 and Minitab software.

It is observed from Table 11 that the variable "Service GDP variation" is significant in the 2nd, 3rd and 4th lags (p-value of 0.003, 0.004 and 0.028, respectively). Granger causality test rejected the null hypothesis at 5% significance, that is, there is evidence of a causality relationship to the variable ΔPIBSER with respect to ΔIBOV (p-value of 2.1%). The residues have evidence of normal distribution (p-value of 0.314).

Figure 1 shows the correlogram of residues.

Figure 1

Correlogram of residue from Service GDP variation of VAR model in the period between 2002-2012.



Source: Authors elaboration from data analyzed in Stata 10 software.

It`s contacted the evidence is not autocorrelation between residuals. So we can adjust a model, according to equation 11.

$$\Delta IBOV = -2.627.\Delta PIBSER(-1) - 3.856.\Delta PIBSER(-2) - 3.626.\Delta PIBSER(-3) - 3.008.\Delta PIBSER(-4) + 0.106.\Delta IBOV(-1) - 0.020.\Delta IBOV(-2) + 0.044.\Delta IBOV(-3) + 0.107.\Delta IBOV(-4) + 15.489 \quad 11)$$

Thus, a change of 1% in Service GDP causes a drop of 3.856% in Ibovespa points two quarters ahead; 3.626% three quarters ahead and 3.008% four quarters ahead.

The impulse response function shows that an impulse positively given in the variation of the "Service GDP " causes complementary to a drop in the Ibovespa points in the 1st quarter which is marked in the 2nd quarter. From the 4th quarter an inversion occurs, increase in the Ibovespa points. Another relevant point is the non dissipation of the effect of impact up to 8 quarter.

The variance decomposition shows that the proportion of dependent variable movement "variation of Ibovespa Points" (ΔIBOV) is mainly affected by the shock in itself. In the 1st quarter 96% of the movement of ΔIBOV variable is due to the shock in itself; from the 4th quarter, this percentage drops to around 85% and stabilizes.

4.2.2.8 Estimation of the VAR model with three lags, with the variables: Agricultural GDP variation (ΔPIBAG) and Ibovespa points variation (ΔIBOV).

Table 12
VAR modelo f Agricultural GDP variation.
ΔPIBAG - Agricultural GDP variation, ΔIBOV – Ibovespa points variation.

Independent a. panel	**ΔPIBAG**	**ΔIBOV**
ΔPIBAG (-1)	-0.377*	0.762
	(0.031)	(0.141)
ΔPIBAG (-2)	-0.987*	0.107
	(0.000)	(0.197)
ΔPIBAG (-3)	-0.373*	0.820
	(0.029)	(0.105)
ΔIBOV (-1)	0.020	0.222
	(0.719)	(0.182)
ΔIBOV (-2)	0.000	-0.105
	(0.998)	(0.501)
ΔIBOV (-3)	0.440	-0.762
	(0.383)	(0.611)
Constante	1.816*	3.199
	(0.027)	(0.188)

Notes:( ) Figures in brackets represent the p-values of the coefficients. * Significant at 5%.
Source: Authors elaboration from data analyzed in Stata 10 software.

The variable "Agricultural GDP variation" does not predict the future variation of Ibovespa points in any lag.

5. FINAL CONSIDERATIONS

In this article, we investigated the relationship between the variation of the Ibovespa Index points (IBOV) and the variation of the following macroeconomic data observed: Agricultural GDP, Industrial GDP, Service GDP, Total GDP, Broad Consumer Price Index, Export Trade Balance, Import Trade Balance, Exchange Rate and Interest Rate.

As the studies done for developed markets by Fama (1981) and Geske and Roll (1983) determined a direct relationship between macroeconomic variables and stock return, this same relationship can not be determined for all variables for Brazilian case. The results provide evidence that the variables: Broad Consumer Price Index variation, Export Trade Balance variation, Import Trade Balance variation, variations in the Selic Rate and Agricultural GDP variation are not significant to predict future variation of the Ibovespa points. Regarding to the Trade Balance variable, the result of this study corroborates that one found by Goswami and Jung (1998), in which the relationship din not show significant.

On the other hand, the variables: Total GDP variation and Industrial GDP variation showed significant coefficients, contradicting the results found by Horobet and Dumitrescu (2008). However, Granger causality test

showed evidence of non causal variables related to the variation of the Ibovespa points, in other words, there is evidence that the variation of Total GDP and Industrial GDP variables does not cause variation of the Ibovespa points. It was not estimated VAR model using the variable Exchange Rates as an independent variable, because the test used to determine the number of lags, policy information by Akaike's (AIC), Schwarz's (SBIC) and Hannan-Quinn (HQIC) methods, did not indicate any lags to be used in model estimation precluding the use of the VAR model.

