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BERNARDO HILLESHEIM PAULSEN

SOME EVIDENCE ON POLITICAL INFORMATION AND EXCHANGE COUPON IN BRAZIL

Porto Alegre

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Work presented in partial fulfilment of the requirements for the degree of Bachelor in Economics

Advisor: Prof. Dr. Nelson Seixas dos Santos

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ABSTRACT

We investigate whether political news affect the exchange coupon in Brazil, in a period ranging from November 24, 2016, until April 16, 2019. Our sample of news is collected via web scrapping, which we apply on a Brazilian news portal. We use two measures for the exchange coupon, and we apply a GARCH model to estimate conditional volatility, which we filter with both a parametric and a non parametric approach. The results from the parametric analysis indicate that the exchange coupon was affected by the corruption scandal of President Temer (May, 2017), the announcement of Jair Bolsonaro as candidate for the republic's presidency (July, 2018), the first round of the presidential elections (October, 2018), and the announcement of changes to the Pension Reform (January, 2019). The results from the non parametric analysis indicate that, besides the events above, the exchange coupon was also affected by news related to the Labour Reform (March, 2017), to the impeachment requests of President Temer that followed the corruption scandal (August and October, 2017), and to the elections for the Chamber of Deputies' presidency (January and February, 2019).

JEL classification: C58, G14.

Keywords: Political information. News. Financial markets. Efficient markets.

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LIST OF ABBREVIATIONS AND ACRONYMS

API	Application Programming Interface
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroscedasticity
BCB	Central Bank of Brazil
BM&F	Commodities and Futures Exchange
BRL	Brazilian Real
CAPM	Capital Asset Pricing Model
CDI	Inter-Bank Deposits Rate
CETIP	Central of Custody and Financial Settlement of Private Securities
CMN	National Monetary Council
CoPoM	Monetary Policy Committee
CSD	Conditional Standard Deviation
CVM	Commission of Transferable Securities
DI1	DI1 Exchange Coupon
EMH	Efficient Market Hypothesis
GARCH	General Autoregressive Conditional Heteroscedasticity
IPI	Tax on Industrialized Products
OAB	Brazilian Bar Association
OC1	OC1 Exchange Coupon
PR	Party of the Republic
PSDB	Party of Social Democracy
PSL	Liberal Social Party
PSOL	Socialism and Liberty Party
PT	Worker's Party

PTAX	PTAX800
Selic	Special Settlement and Custody System Rate
SFN	Brazilian Financial System
SGS	Time Series Management System
TN	National Treasury
USD	United States Dollar
VAR	Vector Autoregression

CONTENTS

1 INTRODUCTION

It is very common for the media around the world to announce the idea that a given political event has made an impact on the financial markets. In fact, newspapers constantly refer to political news as the cause of fluctuations in prices of financial assets. That explanation is inconsistent with the classical semi-strong market efficiency hypothesis as posed by Fama (1970) though, which states prices reflect all available public information.

The evidence on asset prices being affected by news about monetary variables (see Cornell (1983)), by news about the real sector (see, McQueen and Roley (1993), Caporale, Spagnolo and Spagnolo (2015)) complicates the issue further. Still, in general, the semi-strong form market efficiency tests for political information in Brazil have shown supporting evidence for the hypothesis in the case of stock market returns and interest rates (Marques and Santos (2016)).

Indeed, the studies mentioned above test for efficiency in a national investor level, since they took for granted investor's return would be measured in domestic currency terms. But, actually, foreign investors are responsible for 22.61% of the volume daily traded in Brazilian stock market in 2019 as it can be seen in B3 Participation of Investors Report.

The problem we address here is whether political information affects the exchange coupon, which is the difference between the interest rate and exchange rate variation in a country, and measures the return for dollars invested locally. Therefore, the contribution made here is not only to investigate market efficiency in Brazil from a international, broader and more solid perspective but also establish a replicable methodology applicable to other countries' data.

We follow Marques and Santos (2016) methodology, that is: we apply web-scraping to search for news; we find the ones related to national political events by searching the headlines for keywords; we filter the exchange coupon for abnormal volatility; and finally we cross the data to determine whether abnormal volatility was related to political events. To find the periods with abnormal volatility for the exchange coupon, we apply Bollerslev (1986) GARCH as a filter, in which we search for abnormal values of the conditional standard deviation series with both a parametric and a non parametric analysis.

It is worth noticing there are two measures of exchange coupon in Brazil. The first measure is the difference between the average rate of one-day inter-bank deposits (DI) and the exchange rate variation (as measured by PTAX800), while the other is the

excess return of referential rate of the Special Settlement and Custody System (Selic) over exchange rate variation (PTAX800).

The paper is organized as follows: chapter 2 describes the Brazilian institutional environment; chapter 3 reviews the literature on news and market efficiency; Chapter 4 describes the model of market efficiency tested in this paper; Chapter 5 describes the data used and the methods applied; Chapter 6 shows the results; and finally Chapter 7 shows the conclusions.

2 THE INSTITUTIONAL ENVIRONMENT

Brazil's legal basis is defined in the 1988 Constitution (Brasil (1988)). Brazil is a representative federative republic, where the government's power is divided in three branches, the Executive, Legislative and Judiciary, which are independent of each other. The country's president, chief of the Executive, is elected via universal direct secret compulsory vote by the citizens for a four-year term, and can be reelected only once. The senators and deputies, who make up the Legislative, are also elected this way, and have terms of eight and four years respectively. The constituents of the Judiciary, on the other hand, are almost all selected by pubic tender, as the ministers from the Supreme Court and Superior Justice Tribunal are indicated by the republic's president.

The Brazilian Financial System (SFN) as it is today was instituted in Law 4.595, from December 1964 (Brasil (1964)). The National Monetary Council (CMN) was established as the major normative institution of the Financial System, while the Central Bank of Brazil (BCB) was established as the major executive institution. CMN is composed by the Minister of Economy and the Central Bank's President, and defines the guidelines for the budget, fiscal, monetary, credit and exchange policies, while also establishing the rules for the SFN.

The policies which guidelines are defined by the Monetary Council are executed by the Central Bank, which goal is to enforce the norms defined by the first. The Central Bank has the monopoly of currency issue, and executes the monetary policy and the exchange policy with the buying and selling of public debt securities, which are issued by the National Treasury (TN). The Central Bank's president is indicated by the republic's president, who can replace him anytime, therefore the institution is not independent - this issue was recently addressed by President Bolsonaro in a complementary bill project which alters Law 4.595 (Brasil (1964)).

Today's regimes for monetary and exchange policies started in 1999, with the establishment of the so-called Economic Tripod, which is a set of three regimes for economic policy: inflation targeting for the monetary policy, government surplus for the fiscal policy, and floating exchange rate for the exchange policy. The target for the inflation rate is defined by the Monetary Council, while the Monetary Policy Committee (CoPoM) defines the target for the short term interest rate (Selic) used for the monetary policy, and the Central Bank pursues this interest rate.

The transferable securities market (securiries, commodities and derivatives ex-

changes) is disciplined and supervised by the Commission of Transferable Securities (CVM), established in Law 6.385, from December 1976 (Brasil (1976)). Brazil has only one stock exchange, B3, which acts in all branches of the transferable securities market. B3 emerged as the fusion, in 2017, between BM&FBOVESPA (itself the fusion of BM&F (Commodities and Futures Exchange) and BOVESPA (São Paulo Securities Exchange)), and CETIP (Central of Custody and Financial Settlement of Private Securities). In Table 2.1 the structure of the National Financial System is represented for better visualization.

Table 2.1: National Financial System

	Currency, Credit, Capital, Currency Exchange		Private Insurance	Closed Pension
Regulating Entities	CMN (National Monetary Council)		CNSP (National Private Insurance Council)	CNPC (National Supplementary Pension Council)
Supervising Entities	BC (Central Bank of Brazil)	CVM (Commission of Transferable Securities)	Susep (Superintendence of Private Insurance)	Previc (National Superintendence of Supplementary Pension)
Operators	Banks and Savings Banks, Credit Cooperatives, Payment Institutions, Consortium Administrators, Brokers and Distributors, other non banking institutions	Stock, Commodities and Futures Exchanges	Insurers and Reinsurers, Open Pension Entities, Capitalization Companies	Closed Entities of Supplementary Pension

The structure described above has strong impact in the behaviour of the exchange coupon, as the coupon's interest rate component is closely related to the pursue of a inflation target, and it's exchange rate component fluctuates in a floating exchange rate regime.

3 NEWS AND MARKET EFFICIENCY

The Efficient Market Hypothesis (EMH), as posed by Fama (1970), states that security prices "fully reflect" available information, providing "accuarate signals for resource allocation". In the model, information is divided in three subsets. For the weak form efficiency, the information set is the historical prices of the security. For the semi strong form, it is all the publicly available information, and finally, for the strong form, it is all available information, even if held private. There is massive literature on market efficiency, as the hypothesis has enormous implications for trading strategies, since it indicates the impossibility of economic profit with existing information (Kamal (2014)). Our paper focus on semi strong form efficiency, as we work with information in the form of publicly available news.

The evidence on the relationship between financial variables and news support that the first responds to the latter. News about the macroeconomy are shown to affect commodity prices in Caporale, Spagnolo and Spagnolo (2015), while McQueen and Roley (1993) shows not only that the stock market responds to this subset of news, but that the response depends on the state of the economy. The use of news for trading strategies is shown to award economic profit in Larsen and Thorsrud (2017). In Moussa, Delhoumi and Ouda (2017) it is shown that information supply has impact on prices, but the effect is more pronounced on volatility than on returns.

Caporale, Spagnolo and Spagnolo (2015) applies a VAR-GARCH model to analyze the spillovers between mean and variance of both macroeconomic news and commodity returns. The sample of returns is composed by ten commodities and the exchange rate, in a period of over 13 years. The news sample includes the worldwide coverage of four macroeconomic variables: GDP, unemployment, retail sales and durable good, which are are used in the making of two indexes, one for positive and one for negative news. The results show spillovers for all variables but gold and silver. In McQueen and Roley (1993) it is analyzed if stock prices response to news vary over different stages of the business cycle. The sample of equity prices consists in the S&P 500 Index from over 10 years, and the sample of series used to represent the stage of the economy consists of variables related to cash flows and equity discount rates. The results show that the stock market responds positively to good macroeconomic news when the economy is weak, but negatively when the economy is strong.

Textual data is used to analyze the relationship between news topics and stock

returns in Larsen and Thorsrud (2017). The news sample comes from a daily Norwegian newspaper, and the stock prices sample comes from several firms listed in the Oslo Stock Exchange. The results show that news predict daily returns, allowing for investment strategies with economic returns. In Moussa, Delhoumi and Ouda (2017) news headlines are used to measure information supply, while search volume from Google Trends database is used to measure information demand. The sample of stocks is 25 stocks composing the Frech stock market index CAC40 and the index itself, and it's time range is seven years. A model is developed to test the relationship between the samples, and the results indicate that information affects asset prices, but while the effect on volatility is considerable, the effect on returns is small.

When testing for political information, the results also support that security prices are responsive. Both Smales (2015) and Marques and Santos (2016) show that political uncertainty is related to market uncertainty, the first for Australia and the latter for Brazil. The Brazilian stock market is also shown to react to tax announcements in Gabriel, Ribeiro and Ribeiro (2013).

Smales (2015) uses electoral polls data to construct two measures of political uncertainty. One represents overall election uncertainty, the other represents uncertainty about reelection, which is considered of importance as economic policies of a reelected president are well known in caparison with the policies of a newly elected president. The financial series are exchange-traded futures and options based on the Australian stock market index S&P/ASX 200. Market volatility is shown to increase with political uncertainty, and decrease with the probability of reelection. In Marques and Santos (2016) a GARCH model is applied to daily stock returns and short term interest rates in Brazil. The sample for the first is the Bovespa Index, and the sample for the latter is composed by the Selic rate and the DI rate. Samples range from January 2014 to April 2016. The results show that the the stock market only responds to political news in the case of elections, as the only period of abnormal volatility related to news happened to occur around the 2014 presidential elections' date. On the other hand, the short term interest rates do not respond to political news. Gabriel, Ribeiro and Ribeiro (2013) verifies if a government's annunciation of tax cuts affected stock prices of companies from the sector that would be directly affected. The referred tax is the Tax on Industrialized Products (IPI). After filtering for characteristics that would make the calculations possible, 13 stocks made to the final sample. The results indicate that the stock prices were indeed affected by the tax cut annunciation.

4 THE MODEL

Market efficiency, as posed by Fama (1970), is a implication of a perfect capital market (neither transaction or information costs), investor risk aversion, and two-parameter return distributions (Fama and MacBeth (1973)). If weak form market efficiency holds, then chartist or technical analysis is useless, and if the semi-strong form holds, then fundamental analysis, founded on public information, is useless (Oprean (2012)).

For a brief demonstration of the model, we will consider that equilibrium prices are generated in the two parameter Sharpe (1964) world. Two assumptions about the investor are made: that he acts in the basis of two parameters of the distribution of returns of an asset - its expected value and standard deviation; and that he derives utility from returns and disutility from risk. The market is built upon two other assumptions: a common pure rate of interest; and homogeneity of investor expectations, as they agree on expected values, standard deviations, and correlations of the securities. In this world, the equilibrium expected return on a security is a function of it's correlation with a efficient combination of securities.

Let U denote the utility of an investor, E_W denote the expected value of a security W, and σ_W its standard deviation, the utility function of the investor is defined in Equation 4.1.

$$U = f(E_W, \sigma_W) \tag{4.1}$$

As the future value of a security is directly related to its return, let R denote the return, the utility function can be defined as in Equation 4.2.

$$U = g(E_R, \sigma_R) \tag{4.2}$$

The investor likes return and dislikes risk, therefore the utility function is increasing with security's expected return and decreasing with its standard deviation, as shown in Equations 4.3 and 4.4.

$$\frac{dU}{dE_R} > 0 \tag{4.3}$$

$$\frac{dU}{d\sigma_R} < 0 \tag{4.4}$$

Let i denote an investor among the population and r denote the pure rate of interest, the assumption of a common pure rate of interest can be defined in Equation 4.5.

$$r_i = r, \quad \forall i \tag{4.5}$$

Let a and b denote each any security in the market, the assumption of homogeneous expectations can be defined in Equations 4.6, 4.7 and 4.8.

$$E_{W_i} = E_W, \quad \forall i \tag{4.6}$$

$$\sigma_{W_i} = \sigma_W, \quad \forall i \tag{4.7}$$

$$Cor(W_a, W_b)_i = Cor(W_a, W_b), \quad \forall i, a, b \tag{4.8}$$

Let G denote an efficient portfolio, the equilibrium expected return function derived from the assumptions above for any given security can be described in Equation 4.9.

$$E_R = r + \frac{Cov(R_W, R_G)}{\sigma_{R_G}}(E_{R_G} - r) \tag{4.9}$$

The model in Equation 4.9 is called Capital Asset Pricing Model (CAPM), and shows that the equilibrium expected return for a security is a function of its risk.

Successive returns of prices which fully reflect available information are uncorrelated (Samuelson (1965)). Together with the assumption that successive price changes are identically distributed, this leads us to the random walk model (Fama (1970)). The random walk model is a special case of the AR(1) process. Let w_t denote the security price at time t, the process is given by Equation 4.10.

$$w_t = \alpha_0 + \alpha_1 w_{t-1} + \varepsilon \tag{4.10}$$

where

$$\alpha_0 = 0, \quad \alpha_1 = 1$$

The returns from a random walk are white noise. Let r_t denote the security return at time t, white noise is given by Equation 4.11.

$$E(w_t) = w_{t-1}$$

$$E(r_t) = E(w_t) - w_{t-1} = 0$$

$$E(r_t) \sim f(0, \sigma) \tag{4.11}$$

In order to find inefficiency, we look for unusual behaviour in the regression residuals. As with the random walk model, the residual at time t (denoted by e_t) is given by Equation 4.12.

$$e_t = r_t - E(r_t)$$

$$e_t = r_t \tag{4.12}$$

To find unusual behaviour in the residuals, we apply a GARCH (Bollerslev (1986)) model to the exchange coupon series, and filter the conditional standard deviation series extracted from the model for abnormal values.

5 METHODS AND DATA

In order to test the impact of political news on the exchange coupon, we searched for political news, calculated the exchange coupon (both the OC1 and the DI1 measures), tested the coupon for abnormal volatility, and finally we crossed the periods with abnormal volatility in the exchange coupon with the correspondent political news. The information on political news was gathered with web scrapping technique, applied in the main Brazilian news portal. A filter was applied to the news sample to find the ones related to national political events. We calculated the two different measures of exchange coupon negotiated in Brazil from its components (a shared exchange rate measure and two specific interest rate measures). To find the periods with abnormal volatility, we applied a GARCH model to the exchange coupon, and then filtered it's conditional standard deviation for abnormal values, with both a parametric and a non parametric approach.

5.1 Data

Based on data availability, our news sample begins at November 24, 2016, the first date for which there were political news available in the scrapped website. Our exchange rate and interest rates samples begin one day earlier, to allow for the exchange coupon series to begin with the news sample. All samples end at May 16, 2019.

5.1.1 Political News

We gathered information on political news by applying web scrapping technique to a online news portal. The scrapping was made in the political section of G1, a Brazilian news portal maintained by Grupo Globo, a conglomerate based in Rio de Janeiro. It provides content from Grupo Globo's television channels, radio stations, newspapers and magazines, besides it's own content. The scrapping was executed at May 17, 2019, and resulted in a sample of 17.836 news over 837 days. The dollar market closes at 6 pm, therefore all news after this time were pushed to the subsequent day. News from weekends and holidays were pushed to the closest subsequent business day.

To find political events that could impact the exchange coupon, we follow Baker, Bloom and Davis (2015) as we searched our headlines sample for keywords. The key-

words were: related to market uncertainty, 'incerteza', 'mercado' and 'economia' (uncertainty, market, economy); related to components of the exchange coupon, 'dólar', 'selic' and 'cdi' (dollar, Selic, DI) ; and related to federal government matters, 'presidente', 'presidência', 'câmara', 'senado', 'tribunal de contas da união', 'tcu', 'superior tribunal federal' and 'stf' (president, presidency, chamber (as in Chamber of Deputies), senate, Federal Accountability Office and its initials, and Supreme Court and its initials). The search resulted in a sample of 2.333 news. The final sample is 13% the size of the unfiltered sample in terms of number of news, therefore, we excluded 87% of the initial sample as it was composed of political news unrelated to federal political matters.

5.1.2 Exchange Coupon

In order to obtain the series for the exchange coupon (both the OC1 and the DI1 measures), we collected a sample of the dollar exchange rate PTAX 800 (PTAX), that was used for both measures, a sample of the referential rate of the Special Settlement and Custody System (Selic) for the OC1 measure, and a sample of the of the inter-bank deposit rate (DI) for the DI1 measure. All three series were collected from the Central Bank of Brazil Time Series Management System (BACEN-SGS), through it's Application Programming Interface (API). The exchange rate is measured in BRL/USD, and the interests rates are measured in % a day.

Our samples range from November 23, 2016 to May 16, 2019. They begin shortly after the end of the impeachment process of President Dilma Rousseff, at August 31, when President Temer (Ms Dilma's Vice President) took office after three months as Interim President. This happened during the largest economic crisis in Brazilian history, with the fourth trimester of 2016 being the last from a series of eleven in which the Gross Domestic Product decreased. The remaining period from our sample saw economic stagnation. Mr Temer's presidency was marked by reforms - like the Labour Reform, which successfully passed, and the Pension Reform, did not -, and by a corruption scandal involving him related to Operation Car Wash, a investigation on money laundry involving Brazilian politicians, which was very present in the media since even before his presidency. At October 2018 presidential elections were held, and Mr Bolsonaro was elected. The new president took office with his main focus as a new Pension Reform, which is still awaiting for approval by the time this is being written.

Figure 5.1 shows the exchange rate (PTAX) series, Figure 5.2 shows the referential

rate of the Special Settlement and Custody System (Selic) series, and Figure 5.3 shows the inter-bank deposits rate (DI) series. The descriptive statistics for the series are shown in Table 5.1.

Figure 5.1: Dollar Exchange Rate

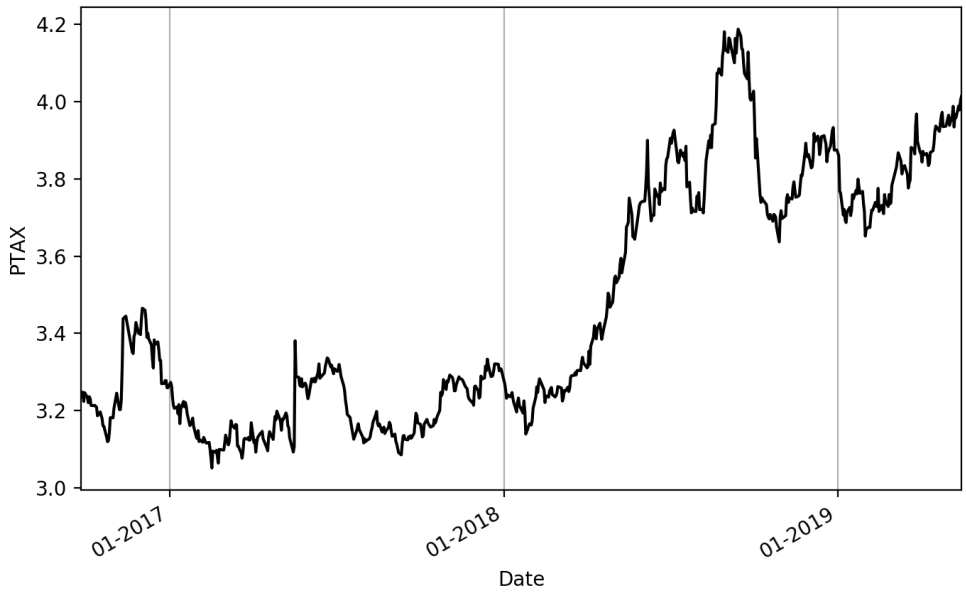


Figure 5.2: Referential Rate of the Special Settlement and Custody System

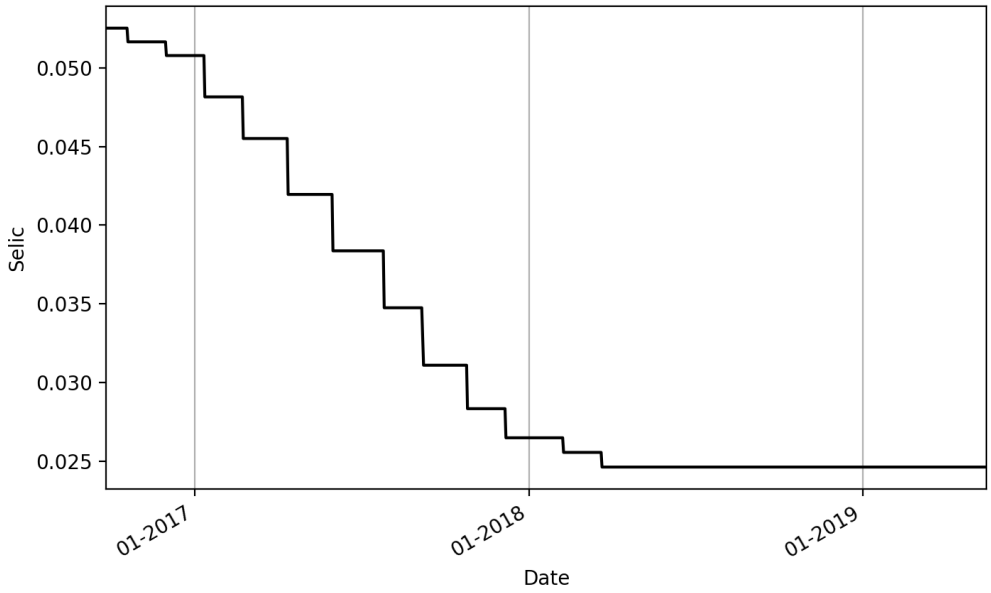


Figure 5.3: Interbank Deposit Rate

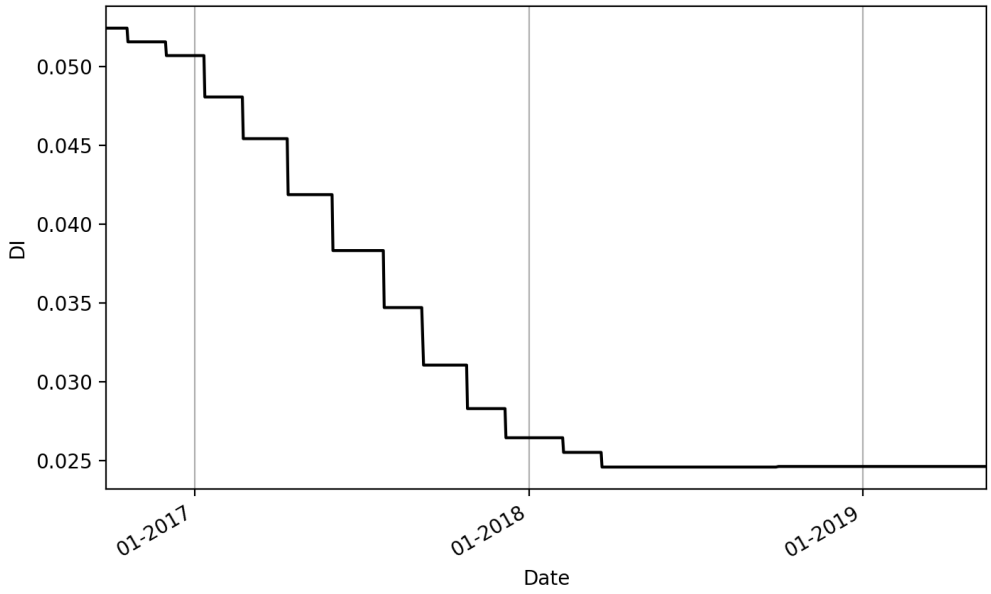


Table 5.1: Descriptive Statistics for PTAX, Selic and DI

Series	Mean	Standard Deviation	Minimum Value	Maximum Value
PTAX	3.467	0.316	3.051	4.188
Selic	0.033	0.010	0.025	0.053
DI	0.033	0.010	0.025	0.052

The exchange coupon is the interest rate obtained from the difference between the accrued interest rate between the operation date and the business day preceding the due date, and the exchange rate variation observed between the business day preceding the operation date and the business day preceding the due date. We calculated both measures of the exchange coupon via Equation 5.1:

$$ExchangeCoupon_t = \frac{1 + \frac{InterestRate_{t-1}}{100}}{\frac{ExchangeRate_t}{ExchangeRate_{t-1}}} - 1 \tag{5.1}$$

Figure 5.4 shows the OC1 exchange coupon series, Figure 5.3 shows the DI1 exchange coupon series, and Table 5.2 shows the descriptive statistics for both measures.