The variable Service GDP variation was significant at 5% to predict the variation of the Ibovespa points, Granger causality test showed evidence of causality from variable Service GDP variation in relation to the variation of the Ibovespa points; the model was estimated with four lags quarterly being significant in the 2nd, 3rd and 4th lags (value of coefficient of -3.856%, -3.626% and -3.008% respectively). The impulse response function and variance decomposition show that an impulse positively given in the variation of the "Service GDP" generates a drop in the Ibovespa points in the 1st quarter which is exacerbated in the 2nd quarter, another important point is the reversal from the 4th quarter (shock to Service GDP variable leads to an increase of the variation of Ibovespa points) and the non dissipation of the effect of impact up to 8 quarter; the variance decomposition shows that the variation of the Ibovespa points variable is mainly caused by the shock in itself, starting from a value of 96% of the movement to 85% from the 4th quarter.

Regarding future researches it is suggested the use of other frequencies and the interaction of the variables in the estimation of VAR models; beyond the separation of companies by sectors.

REFERENCES

AGRAWAL, G; SRIVASTAV, A. K.; SRIVASTAVA, A. A study of exchange rates movement and stock market volatility**. International Journal of Business and Management,**v. 5, n. 12, p. 62-73. Dec. 2010.

BCB. Banco Central do Brasil. Disponível em: <http://www4.bcb.gov.br/?FOCUSERIES>. Acessoem 2012.

BLACK, A. e FRASER, P., U.K. **Stock returns: predictability and business conditions**. The Manchester School, Supplement 1995, p. 85-102, 1995.

BRIGHAM, E.F. e HOUSTON, J.F. **Fundamentos da moderna administração financeira**. Rio de Janeiro: Campus, 1999.

BROOKS, C**. IntroductoryEconometrics for Finance**. Cambridge: Cambridge Universitypress, 2008.

BRUNI, A. L. Risco, retorno e equilíbrio: uma análise do modelo de precificação de ativos financeiros na avaliação de ações negociadas na Bovespa (1988-1996).1998. 163 f.Dissertação (Mestrado em Economia) – Faculdade de Economia, Administração e Contabilidade, Universidade de São Paulo, São Paulo.

CHEN, J., NAYLOR, M., e LU, X. Some insights into the foreign exchange pricing puzzle: evidence from a small open economy. **Pacific-Basin Finance Journal**, v. 12, p. 41– 64.2004.

CHEN, N.; ROLL, R.; ROSS, S. A. Economic forces and the stock market. **Journal of Business**, v.59, n.3, p.383-403, july. 1986.

EMILIANO, Paulo César *et al*. Foundations and comparison of information criteria Akaike and Bayesian. **Revista Brasileira de Biometria**, São Paulo, v.27, n.3, p.394-411, 2009.

FABOZZI, F. J.; FOCARDI, S. M. KOLM, P. N. **Financial modeling of the equity market**: from CAPM to cointegration. New Jersey: John Wiley, 2006. Fabozzi Series.

FAMA, E.F. Stock returns, real activity, inflation, and money. **The American Economic Review**, v. 71, n. 4, p. 545-65, 1981.

FANG, W. The effects of currency depreciation on stock returns: Evidence from five East Asian economies. **Applied Economics Letters**, v. 9, n. 3, p. 195-9, 2002.

FLANNERY, M. J. ; PROTOPAPADAKIS, A. A. Macroeconomic factors do influence aggregate stock returns **Review of Financial Studies**, v.15, n.3, p.751-82.

FRIMPONG, J. M. Economic forces and the stock market in a developing economy: cointegration evidence from Ghana. **European Journal of Economics, Finance and Administrative Sciences**, v. 16, p. 1450-2275, 2009.

GESKE, R.; ROLL, R. The fiscal and monetary linkages between stock returns and inflation**. Journal of Finance**, v. 38, n. 1, p. 1-34, 1983.

GOSWAMI, G. ; JUNG, Sung-Chang. Stock market and economic forces: evidence from Korea. In: PROCEEDINGS OF GLOBAL FINANCE CONFERENCE, 1998, México. **Anais**…Mexico, 1998. Disponível em: <http://www.craig.csufresno.edu/International_Programs/JC/GLOBES/programs.htm. Acesso em: 20 nov. 2008.

GREENE, W.H. **Econometric analysis**. 6º ed. New Jersey: Hardcover, 2007

GRÔPPO, G. S. Causalidade das variáveis macroeconômicas sobre o IBOVESPA. 2004. 107f. Dissertação (Mestrado em Economia Aplicada) - Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo, São Paulo.

GUJARATI, Damodar N. **Econometria Básica**. 3º ed. São Paulo: Pearson, 2004.

GUNSEL, N. ÇUKUR, S. The effects of macroeconomic factors on the London stock returns: a sectoral approach. **International Research Journal of Finance and Economics**, v.10, p. 140- 152, 2007.