Figure 5.4: OC1 Exchange Coupon

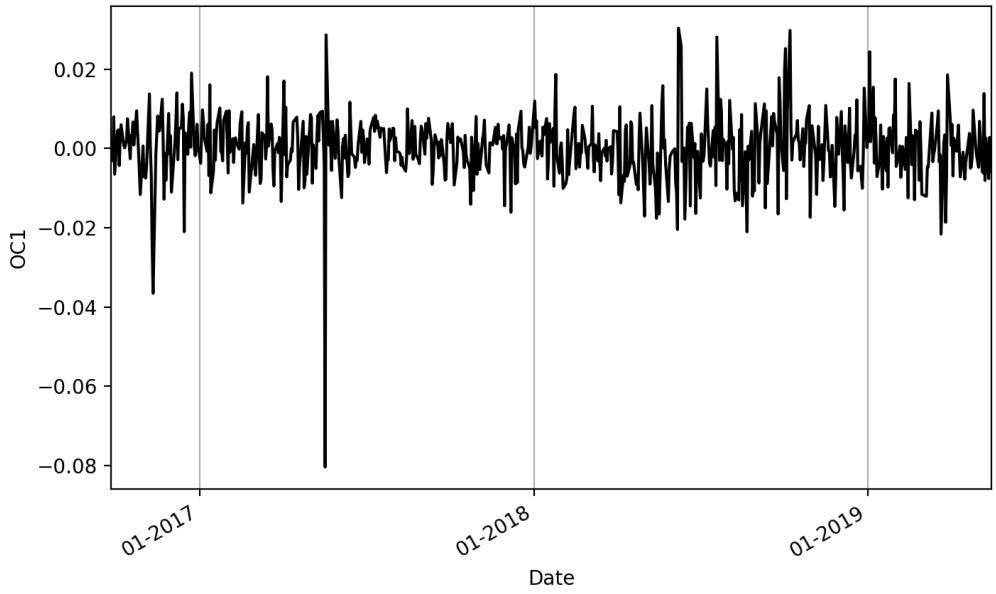


Figure 5.5: DI1 Exchange Coupon

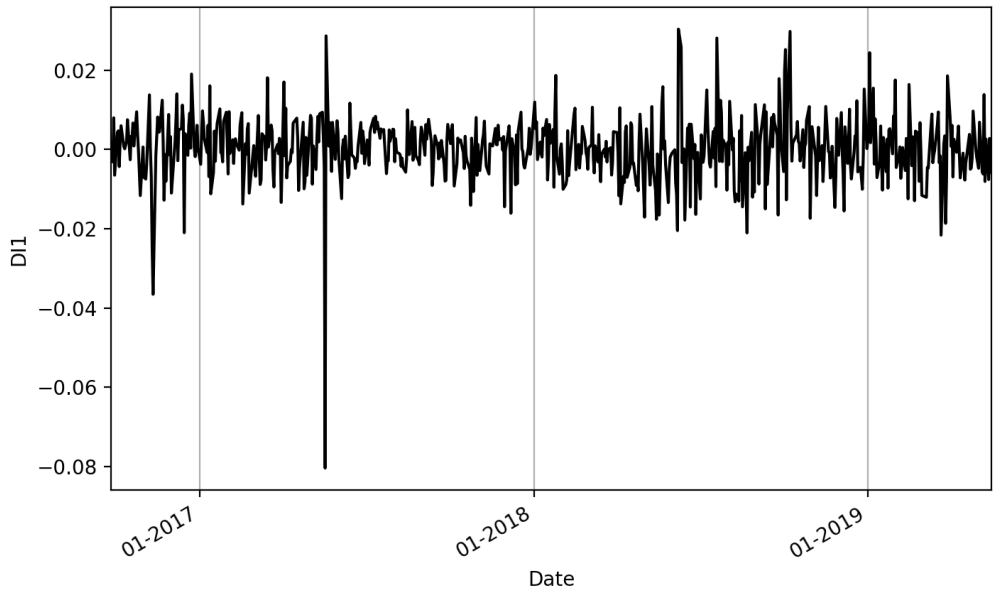


Table 5.2: Descriptive Statistics for OC1 and DI1 Exchange Coupons

Series	Mean	Standard Deviation	Minimum Value	Maximum Value
OC1	0.000	0.008	-0.080	0.030
DI1	0.000	0.008	-0.080	0.030

Visually, both exchange coupon measures show a stationary form, nevertheless, we tested the series against the null hypothesis of presence of a unit root with the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller (1979)), and against the null hypothesis of stationarity around a deterministic trend with the Kwiatkowski– Phillips–Schmidt–Shin (KPSS) test (Kwiatkowski et al. (1992)). The results for the ADF test are shown in Table 5.3, and the results for the KPSS test are shown in Table 5.4.

Table 5.3: Augmented Dickey-Fuller Test

Series	Test Statistic	Critical Value at 5% Level
OC1	-2.564e+01	-2.866e+00
DI1	-2.564e+01	-2.866e+00

Table 5.4: Kwiatkowski–Phillips–Schmidt–Shin Test

Series	Test Statistic	Critical Value at 5% Level
OC1	1.437e-01	4.630e-01
DI1	1.436e-01	4.630e-01

The tests results in Tables 5.3 and 5.4 show support for the hypothesis of stationarity of the series that the visual analysis suggested to be true. For both measures of the exchange coupon the Augmented Dickey-Fuller test rejected the null hypothesis of presence of a unit root and the Kwiatkowski– Phillips–Schmidt–Shin test accepted the null hypothesis of stationarity around a deterministic trend.

5.2 Methods

5.2.1 Generalized Autoregressive Conditional Heteroskedastic Model

The Generalized Autoregressive Conditional Heteroskedastic (GARCH) model, introduced in Bollerslev (1986), is a generalization of the Autoregressive Conditional Heteroskedastic (ARCH) model introduced in Engle (1982), which models heteroscedasticity. While the most common models for time series assume a constant variance for the process (as ARIMA), the ARCH process assumes an inconstant variance conditional on past variance, together with a constant unconditional variance. The GARCH process assumes inconstant variance conditional on past conditional variance as well as past variance. Both ARCH and GARCH are serial uncorrelated processes with zero mean.

Let y_t denote a real-valued discrete time process and ψ_t denote the information set at time t, the ARCH process is given by Equation 5.2 and Equation 5.3 while the GARCH process is given by Equation 5.2 and Equation 5.4.

$$y_t|\psi_{t-1} \sim N(0, h_t) \tag{5.2}$$

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i y_{t-i}^2 \tag{5.3}$$

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i y_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} \tag{5.4}$$

where

$$q > 0, \quad p \geq 0$$

$$\alpha_0 > 0, \quad \alpha_i \geq 0, \quad i = 1, ..., q$$

$$\beta_i \geq 0, \quad i = 1, ..., p$$

As we can see above, if $p = 0$ than it becomes a ARCH process. If also $q = 0$ than the process is white noise. We will use h_t, the conditional standard deviation, as a estimate for the exchange coupon's standard deviation at time t.

5.2.2 Estimation

We estimate a GARCH model for both measures of the exchange coupon. The model estimated will be a GARCH(1,1), therefore we must visually check if one lag for both the auto regressive and the moving average parts of the model is appropriate. We do so by visually inspecting the auto-correlation and partial auto-correlation functions. The graphs for the auto-correlation function and for the partial auto-correlation function are given in Figure 5.6 and Figure 5.7, respectively, for the OC1 exchange coupon, and in Figure 5.8 and Figure 5.9 for the DI1 exchange coupon.

Figure 5.6: Auto-Correlation Funcion for OC1 Exchange Coupon

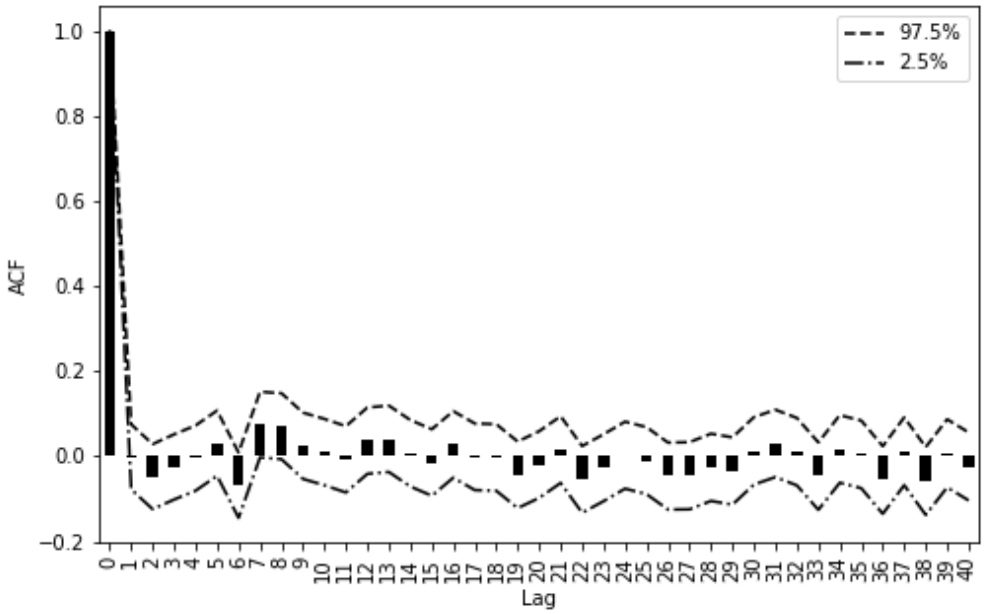


Figure 5.7: Partial Auto-Correlation Funcion for OC1 Exchange Coupon

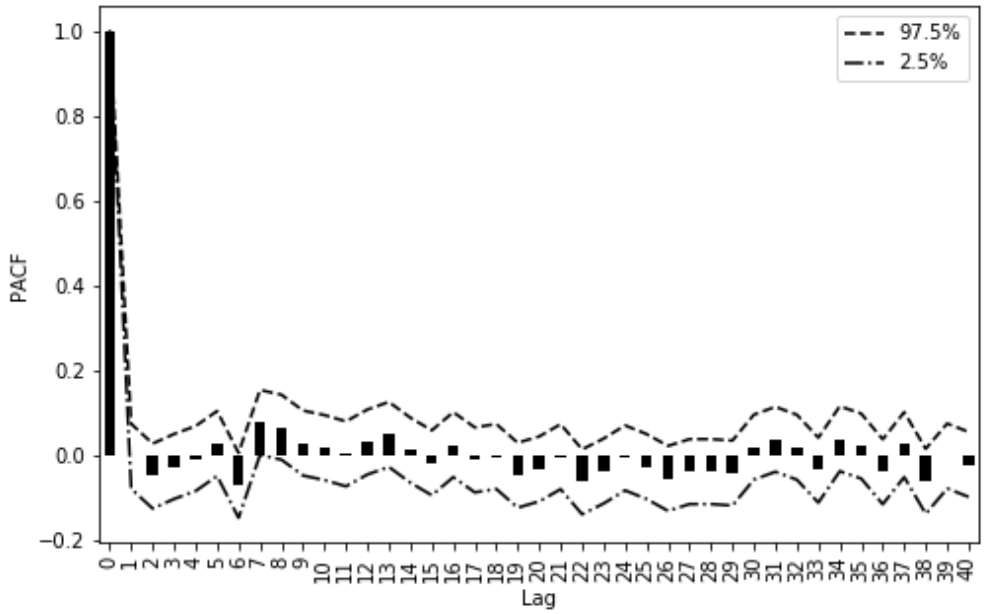


Figure 5.8: Auto-Correlation Funcion for DI1 Exchange Coupon

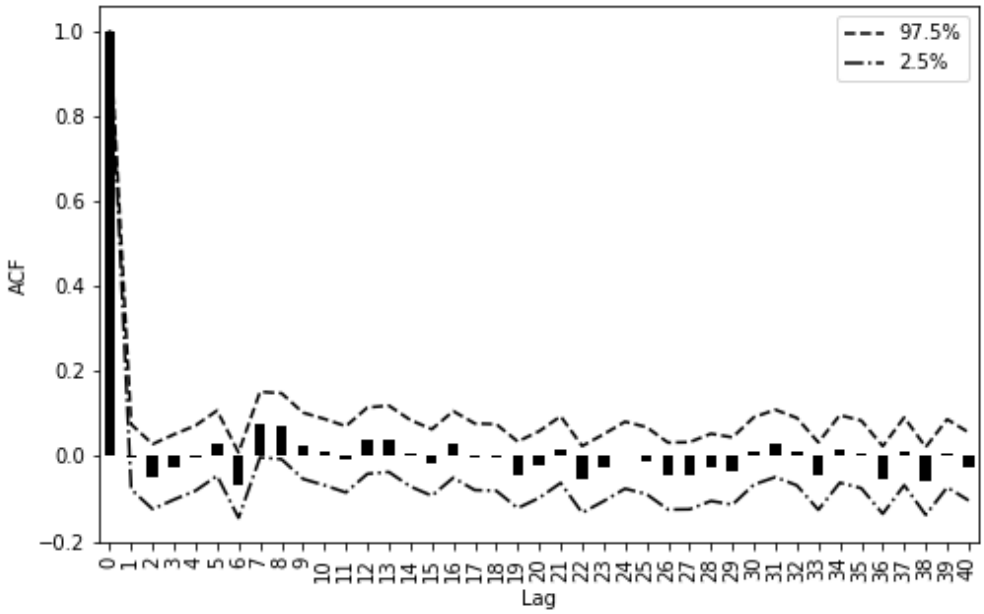
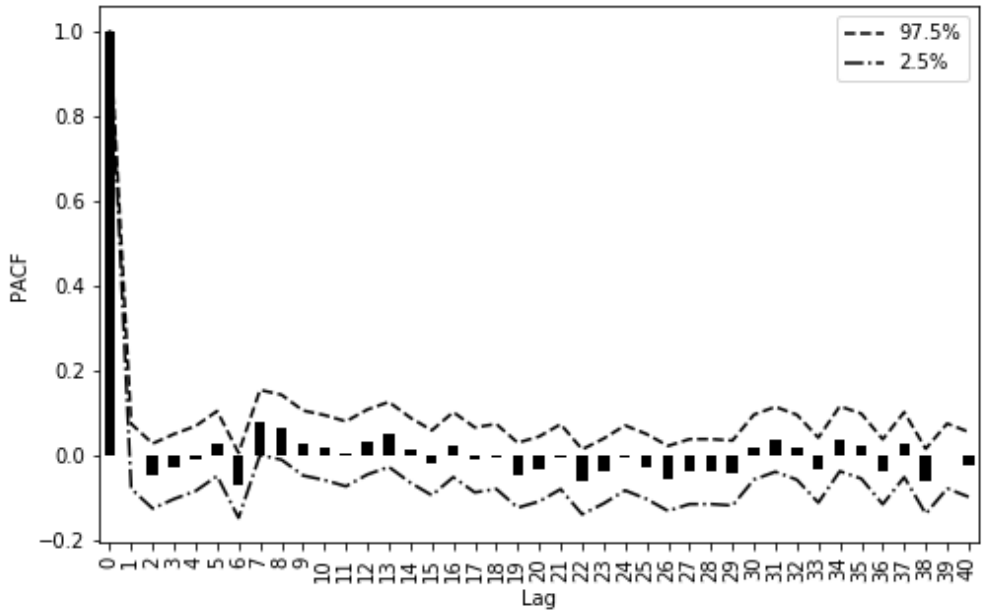


Figure 5.9: Partial Auto-Correlation Funcion for DI1 Exchange Coupon



The visual inspection shows support for the use of GARCH(1,1). After the fitting of the model, the residuals must behave like white noise, that is, the mean must be constant and equal to zero, and there must be no auto-correlation in the series. First, we inspect this behavior visually with the residuals graph and auto-correlation function. The graph for the residuals is shown in Figure 5.10 for the OC1 measure, and in Figure 5.12 for the

DI1 measure. The graph for the auto-correlation function is shown in Figure 5.11 for the OC1 measure and in Figure 5.13 for the DI1 measure.

Figure 5.10: Residuals of OC1's GARCH

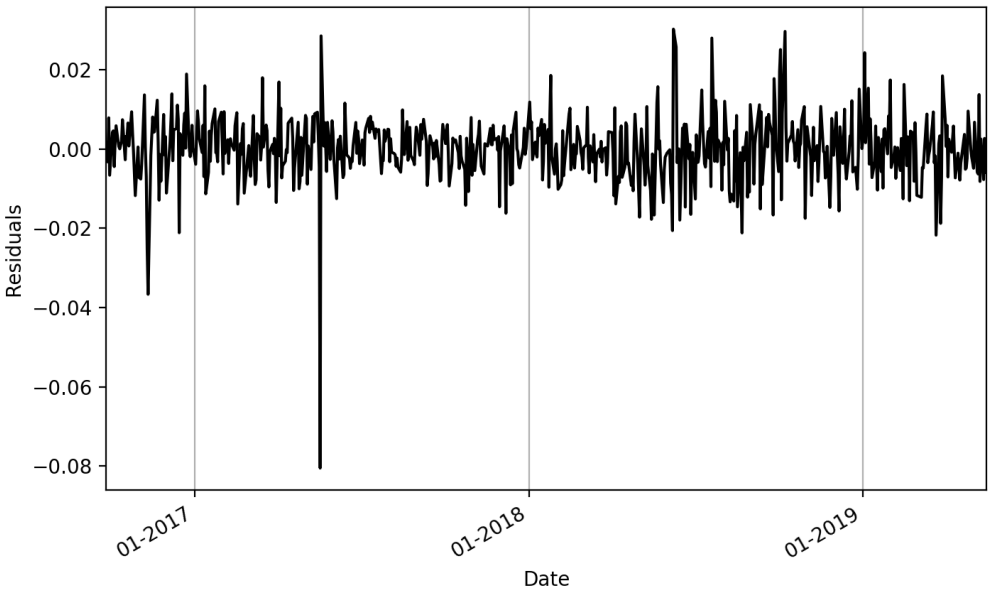


Figure 5.11: Auto-Correlation Funcion for Residuals of OC1

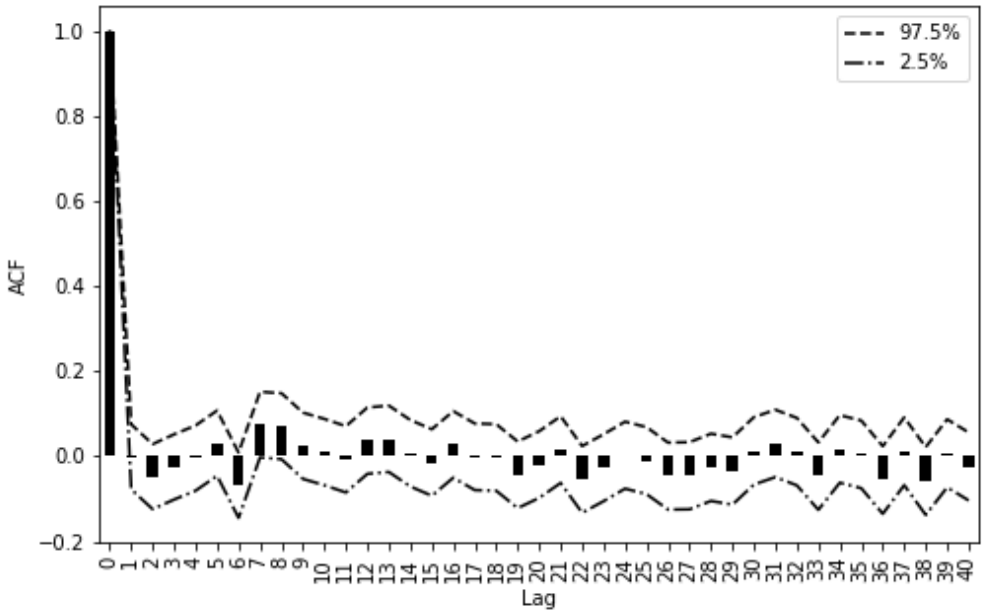


Figure 5.12: Residuals of DI1's GARCH

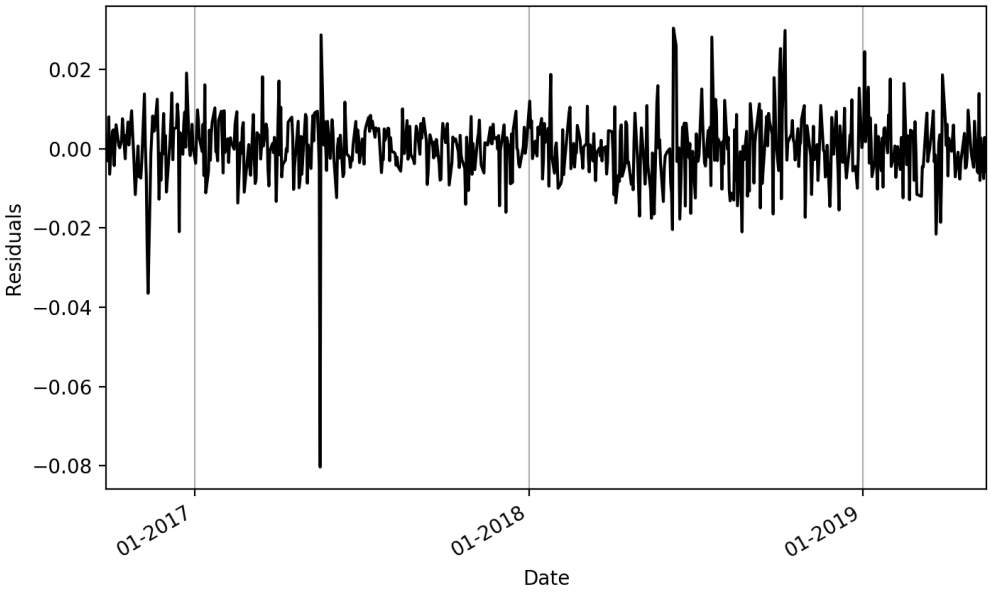
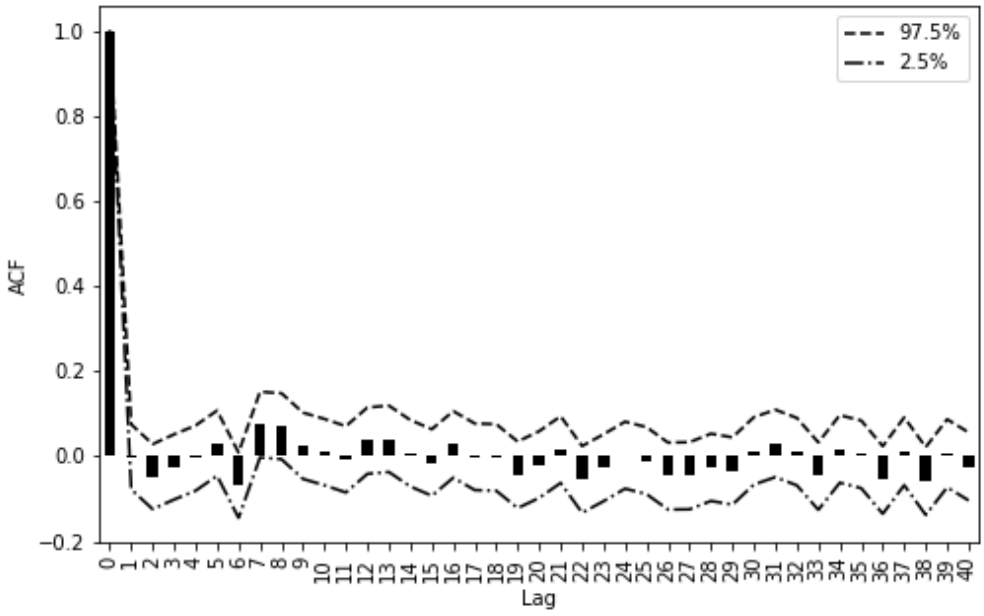


Figure 5.13: Auto-Correlation Funcion for Residuals of DI1



The visual inspection shows white noise behaviour. To certify this behaviour, we test the null hypothesis that the residuals are independently distributed with the Ljung-Box test (Box and Pierce (1970) and Ljung and Box (1978)), and the null hypothesis that the residuals sample comes from a normal distributed population with the Shapiro-Wilk test (Shapiro and Wilk (1965)). The results for the tests, for both measures of the exchange

coupon, are shown in Table 5.5.

Table 5.5: Ljung-Box Test and Shapiro-Wilk Test

Series	P-value for Ljung-Box Test	P-value for Shapiro-Wilk Test
Residuals of OC1's GARCH	8.069e-01	3.598e-19
Residuals of DI1's GARCH	8.069e-01	3.595e-19

The results shown in Table 5.5 support the hypothesis that the residuals behave as white noise. The Ljung-Box tests cannot reject the null hypothesis that the residuals are independently distributed, while the Shapiro-Wilk tests accepted the null hypothesis that the residuals sample comes from a normal distributed population.

5.2.3 Conditional Standard Deviation

From the GARCH model, we extract the conditional standard deviation (CSD) series, which values we use as an estimate for each period's standard deviation. The CSD series are shown in Figure 5.14 for the OC1 measure, and in Figure 5.15 for the DI1 measure. The descriptive statistics for the series are shown in Table 5.6

Figure 5.14: OC1's Conditional Standard Deviation

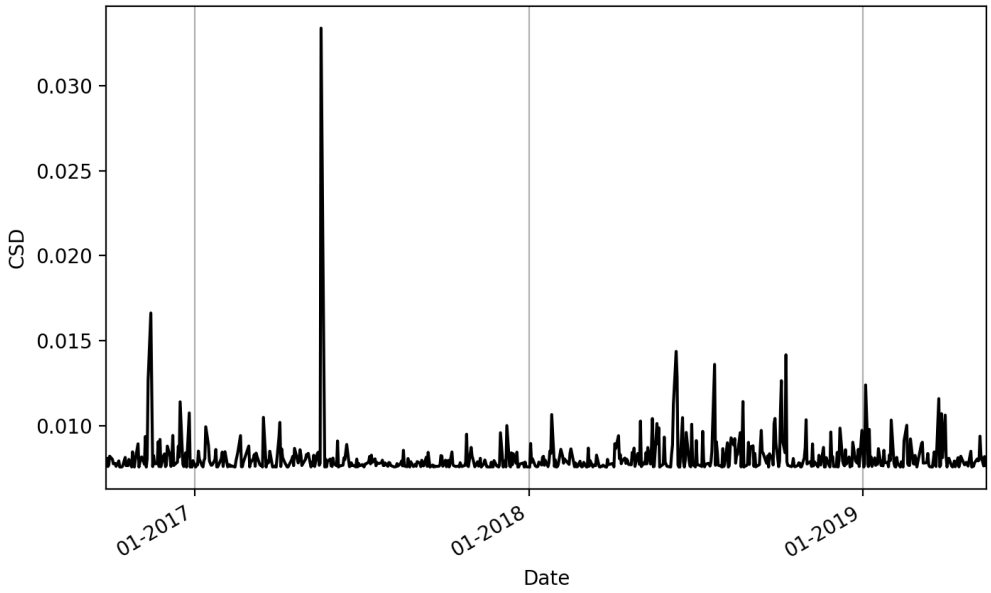


Figure 5.15: DI1's Conditional Standard Deviation

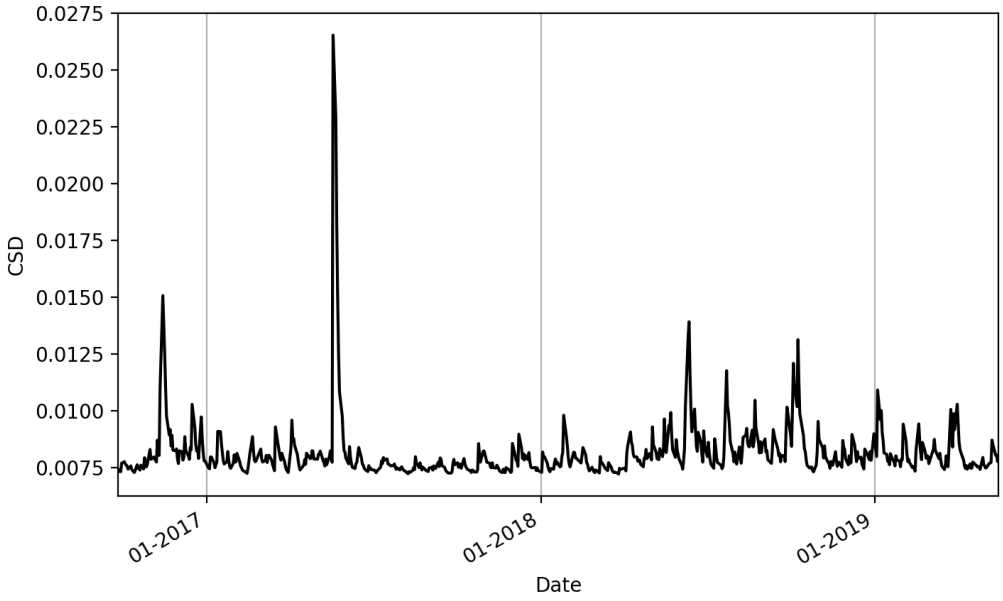


Table 5.6: Descriptive Statistics for OC1 and DI1's CSD

Series	Mean	Standard Deviation	Minimum Value	Maximum Value
OC1's CSD	0.008	0.001	0.008	0.033
DI1's CSD	0.008	0.001	0.007	0.027

We consider abnormal volatility every value outside the 95% confidence interval, and we use both a parametric and a non parametric analysis to filter for abnormal volatility. In the former, we assume a two-parameter distribution for the population, in the latter we do not make this assumption.