HOROBET, A.; DUMITRESCU, S.. On the causal relationships between monetary, financial and real macroeconomic variables: evidence from Central Eastern Europe. In: INTERNATIONAL CONFERENCE 2008: MONETARY AND FINANCIAL TRANSFORMATIONS IN CEECS. Paris, 2008.Disponível em: <HTTP://www.esce.fr/dlw/recherche/ArticlesColl2008/Horobet.pdf> Acesso em: 16 fev. 2009.

HONDROYIANNIS, G. ; PAPAPETROU, E. Macroeconomics influences on the stock market. **Journal of Economics and Finance**, v. 25, n.1, p.33-49, 2001.

HORNG, W. J; CHEN, C. H. DCC and Analysis of the exchange rate and the stock market returns volatility: an evidence study of Thailand country. **iBusiness**, v.2., p. 218-23, 2010.

JARVINEN, J., Industry Portfolios, economic news and business conditions: evidence from the Finnish Stock Market. **The Finnish Journal of Business Economics**, v. 49, n.2, p. 209-32, 2000.

KARAMUSTAFA, O.; KUCUKKALE, Y. Long Run Relationships between stock market returns and macroeconomic performance: evidence from turkey, EconWPA No. 0309010. 2003.

LEUNG, M.T., DAOUK, H. e CHEN, A.S., Forecasting stock indices: a comparison of classification and level estimation models. **International Journal of Forecasting**, v. 16, p. 173-90, 2000.

MAGHREBI, N.; HOLMES, M.J.; PENTECOST, E.J. Are the asymetries in the relationship between exchange rate fluctuations and stock market volatility in pacific basin countries? **Review of Pacific Basin Financial Markets and Policies**, v.9, n.2, p. 229-56, 2006.

MEDEIROS, O. R.; RAMOS, Fl. C.. Determinantes do desempenho e volatilidade da bovespa: um estudo empírico. 4º CONGRESSO USP DE CONTROLADORIA E CONTABILIDADE. 07 e 08 outubro de 2004. Disponível em: <http://www.congressousp.fipecafi.org/artigos42004/71.pdf.> Acesso em: 21 set. 2010.

NISHAT, M.; SHAHEEN, R.. Macroeconomic factors and Pakistani equity market, the Pakistan development review. **PakistanInstituteofDevelopmentEconomics**, v. 43, n.4, p. 619-37, 2004.

OFFICER, R.R.The variability of the market factor of the New York stock exchange.**Journal of Business,** v. 43, p. 434-53, July 1973.

OMRAN, M. M. Time series analysis of the impact of real interest rates on stock market activity and liquidity in Egypt: co-integration and error correction model approach. **International Journal of Business,** v. 8, n.3, p. 360-74, 2003.

PILINKUS, D. Stock market and macroeconomic variables: evidences from Lithuania. **Economics & Management**, v.14, p. 884-91, 2009.

PIMENTA JR, T., HIGUCHI, R. H..Variáveis macroeconômicas e o Ibovespa: um estudo da relação de causalidade. **REAd**, v. 14, n. 2, maio/ago. 2008.

ROLL, R. ; ROSS, S.A. An empirical investigation of the arbitrage pricing theory.**Journal of Finance**, v.35, n.5, p.1073-103, Dec. 1980.

ROSS, S.A. The arbitrage theory of capital asset pricing.**Journal of Economic Theory**, v.13, n.3, p.341-60, Dec. 1976.

SCHOR, A.; BONOMO, M.; PEREIRA, P. L. V.. ArbitragePricingTheory (APT) e variáveis macroeconômicas: um estudo empírico sobre o mercado acionário brasileiro. Rio de Janeiro: Departamento de Economia da Pontifícia Universidade Católica do Rio de Janeiro. Dez. 1998.Working Paper.

TEIXEIRA; E.E.M; BARBOSA; F.V; SOUZA,A.A. Relating Economic Expectations as Disclosed in the Brazilian "Focus Report" to the Volatility and Return of the Most Frequently Traded Stocks Included in the São Paulo Stock Exchange Index (Ibovespa). XII Encontro Brasileiro de Finanças, 2012.

TERRA, P. R.S..Estrutura de capital e fatores macroeconômicos na América Latina. **Revista de Administração**, São Paulo, v.42, n.2, p.192-204, abr./maio/jun. 2007.

TUNALI, H.. The Analysis of relationships between macroeconomic factors and stock returns: evidence from Turkey using VAR model**.International Research Journal of Finance and Economics,** v 57, p.169-82. 2010.

ZHANG, J.; YONG, H.H.A; LEE, M.; GAN, C.. Macroeconomics variables and stock market interactions: New Zealand evidence. **Investment Management and Financial Innovations**, v. 3, n.4, 2006.