5.2.4 Parametric

In the parametric analysis, we assume a two parameter distribution for the conditional standard deviation series when computing the 95% confidence interval that will be used to filter the series for abnormal volatility. The upper and lower limits are defined in Equations 5.5 and 5.6:

$$\bar{X} = \frac{1}{n}\sum_{i=0}^{n} CSD_t$$

$$\sigma^2 = \frac{1}{n-1}\sum_{i=0}^{n}(CSD_t - \bar{X})^2$$

$$\sigma = \sqrt{\sigma^2}$$

$$UpperLimit_t = \bar{X} + 1.96 * \sigma \tag{5.5}$$

$$LowerLimit_t = \bar{X} - 1.96 * \sigma \tag{5.6}$$

We test the the null hypothesis that the conditional standard deviation samples come from a normal distributed population with the Shapiro-Wilk test, which results are shown in Table 5.7.

Table 5.7: Shapiro-Wilk Test

Series	P-value
OC1's CSD	1.108e-42
DI1's CSD	3.589e-40

The test results shown in Table 5.7 support the null hypothesis that the sample comes from a normally distributed population.

The lower and upper limits are shown in Table 5.8 for both measures of the exchange coupon. Figure 5.16 and Figure 5.17 show the upper and lower limits altogether with the CDS series, for the OC1 and DI1 exchange coupons respectively.

Table 5.8: Limits from Parametric Analysis

Series	Upper Limit	Lower Limit
OC1's CSD	0.011	0.005
DI1's CSD	0.011	0.005

Figure 5.16: Parametric Limits for OC1's CSD

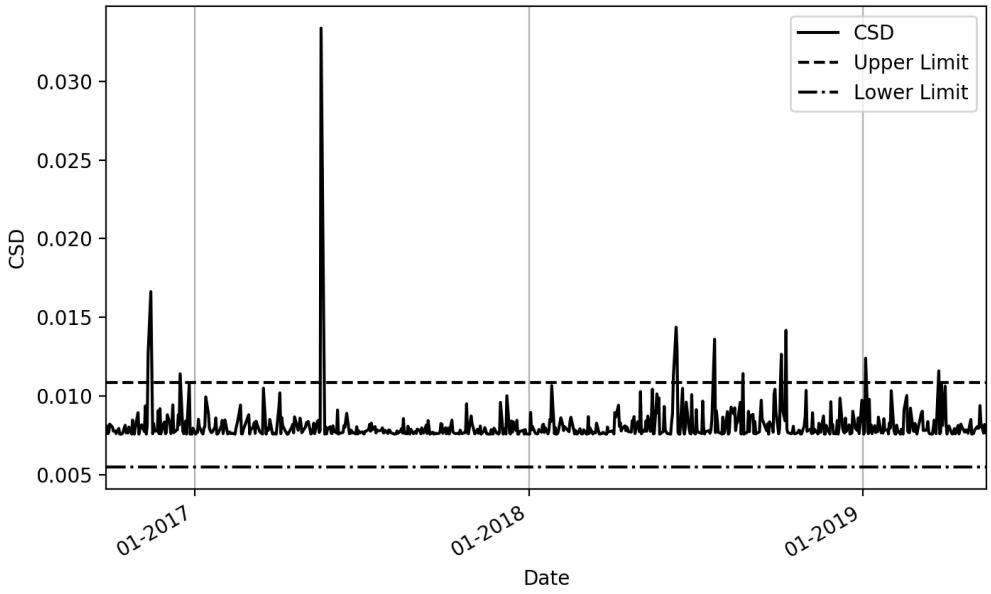


Figure 5.17: Parametric Limits for DI1's CSD

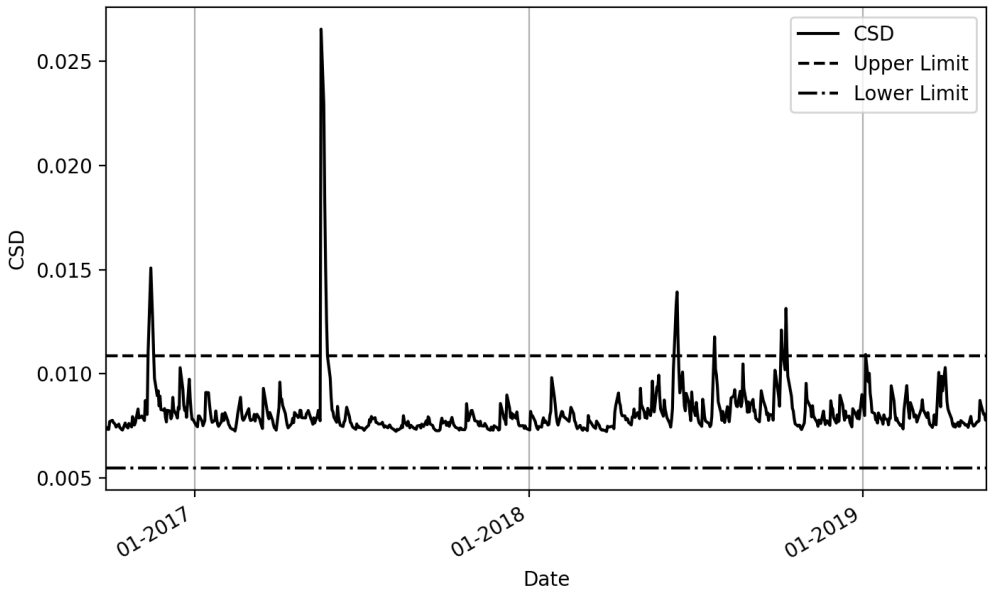


Table 5.9 and Table 5.10 show the details of each day with abnormal volatility, that is, the days in which the conditional standard deviation was outside the limits of the 95% confidence interval, for the OC1 exchange coupon and for the DI1 exchange coupon respectively.

Table 5.9: Days with Abnormal Returns for OC1 Exchange Coupon by Parametric Analysis

	Date	Exchange Coupon	CSD	Lower Limit	Upper Limit
1	2016/11/11	-0.037	0.013	0.005	0.011
2	2016/11/14	-0.001	0.017	0.005	0.011
3	2016/12/16	0.004	0.011	0.005	0.011
4	2017/05/19	0.029	0.033	0.005	0.011
5	2017/05/22	0.001	0.014	0.005	0.011
6	2018/06/08	0.030	0.011	0.005	0.011
7	2018/06/11	0.026	0.014	0.005	0.011
8	2018/06/12	-0.003	0.013	0.005	0.011
9	2018/07/23	-0.003	0.014	0.005	0.011
10	2018/08/23	0.001	0.011	0.005	0.011
11	2018/10/03	0.025	0.011	0.005	0.011
12	2018/10/04	-0.013	0.013	0.005	0.011
13	2018/10/09	0.006	0.014	0.005	0.011
14	2019/01/04	0.002	0.012	0.005	0.011
15	2019/03/25	0.001	0.012	0.005	0.011

Table 5.10: Days with Abnormal Returns for DI1 Exchange Coupon by Parametric Analysis

	Date	Exchange Coupon	CSD	Lower Limit	Upper Limit
1	2016/11/11	-0.037	0.011	0.005	0.011
2	2016/11/14	-0.001	0.015	0.005	0.011
3	2016/11/16	0.008	0.013	0.005	0.011
4	2016/11/17	0.004	0.011	0.005	0.011
5	2017/05/19	0.029	0.027	0.005	0.011
6	2017/05/22	0.001	0.023	0.005	0.011
7	2017/05/23	0.007	0.018	0.005	0.011
8	2017/05/24	0.001	0.015	0.005	0.011
9	2017/05/25	-0.006	0.013	0.005	0.011
10	2018/06/11	0.026	0.013	0.005	0.011
11	2018/06/12	-0.003	0.014	0.005	0.011
12	2018/06/13	-0.000	0.012	0.005	0.011
13	2018/07/23	-0.003	0.012	0.005	0.011
14	2018/10/04	-0.013	0.012	0.005	0.011
15	2018/10/05	0.009	0.011	0.005	0.011
16	2018/10/09	0.006	0.013	0.005	0.011
17	2018/10/10	-0.003	0.011	0.005	0.011
18	2019/01/04	0.002	0.011	0.005	0.011

As we see in the tables above, the results are basically the same for both measures of the exchange coupon. There were 18 days of abnormal volatility, of which 4 are from 2016, 5 are from 2017, 8 are from 2018, and 1 is from 2019. Of these 18 days, in 10 the exchange coupons show positive values.

5.2.5 Non Parametric

While in the parametric analysis we assumed a normal distribution for the population, in the non-parametric analysis we do not make this assumption. We calculated the mean and standard deviation for each day with a 63 days window (22 days before and 22 days after), which corresponds to three months of data. The definition of the 63 days windows was made based on the frequency of CoPoM meetings (one for every one and

a half month), in which the goal for the Selic is defined, affecting directly both the Selic and the DI. The window is twice the period between meetings, therefore a quarter of year.

We define the limits of the non-parametric analysis in Equations 5.7 and 5.8.

$$\bar{X}_t = \frac{1}{63} \sum_{i=t-22}^{t+22} CSD_t$$

$$\sigma_t^2 = \frac{1}{62} \sum_{i=t-22}^{t+22} (CSD_t - \bar{X}_t)^2$$

$$\sigma_t = \sqrt{\sigma^2 t}$$

$$UpperLimit_t = \bar{X}_t + 1.96 * \sigma_t \tag{5.7}$$

$$UpperLimit_t = \bar{X}_t - 1.96 * \sigma_t \tag{5.8}$$

The lower and upper limits are shown in Table 5.11 for both measures of the exchange coupon. Figure 5.18 and Figure 5.19 show the upper and lower limits altogether with the CDS series, for the OC1 and DI1 exchange coupons respectively.

Table 5.11: Limits from Non Parametric Analysis

Series	Mean of Upper Limits	Mean of Lower Limits
OC1's CSD	0.010	0.006
DI1's CSD	0.010	0.006

Figure 5.18: Non-Parametric Limits for OC1's CSD

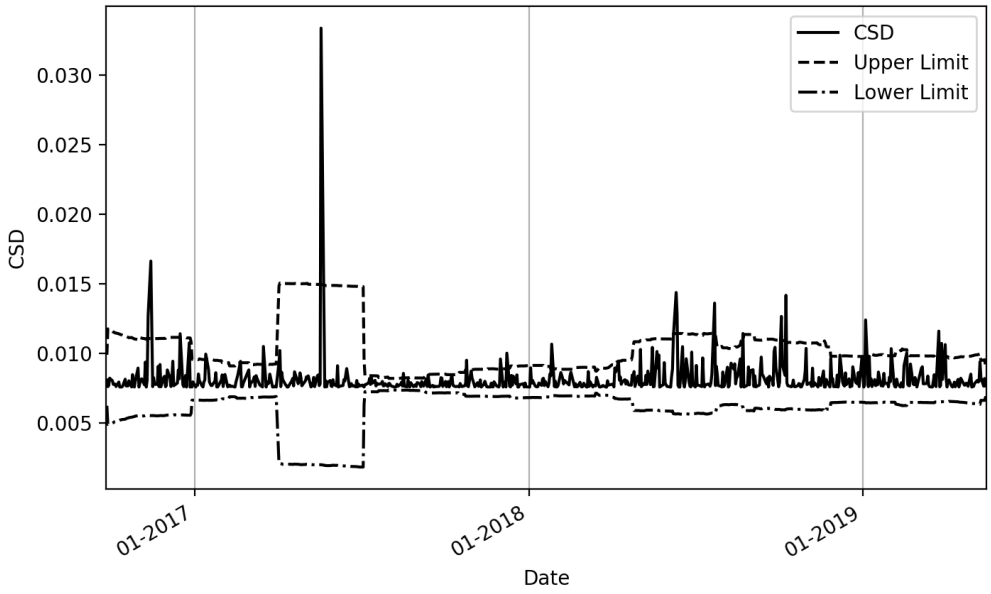


Figure 5.19: Non-Parametric Limits for DI1's CSD

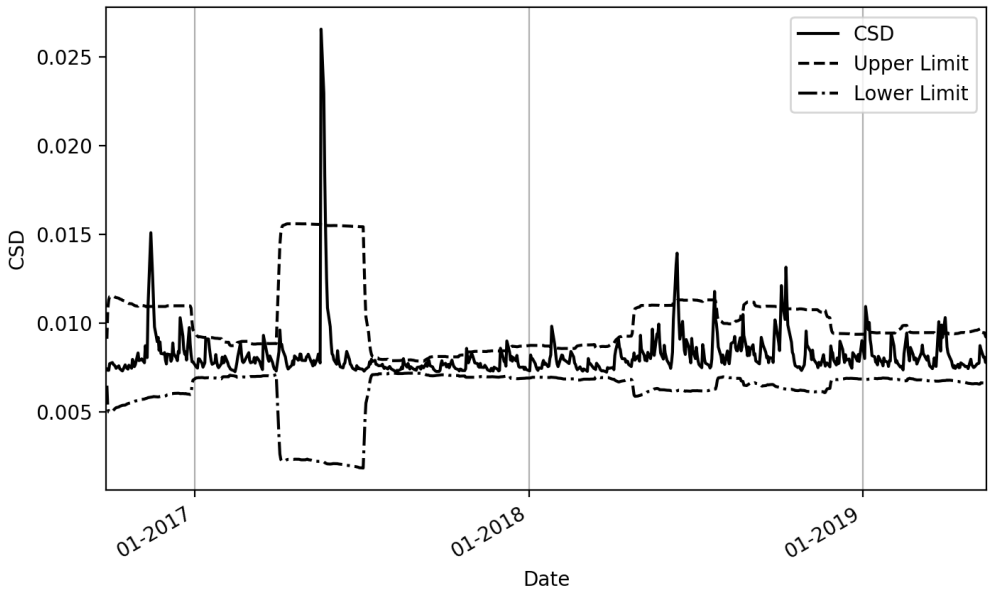


Table 5.12 and Table 5.13 show the details of each day with abnormal volatility, that is, the days in which the conditional standard deviation was outside the limits of the 95% confidence interval, for the OC1 exchange coupon and for the DI1 exchange coupon respectively.

Table 5.12: Days with Abnormal Returns for OC1 Exchange Coupon by Non Parametric Analysis

	Date	Exchange Coupon	CSD	Lower Limit	Upper Limit
1	2016/11/11	-0.037	0.013	0.006	0.011
2	2016/11/14	-0.001	0.017	0.006	0.011
3	2016/12/16	0.004	0.011	0.006	0.011
4	2017/01/13	-0.011	0.010	0.007	0.010
5	2017/02/20	0.002	0.009	0.007	0.009
6	2017/03/17	0.001	0.010	0.007	0.009
7	2017/05/19	0.029	0.033	0.002	0.015
8	2017/08/17	0.002	0.009	0.007	0.008
9	2017/09/13	-0.006	0.008	0.007	0.008
10	2017/10/25	0.003	0.009	0.007	0.009
11	2017/12/01	-0.000	0.010	0.007	0.009
12	2017/12/08	0.003	0.010	0.007	0.009
13	2018/01/26	-0.002	0.011	0.007	0.009
14	2018/06/11	0.026	0.014	0.006	0.011
15	2018/06/12	-0.003	0.013	0.006	0.011
16	2018/07/23	-0.003	0.014	0.006	0.011
17	2018/08/23	0.001	0.011	0.006	0.011
18	2018/10/04	-0.013	0.013	0.006	0.011
19	2018/10/09	0.006	0.014	0.006	0.011
20	2018/12/07	0.006	0.010	0.006	0.010
21	2019/01/04	0.002	0.012	0.006	0.010
22	2019/02/01	-0.005	0.010	0.006	0.010
23	2019/03/25	0.001	0.012	0.006	0.010
24	2019/03/28	-0.007	0.011	0.007	0.010
25	2019/04/01	0.008	0.011	0.007	0.010

Table 5.13: Days with Abnormal Returns for DI1 Exchange Coupon by Non Parametric Analysis

	Date	Exchange Coupon	CSD	Lower Limit	Upper Limit
1	2016/11/11	-0.037	0.011	0.006	0.011
2	2016/11/14	-0.001	0.015	0.006	0.011
3	2016/11/16	0.008	0.013	0.006	0.011
4	2016/11/17	0.004	0.011	0.006	0.011
5	2017/03/17	0.001	0.009	0.007	0.009
6	2017/05/19	0.029	0.027	0.002	0.016
7	2017/05/22	0.001	0.023	0.002	0.016
8	2017/05/23	0.007	0.018	0.002	0.016
9	2017/08/17	0.002	0.008	0.007	0.008
10	2017/10/25	0.003	0.009	0.007	0.008
11	2017/12/01	-0.000	0.009	0.007	0.008
12	2017/12/08	0.003	0.009	0.007	0.008
13	2018/01/26	-0.002	0.010	0.007	0.009
14	2018/01/29	-0.006	0.009	0.007	0.009
15	2018/06/11	0.026	0.013	0.006	0.011
16	2018/06/12	-0.003	0.014	0.006	0.011
17	2018/06/13	-0.000	0.012	0.006	0.011
18	2018/07/23	-0.003	0.012	0.006	0.011
19	2018/10/04	-0.013	0.012	0.006	0.011
20	2018/10/05	0.009	0.011	0.006	0.011
21	2018/10/09	0.006	0.013	0.006	0.011
22	2018/10/10	-0.003	0.011	0.006	0.011
23	2019/01/04	0.002	0.011	0.007	0.009
24	2019/01/07	0.015	0.010	0.007	0.009
25	2019/01/08	-0.004	0.010	0.007	0.009
26	2019/03/25	0.001	0.010	0.007	0.009
27	2019/03/28	-0.007	0.010	0.007	0.009
28	2019/04/01	0.008	0.010	0.007	0.009
29	2019/04/02	0.001	0.009	0.007	0.009

As we see in the tables above, the results are basically the same for both measures

of the exchange coupon. There were 29 days of abnormal volatility, of which 3 are from 2016, 8 are from 2017, 10 are from 2018, and 8 are from 2019. Of these 29 days, in 16 the exchange coupons show positive values.

6 RESULTS AND DISCUSSION

After having filtered the exchange coupon for abnormal volatility, and the news for national political events, we match the two samples to find what political events happened to occur in the days of abnormal volatility. With this information we can analyze the impact of political news in the exchange coupon.

The days of abnormal volatility for both measures of the exchange coupon were the same in each approach (parametric and non parametric), therefore we will talk about the results without referencing a specific measure.

6.1 Parametric

The political news for each day of abnormal volatility for the parametric analysis are shown in Table 6.1. There are a total of 69 news in 14 days of abnormal volatility.

Table 6.1: Political News in Days of Abnormal Volatility by Parametric Analysis

	Ab. Vol.	News Time	Headline
1	2016/12/16	12/15 18:27	CCJ define relator de consulta sobre reel[...]
2	2016/12/16	12/15 18:27	CCJ define relator de consulta sobre reel[...]
3	2016/12/16	12/15 19:55	PSDB prorroga mandato de Aécio como presi[...]
4	2016/12/16	12/16 13:35	Câmara envia a Fux recurso contra decisão[...]
5	2016/12/16	12/16 17:32	Janot reitera ao STF pedido para afastar [...]
6	2017/05/19	05/18 19:00	Manifestações em diferentes cidades brasi[...]
7	2017/05/19	05/18 19:29	Após denúncias, PTB na Câmara e PR reiter[...]
8	2017/05/19	05/19 15:12	Delator diz que ouviu de Temer que presid[...]
9	2017/05/19	05/19 14:28	Dono da JBS diz que deu R$ 30 milhões pa[...]
10	2017/05/19	05/19 15:11	JBS admite que comprou dólar nos últimos [...]
11	2017/05/19	05/19 15:45	Gravação de Joesley com Temer é legal, di[...]
12	2017/05/22	05/19 19:14	CVM investiga JBS por uso de informação p[...]
13	2017/05/22	05/20 14:52	Temer diz que segue na Presidência e pede[...]
14	2017/05/22	05/21 00:23	OAB decide apresentar à Câmara pedido de [...]

Continued on next page

Table 6.1 – continued from previous page

	Ab. Vol.	News Time	Headline
15	2017/05/22	05/22 16:20	Câmara acumula 14 pedidos de impeachment [...]
16	2018/06/08	06/07 22:54	Lewandowski manda desbloquear bens de Sér[...]
17	2018/06/08	06/07 23:24	Barroso autoriza deputado preso a trabalh[...]
18	2018/06/08	06/07 19:39	Em dia de turbulências na economia, Temer[...]
19	2018/06/08	06/08 08:31	Dólar dispara e Banco Central amplia ação[...]
20	2018/06/08	06/08 09:43	Diante da alta do dólar, Temer se reúne e[...]
21	2018/06/11	06/10 11:13	Empresas buscam proteção após alta do dól[...]
22	2018/06/11	06/11 13:46	Presidente eleito do Paraguai, Benítez vi[...]
23	2018/06/11	06/11 17:38	Deputado preso volta a trabalhar na Câmar[...]
24	2018/06/12	06/12 14:16	Ministério da Fazenda diz que greve dos c[...]
25	2018/06/12	06/12 14:35	Presidente da Petrobras se encontra com c[...]
26	2018/06/12	06/12 17:28	Em audiência na Câmara, representantes do[...]
27	2018/07/23	07/21 11:06	PMN rejeita Valéria Monteiro para disputa[...]
28	2018/07/23	07/20 20:57	PSTU oficializa Vera Lúcia para disputa d[...]
29	2018/07/23	07/23 05:00	Temer viaja para o México nesta segunda-f[...]
30	2018/07/23	07/22 12:47	PSL oficializa candidatura de Jair Bolson[...]
31	2018/07/23	07/22 09:39	Servidores têm bancada mais forte da Câma[...]
32	2018/07/23	07/21 16:37	PSOL confirma Guilherme Boulos para dispu[...]
33	2018/07/23	07/23 08:37	Só em 2020 economia anulará perdas da rec[...]
34	2018/07/23	07/23 13:59	Com Cármen Lúcia no Planalto, Dias Toffol[...]
35	2018/07/23	07/23 13:01	Alckmin trabalha para acalmar aliados em [...]
36	2018/08/23	08/23 07:58	ŏ0c0 Polícia Federal, chefe de gabinete[...]
37	2018/08/23	08/22 21:54	José Maria Eymael cumpre agenda de campan[...]
38	2018/08/23	08/23 11:58	TSE apresenta previsão do tempo de propag[...]
39	2018/08/23	08/23 17:37	Depósito automático de recursos do PIS/Pa[...]
40	2018/10/03	10/02 18:12	Motorista de presidente de concessionária[...]
41	2018/10/03	10/02 19:05	Pesquisa Datafolha para presidente: Bolso[...]
42	2018/10/03	10/03 08:08	Pesquisa Datafolha de 2 de outubro para p[...]
43	2018/10/03	10/03 05:00	Pesquisa Datafolha de 2 de outubro para p[...]
44	2018/10/03	10/03 15:50	Pesquisa Datafolha: veja perfil dos eleit[...]

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Table 6.1 – continued from previous page

	Ab. Vol.	News Time	Headline
45	2018/10/04	10/03 18:55	Pesquisa Ibope para presidente: Bolsonaro[...]
46	2018/10/04	10/04 05:00	Pesquisa Ibope de 3 de outubro para presi[...]
47	2018/10/04	10/04 06:00	Pesquisa Ibope de 3 de outubro para presi[...]
48	2018/10/04	10/03 22:14	Candidato à Presidência, João Goulart Fil[...]
49	2018/10/04	10/04 14:27	Pesquisas Ibope nos estados: veja evoluçã[...]
50	2018/10/09	10/09 05:00	Número cai, mas quase metade da Câmara se[...]
51	2018/10/09	10/08 19:43	Levy Fidelix, presidente do partido do vi[...]
52	2018/10/09	10/08 19:43	Levy Fidelix, presidente do partido do vi[...]
53	2018/10/09	10/09 11:12	Novo declara que não apoiará nenhum candi[...]
54	2018/10/09	10/09 16:17	CNJ afasta presidente do TRE-MS suspeita [...]
55	2019/01/04	01/03 21:10	PT e PSOL denunciam invasão de gabinetes [...]
56	2019/01/04	01/04 12:30	Bolsonaro sinaliza reforma da Previdência[...]
57	2019/03/25	03/23 08:46	No terceiro dia no Chile, Bolsonaro tem r[...]
58	2019/03/25	03/24 12:08	De volta do Chile, Bolsonaro recebe líder[...]
59	2019/03/25	03/23 09:40	Maia diz que Bolsonaro deve liderar refor[...]
60	2019/03/25	03/24 18:43	Presidente que não entende que ̆2018o Co[...]
61	2019/03/25	03/25 08:14	Apesar do tom de Bolsonaro, Câmara deve m[...]
			End of table

The 14 days of abnormal volatility are divided in 5 periods. The first period started at April 19, 2017 with the corruption scandal of President Michel Temer, and lasted until April 25 - therefore, a whole week. The scandal begun with the disclosure by the Supreme Court of a recording of a conversation between Mr Temer and the businessman Joesley Batista - owner of JBS, which was, and still is by the time this is written, the largest meat processing company in the world -, who delivered the recording to the authorities as part of a plea bargain. The date in which the recording was revealed was commonly dubbed as 'Joesley Day', as it was a day of of high volatility both in the stock and in the dollar markets. In fact, the conditional standard deviation for both measures of exchange coupon was of 0.033 (for scale, the maximum and minimum value of the 95% confidence interval are of 0.011 and 0.005 respectively).

The second period was between June 11 and 13, 2019, when news dealt with the visit of Paraguay's newly elected president Marido Abdo Benítez to President Temer, with

a encounter of Petrobra's President with the Legislative and Judiciary, and with the change of judges from Superior Justice Tribunal in a process from Operation Car Wash, among other topics. The third period lasted only a single day, the 23th of July, 2018. In this date both Jair Bolsonaro, from Liberal Social Party (PSL), and Guilherme Boulos, from Socialism and Liberty Party (PSOL), were confirmed as candidates for the presidential elections that would be held in October.

The fourth and second last period of abnormal volatility begun 6 days before, and ended 2 days after, the first round of the 2018 presidential elections. At October 4th, when the period of abnormal volatility started, a voter intent survey was released which result was, in the case of a second round between Jair Bolsonaro (PSL) and Fernanando Haddad (Worker's Party (PT)), of 43% of votes for the first and 42% for the latter, therefore a technical draw.

The last period was the January 4th. At the time, Bolsonaro was talking about trying to pass a new Pension Reform rather than working on the approval of the one from the previous president, Mr Temer.

After knowing the political news that match with the abnormal volatility days, we are able to hypothesize on which political news actually had an effect in the exchange coupon. We considered that mainly matters related to changes in the presidency affected the financial variable, followed by matters about the Pension Reform. Both the arise of the possibility of a impeachment of President Temer caused by a corruption scandal, and the presidential elections with two opposing leading candidates, brought abnormal volatility. The annoucement of a new Pension Reform also had this effect. These periods are shown in Table 6.2.

Table 6.2: Periods of Abnormal Volatility related to Political News, by Parametric Analysis

Period	News Topic
17/05/19 - 17/05/25	President Temer's corruption scandal
18/07/23	Announcement of Mr Bolsonaro's candidacy
18/10/04 - 18/10/10	First Round of Presidential Elections
19/01/04	Announcement of new Pension Reform

6.2 Non Parametric

The political news for each day of abnormal volatility, for the non parametric analysis, are shown in Table 6.3. There are a total of 151 news in 26 days of abnormal volatility.

Table 6.3: Political News in Days of Abnormal Volatility by Parametric Analysis

	Ab. Vol.	News Time	Headline
1	2016/12/16	12/15 18:27	CCJ define relator de consulta sobre reel[...]
2	2016/12/16	12/15 18:27	CCJ define relator de consulta sobre reel[...]
3	2016/12/16	12/15 19:55	PSDB prorroga mandato de Aécio como presi[...]
4	2016/12/16	12/16 13:35	Câmara envia a Fux recurso contra decisão[...]
5	2016/12/16	12/16 17:32	Janot reitera ao STF pedido para afastar [...]
6	2017/01/13	01/13 06:00	Partidos articulam blocos na Câmara para [...]
7	2017/03/17	03/16 20:29	Maia diz que reforma trabalhista será vot[...]
8	2017/03/17	03/17 03:00	Empreiteiras encolheram e perderam protag[...]
9	2017/03/17	03/17 12:39	Presidente do STF diz que 'já passou da h[...]
10	2017/03/17	03/16 21:23	Presidente do Senado dominicano nega vínc[...]
11	2017/05/19	05/18 19:00	Manifestações em diferentes cidades brasi[...]
12	2017/05/19	05/18 19:29	Após denúncias, PTB na Câmara e PR reiter[...]
13	2017/05/19	05/19 15:12	Delator diz que ouviu de Temer que presid[...]
14	2017/05/19	05/19 14:28	Dono da JBS diz que deu R$ 30 milhões pa[...]
15	2017/05/19	05/19 15:11	JBS admite que comprou dólar nos últimos [...]
16	2017/05/19	05/19 15:45	Gravação de Joesley com Temer é legal, di[...]
17	2017/08/17	08/16 22:03	Câmara inicia discussão, mas adia votação[...]
18	2017/08/17	08/16 22:48	Aldo Rebelo pediu afastamento do partido,[...]
19	2017/08/17	08/16 20:44	Câmara discute PEC que cria fundo eleitor[...]
20	2017/08/17	08/16 19:40	Câmara aprova tornar crime hediondo posse[...]
21	2017/08/17	08/17 10:35	OAB aciona Supremo para que presidente da[...]
22	2017/08/17	08/17 10:35	OAB aciona Supremo para que presidente da[...]
23	2017/09/13	09/12 18:32	Câmara lança ferramenta na web para usuár[...]

Continued on next page

Table 6.3 – continued from previous page

	Ab. Vol.	News Time	Headline
24	2017/09/13	09/12 23:13	Câmara aprova renegociação de dívidas de [...]
25	2017/09/13	09/13 05:02	Ex-presidente Lula será ouvido por Moro p[...]
26	2017/09/13	09/12 22:12	Investigadores usam diagrama para explica[...]
27	2017/09/13	09/12 21:04	Deputados batem boca na Câmara sobre expo[...]
28	2017/09/13	09/13 14:03	Vice da Câmara xinga ministro da articula[...]
29	2017/09/13	09/13 17:10	Comissão da Câmara aprova fundo de campan[...]
30	2017/10/25	10/24 18:44	Presidente do Conselho de Ǒ0c9tica arqu[...]
31	2017/10/25	10/25 09:21	Câmara inicia sessão para votar denúncia [...]
32	2017/10/25	10/24 20:55	Para Maia, Câmara precisa encerrar nesta [...]
33	2017/10/25	10/25 05:01	Saiba como será a votação na Câmara da de[...]
34	2017/10/25	10/25 14:36	G1 checa pronunciamentos da sessão da Câm[...]
35	2017/10/25	10/25 10:11	Veja frases da votação da segunda denúnci[...]
36	2017/10/25	10/25 11:53	Câmara vota segunda denúncia contra Temer[...]
37	2017/10/25	10/25 14:33	Maia encerra sessão, e Câmara terá que re[...]
38	2017/10/25	10/25 17:04	Após 8 horas, Câmara atinge quórum e inic[...]
39	2017/12/01	12/01 09:17	Presidente do PR usou apartamento funcion[...]
40	2017/12/01	12/01 09:17	Presidente do PR usou apartamento funcion[...]
41	2017/12/08	12/07 20:01	João Batista Brito Pereira é eleito novo [...]
42	2017/12/08	12/07 19:55	Sérgio Moro manda desbloquear dinheiro da[...]
43	2018/01/26	01/26 11:50	Contrariando tendência histórica, corrupç[...]
44	2018/06/11	06/10 11:13	Empresas buscam proteção após alta do dól[...]
45	2018/06/11	06/11 13:46	Presidente eleito do Paraguai, Benítez vi[...]
46	2018/06/11	06/11 17:38	Deputado preso volta a trabalhar na Câmar[...]
47	2018/06/12	06/12 14:16	Ministério da Fazenda diz que greve dos c[...]
48	2018/06/12	06/12 14:35	Presidente da Petrobras se encontra com c[...]
49	2018/06/12	06/12 17:28	Em audiência na Câmara, representantes do[...]
50	2018/07/23	07/21 11:06	PMN rejeita Valéria Monteiro para disputa[...]
51	2018/07/23	07/20 20:57	PSTU oficializa Vera Lúcia para disputa d[...]
52	2018/07/23	07/23 05:00	Temer viaja para o México nesta segunda-f[...]
53	2018/07/23	07/22 12:47	PSL oficializa candidatura de Jair Bolson[...]

Continued on next page

Table 6.3 – continued from previous page

	Ab. Vol.	News Time	Headline
54	2018/07/23	07/22 09:39	Servidores têm bancada mais forte da Câma[...]
55	2018/07/23	07/21 16:37	PSOL confirma Guilherme Boulos para dispu[...]
56	2018/07/23	07/23 08:37	Só em 2020 economia anulará perdas da rec[...]
57	2018/07/23	07/23 13:59	Com Cármen Lúcia no Planalto, Dias Toffol[...]
58	2018/07/23	07/23 13:01	Alckmin trabalha para acalmar aliados em [...]
59	2018/08/23	08/23 07:58	Ŏ0c0 Polícia Federal, chefe de gabinete[...]
60	2018/08/23	08/22 21:54	José Maria Eymael cumpre agenda de campan[...]
61	2018/08/23	08/23 11:58	TSE apresenta previsão do tempo de propag[...]
62	2018/08/23	08/23 17:37	Depósito automático de recursos do PIS/Pa[...]
63	2018/10/04	10/03 18:55	Pesquisa Ibope para presidente: Bolsonaro[...]
64	2018/10/04	10/04 05:00	Pesquisa Ibope de 3 de outubro para presi[...]
65	2018/10/04	10/04 06:00	Pesquisa Ibope de 3 de outubro para presi[...]
66	2018/10/04	10/03 22:14	Candidato à Presidência, João Goulart Fil[...]
67	2018/10/04	10/04 14:27	Pesquisas Ibope nos estados: veja evoluçã[...]
68	2018/10/09	10/09 05:00	Número cai, mas quase metade da Câmara se[...]
69	2018/10/09	10/08 19:43	Levy Fidelix, presidente do partido do vi[...]
70	2018/10/09	10/08 19:43	Levy Fidelix, presidente do partido do vi[...]
71	2018/10/09	10/09 11:12	Novo declara que não apoiará nenhum candi[...]
72	2018/10/09	10/09 16:17	CNJ afasta presidente do TRE-MS suspeita [...]
73	2018/12/07	12/06 18:30	Barroso diz que aplicativos 'revolucionar[...]
74	2018/12/07	12/07 09:24	Deputados do PSL, sigla de Bolsonaro, pro[...]
75	2018/12/07	12/07 11:58	Preocupados com Previdência, generais que[...]
76	2019/01/04	01/03 21:10	PT e PSOL denunciam invasão de gabinetes [...]
77	2019/01/04	01/04 12:30	Bolsonaro sinaliza reforma da Previdência[...]
78	2019/02/01	01/31 19:26	PT, PSB, PSOL e Rede anunciam bloco para [...]
79	2019/02/01	02/01 05:00	Conheça os candidatos que devem disputar [...]
80	2019/02/01	01/31 20:38	Renan recebe ligação de Bolsonaro após se[...]
81	2019/02/01	01/31 20:17	MDB decide indicar Renan Calheiros como c[...]
82	2019/02/01	02/01 05:01	Saiba o que está em jogo na disputa pela [...]
83	2019/02/01	02/01 05:01	Saiba o que está em jogo na disputa pela [...]

Continued on next page

Table 6.3 – continued from previous page

	Ab. Vol.	News Time	Headline
84	2019/02/01	02/01 05:00	Conheça os deputados que devem disputar a[...]
85	2019/02/01	02/01 05:00	Conheça os deputados que devem disputar a[...]
86	2019/02/01	01/31 22:16	Felipe Santa Cruz é eleito presidente da [...]
87	2019/02/01	02/01 05:00	MDB perdeu só uma das eleições da presidê[...]
88	2019/02/01	01/31 20:29	Deputados elegem nesta sexta-feira o pres[...]
89	2019/02/01	01/31 20:29	Deputados elegem nesta sexta-feira o pres[...]
90	2019/02/01	01/31 19:59	Presidente do STJ manda soltar ex-governa[...]
91	2019/02/01	02/01 05:01	Nova Câmara dos Deputados tem o maior núm[...]
92	2019/02/01	02/01 05:01	Senadores elegem novo presidente nesta se[...]
93	2019/02/01	02/01 09:41	Senado tira adversário e coloca aliado de[...]
94	2019/02/01	02/01 10:10	Preso na Lava Jato, Beto Richa é solto ap[...]
95	2019/02/01	02/01 09:06	Congresso toma posse hoje e escolhe presi[...]
96	2019/02/01	02/01 08:37	Ministros são exonerados para tomar posse[...]
97	2019/02/01	02/01 13:52	Fernando Collor é o primeiro a se inscrev[...]
98	2019/02/01	02/01 13:24	Saiba quem são os candidatos à presidênci[...]
99	2019/02/01	02/01 13:24	Saiba quem são os candidatos à presidênci[...]
100	2019/02/01	02/01 10:41	Deputados eleitos em outubro tomam posse [...]
101	2019/02/01	02/01 13:19	Partidos na Câmara dos Deputados oficiali[...]
102	2019/02/01	02/01 11:46	Presidente do Senado em exercício, Davi A[...]
103	2019/02/01	02/01 11:46	Presidente do Senado em exercício, Davi A[...]
104	2019/02/01	02/01 17:21	Saiba quem são os candidatos à presidênci[...]
105	2019/02/01	02/01 16:16	Deputado diz que aceitará candidatos a pr[...]
106	2019/02/01	02/01 16:16	Deputado diz que aceitará candidatos a pr[...]
107	2019/02/01	02/01 16:01	Decisões de presidente interino do Senado[...]
108	2019/02/01	02/01 17:49	Debate sobre votação secreta gera tumulto[...]
109	2019/03/25	03/23 08:46	No terceiro dia no Chile, Bolsonaro tem r[...]
110	2019/03/25	03/24 12:08	De volta do Chile, Bolsonaro recebe líder[...]
111	2019/03/25	03/23 09:40	Maia diz que Bolsonaro deve liderar refor[...]
112	2019/03/25	03/24 18:43	Presidente que não entende que ŏ2018o Co[...]
113	2019/03/25	03/25 08:14	Apesar do tom de Bolsonaro, Câmara deve m[...]

Continued on next page

Table 6.3 – continued from previous page

	Ab. Vol.	News Time	Headline
114	2019/03/28	03/28 08:35	Maia e Bolsonaro prolongam troca de farpa[...]
115	2019/03/28	03/27 20:31	Câmara aprova texto que altera regras par[...]
116	2019/03/28	03/28 12:03	Presidente do PSL diz que o partido fecho[...]
117	2019/03/28	03/28 17:00	Delegado Marcelo Freitas é escolhido rela[...]
118	2019/03/28	03/28 14:52	Câmara aprova projeto que exige notificaç[...]
119	2019/03/28	03/28 13:13	Presidente afastado da Vale diz que nunca[...]
120	2019/03/28	03/28 17:10	Presidente da Embratur pede demissão, diz[...]
121	2019/04/01	03/30 13:19	Presidente Bolsonaro embarca para Israel,[...]
122	2019/04/01	03/29 21:08	Rodrigo Maia anula convocação de Sérgio M[...]
123	2019/04/01	03/31 15:53	A incerteza do voto, link: https://g1.glo[...]
124	2019/04/01	04/01 17:36	'Decisão do presidente. Foi divulgado pel[...]
			End of table

The 26 days of abnormal volatility are divided in 15 periods. At March 17, 2017, there was news about the voting of the Labour Reform. The three days of abnormal volatility between April 19 and 23, 2017, saw the beginning of the corruption scandal of President Temer, as mentioned in the previous section. Abnormal volatility returned at August 17, when the Brazilian Bar Association (OAB) triggered the Supreme Court to make the Chamber of Representatives' President analyze the impeachment requests he had received (there were 25 at the time). The impeachment matter correlated with abnormal volatility for the last time at October 25, when the Chamber of Representatives voted for the corruption denunciation against President Temer not to be sent to the Supreme Court, where it would be judged. At December 1st, is was disclosed that the president of the Party of the Republic (PR) used a apartment of the Chamber of Deputies while fugitive (he was convicted for corruption).

Abnormal volatility for the year of 2018 started in a period ranging from January 26 to January 29, where news about corruption being more decisive than economics in the presidential elections were published. Between June 11 and June 13, there were 11 news, from which the main ones were listed in the previous sub chapter. At July 23, both Jair Bolsonaro, from Liberal Social Party (PSL), and Guilherme Boulos, from Socialism and Liberty Party (PSOL), were confirmed as candidates for the presidential elections that would occur in October. As in the parametric analysis, the days surrounding the first

round of the presidential elections (October 4 to 10) were of abnormal volatility.

The fourth day of 2019 presidency was the first day of Bolsonaro's presidency to show abnormal volatility. At the time, Bolsonaro was talking about trying to pass a new Pension Reform rather than working on the approval of the reform from the previous president, Mr Temer. From January 7 to January 8, both Brazilian Party of Social Democracy (PSDB), Party of the Republic (PR) and party Podemos (called National Labour Party until 2016) announced support for the reelection of Rodrigo Maia for the Chamber of Deputies' presidency. The reelection occurred at February 1st, the date with the most political news - 31 - and correlated with abnormal volatility. At March 25 Chamber of Representative's president, Rodrigo Maia, said president Bolsonaro would lead the political articulation for the Pension Reform, and three days later the rapporteur for the Reform was chosen. The last period of abnormal volatility for our sample ranged from April 1st to 2nd, when the Plateau Palace, house of president Bolsonaro, share a video negating the denomination 'coup' for the military movement of 1964 which overthrew the government.

The results from the non parametric analysis add to the results of the parametric analysis, as they show that not only matters related to changes in the presidency and the Pension Reform affected the exchange coupon, but matters related to the presidency of the Chamber of Deputies and the Labour reform also did - the remaining news topics from our sample were considered of minor significance. The announcement of the voting of the Labour Reform had effect at March 2017. Even in the matters related to the presidency, more political events affected the exchange coupon: the possibility of impeachment of president Michel Temer impacted the exchange coupon not only in May 2017 (as in the parametric analysis), but in August and October as well. In August, OAB triggered the Supreme Court to make the Chamber of Representatives' President analyze the impeachment requests he had received, while in October the denunciation against the president was rejected by the Chamber of Deputies. The 2018 presidential elections had effect on the exchange coupon just like in the parametric analysis, with the announcement of Jair Bolsonaro as candidate (July 2018) and the first round of the elections (October 2018). The announcement of a new Pension Reform at January 2019 also had the same effect as in the parametric analysis. The elections for the presidency of the Chamber of Deputies, that took place in February 2019, also brought abnormal volatility, with both the announcement of support for the reelection of Mr Maia by PSDB, and the reelection itself. These periods are shown in Table 6.4.

Table 6.4: Periods of Abnormal Volatility related to Political News, by Non Parametric Analysis

Period	News Topic
17/03/17	Voting of the Labour Reform
17/05/19 - 23/05/17	President Temer's corruption scandal
17/08/17	OAB's triggering of the Supreme Court
17/10/25	Rejection of the denunciation against President Temer
18/07/23	Announcement of Mr Bolsonaro's candidacy
18/10/04 - 18/10/10	First Round of Presidential elections
19/01/04	Announcement of a new Pension Reform
19/01/08	PSDB's support for Rodrigo Maia's candidacy
19/02/01	Election for Chamber of Deputies' presidency

7 CONCLUSION

In order to test the market for semi-strong form efficiency, we analyzed the impact of political news on the country's exchange coupon. We cross referenced the days with abnormal returns for the exchange coupon with the days with political news. Ir order to achieve that, we filtered the news collected via web scrapping for national political events, and applied a GARCH filter in the exchange coupon to find abnormal returns. We performed both a parametric and a non parametric analysis.

The results, from both the parametric and non parametric analysis, show support for the semi-strong form efficient market hypothesis. From 2333 with political news, only a small fraction had effect over the exchange coupon - 58 news in the parametric analysis (2.5% of the total), and 105 news in the non parametric analysis (4.5%). Nevertheless, if compared to other types of news that could impact the exchange coupon - such as macroeconomic and international - political news had considerable impact. In the parametric analysis, political news were accountable for 11 out of 18 days of abnormal volatility (61%), and in the non parametric analysis they were accountable for 13 out of 29 days (45%).

The parametric and non parametric analysis differ in their results, but both indicate that the exchange coupon was affected by political news about changes in the federal presidency and about the Pension Reform. Changes in the presidency means both the 2018 elections, with its first round and the announcement of later-to-become president Jair Bolsonaro as candidate, and the corruption scandal with President Michel Temer at May 2017, which was followed by various impeachment requests. The Pension Reform had its effect with the announcement by President Bolsonaro of a new one, rather than working for the approval of the Reform proposed by Mr Temer.

While the parametric analysis indicates that the relationship between political news and the exchange coupon is limited to the one mentioned above, the non parametric analysis indicates that this relationship goes further, as political news of less (but in no way small) significance also affected the exchange coupon. In the case of the corruption scandal with President Temer, abnormal volatility was brought also by the triggering of the Supreme Court, by the Brazilian Bar Association (OAB), to make the Chamber of Representatives' President analyze the impeachment requests he had received (August 2017), and by the voting by the Chamber of Deputies for the corruption denunciation not to be sent to the Supreme Court (October 2017). Other than the elections for the federal

presidency, the elections for the Chamber of Deputies' presidency also were shown to affect the coupon, as both announcement of support for Rodrigo Maria's candidacy (January 2019) and the election itself (February 2019) caused abnormal volatility. In the non parametric analysis, not only the Pension Reform affected the exchange coupon but also the Labour Reform, when the Chamber of Deputies' president announced its voting at March 2017.

These results follow Smales (2015) and Marques and Santos (2016), as they both show that political uncertainty, as with who will win the elections, causes market uncertainty. Nevertheless, in our analysis more events related to the republic's presidency had effect over the market, just as matters related to the Chamber of Deputies and to reforms also did. This difference in results may arrive from differences between the foreign and national investors, with the first being more sensitive to political information.

As extension to the current research, the analysis could be made on an more extensive period, on an more extensive news sample (as from other sources), and on other securities from the Brazilian market.

8 APPENDIX - CODES

8.1 Main

```
'''

github : https://github.com/profnssorg/information-asset-returns

'''
#
# IMPORT PACKAGES
#
#
# Impoprt (and transform) data
import os # scrapping - os run command
#import scrapy # scrapping - package
#import numpy as np # api - array used for series and dataframe data structures
                    # fundamental package for scientific computing
#import pandas as pd # api - series and datagrame data structues & various
                     # data structures and data analysis tools
#
# Transform data
#from arch import arch_model # garch model
#import statsmodels.tsa.stattools as stat # adf, kpss, shapito white
#import statsmodels.stats.diagnostic as dig #ljung box
#from scipy import stats # confidence interval
```

```
#
# Output data
#         Graphs
#from matplotlib import pyplot as plt # graphs
#import matplotlib.dates as mdates
#
# IMPORT MODULES
    ↪ ------------------------------------------------------------------------
    ↪
#
from modules import importbacen # module for importing data
    ↪  from BACEN SGS
from modules import calculations # module for calculations
    ↪ with time series
from modules import graphs # muodule for output of graphs
from modules import tables # module for output of tables
from modules import news # module for dealing with news
#
# IMPORT DATA
    ↪ ------------------------------------------------------------------------
    ↪
#
# NUMBERS OF SERIES
#sgs_numbers = [1, 11, 12]

# INITIAL DATE FOR SERIES
#sgs_initial_date = '26/09/2016'

# FINAL DATE FOR SERIES
#sgs_final_date = '16/05/2019'

#
# PRECESS DATA
    ↪ ------------------------------------------------------------------------
```

```
    ↪
#
# Scrapping
#os.system('scrapy crawl g1 -o noticias.json')

# CREATES DATAFRAM WITH SERIES FROM BACEN-SGS
BASE = ImportBacen.create(names = ['Ptax', 'Selic', 'Di'],
                          numbers = [1, 11, 12],
                          initial_date = '26/09/2016',
                          final_date = '16/05/2019')

# APPENDS EXCHANGE COUPONS TO DATAFRAME
Calculations.exchange_coupon(BASE, 0, [1, 2], ['Oc1', 'Di1'
    ↪ ])

# APPENDS GARCH'S CSD AND RESIDUALS OF EXCHANGE COUPONS TO
    ↪ DATAFRAME
Calculations.garch(BASE, [3,4])

# APPENDS LIMITS FROM BOTH PARAMETRIC AND NON PARAMETRIC
    ↪ ANALYSIS FOR BOTH MEASU
#RES OF EXCHANGE COUPON TO DATAGRAME
Calculations.limits(BASE, [5, 7])

# Creates list with relevant news
'''
noticias_relevantes = transformar(separar_noticias('
    ↪ noticias.json',
            ['incerteza',
             'mercado',
             'economia',
             'd\\u00f3lar',
             'selic',
             'cdi',
```

```
            'c\\u00e2mara',
            'senado'
            'stf'
            'superior tribunal federal'
            'tcu',
    'tribunal de contas da uni\\u00e3o',
            'presidente',
            'presid\\u00eancia']))'''

# CREATES LIST WITH RELEVANT NEWS
noticias_relevantes = News.transformar(News.
    ↪ separar_noticias(News.juntar(News.corrigir(News.
    ↪ datas_do_ano(),
                                   BASE.Ptax),
                          News.proximodia(News.arrumar(News.
                              ↪ noticias('noticias.json')),
                          News.lista_datas(News.corrigir(News.
                              ↪ datas_do_ano(), BASE.Ptax)))),
                              ['incerteza',
                               'mercado',
                               'economia',
                               'd\\u00f3lar',
                               'selic',
                               'cdi',
                               'c\\u00e2mara',
                               'senado'
                               'stf'
                               'superior tribunal federal'
                               'tcu',
                               'tribunal de contas da uni\\
                                   ↪ u00e3o',
                               'presidente',
                               'presid\\u00eancia']))
```

```
# OUTPUT DATA
    ↪ ------------------------------------------------------------------------
    ↪

#          PTAX, SELIC AND DI
    ↪ ------------------------------------------------------------------------

# GRAPH FOR PTAX
Graph.series([BASE.Ptax],
        [],
        'PTAX',
        'Dollar Exchange Rate',
        'ptax')

# GRAPH FOR SELIC
Graph.series([BASE.Selic],
        [],
        'Selic',
        'Referential Rate of the Special Settlement and
            ↪ Custody System',
        'selic')

# GRAPH FOR DI
Graph.series([BASE.Di],
        [],
        'DI',
        'Interbank Deposit Rate',
        'di')

# DESCRIPTIVE STATISTICS TABLE FOR PTAX, SELIC AND DI
```

```
Tables.des('PTAX, Selic and DI',
    'desptaxselicdi',
    [BASE.Ptax, BASE.Selic, BASE.Di],
    ['PTAX', 'Selic', 'DI'])

#         EXCHANGE COUPONS
    ↪ ------------------------------------------------------------------
    ↪

Graph.series([BASE.Oc1],
        [],
        'OC1',
        'OC1 Exchange Coupon',
        'oc')

Graph.series([BASE.Di1],
        [],
        'DI1',
        'DI1 Exchange Coupon',
        'di1')

Tables.des('OC1 and DI1 Exchange Coupons',
    'desocdi',
    [BASE.Oc1, BASE.Di1],
    ['OC1', 'DI1'])

Tables.adf('ocdiadf',
    [BASE.Oc1, BASE.Di1],
    ['OC1', 'DI1'])

Tables.kpss('ocdikpss',
    [BASE.Oc1, BASE.Di1],
    ['OC1', 'DI1'])
```

```
#    4_2_2 ESTIMATION
    ↪ ————————————————————————————————————————————————

Tables.ljung_shapiro('reswhite',
                [BASE.Oc1Res, BASE.Di1Res],
                ['Residuals␣of␣OC1\'s␣GARCH', 'Residuals␣of␣
                    ↪ DI1\'s␣GARCH'])

Graph.series([BASE.Oc1Res],
        [],
        'Residuals',
        'Residuals␣of␣OC1\'s␣GARCH',
        'ocres')

Graph.series([BASE.Di1Res],
        [],
        'Residuals',
        'Residuals␣of␣DI1\'s␣GARCH',
        'dires')

Graph.acf_pacf(BASE.Oc1, 'OC1␣Exchange␣Coupon', 'oc', True)

Graph.acf_pacf(BASE.Di1, 'DI1␣Exchange␣Coupon', 'di', True)

Graph.acf_pacf(BASE.Oc1Res, 'Residuals␣of␣OC1', 'ocres')

Graph.acf_pacf(BASE.Di1Res, 'Residuals␣of␣DI1', 'dires')


#    4_2_3 VOLATILITY ESTIMATE
    ↪ ————————————————————————————————————————

Graph.series([BASE.Oc1Csd],
```

```
        [],
        'CSD',
        'OC1\'s Conditional Standard Deviation',
        'occsd')

Graph.series([BASE.Di1Csd],
        [],
        'CSD',
        'DI1\'s Conditional Standard Deviation',
        'dicsd')

Tables.des('OC1 and DI1\'s CSD',
     'descsd',
     [BASE.Oc1Csd, BASE.Di1Csd],
     ['OC1\'s CSD', 'DI1\'s CSD'])

#    4_2_4 PARAMETRIC
   ↪ ----------------------------------------------------------

Tables.shapiro('csdshapiro',
          [BASE.Oc1Csd, BASE.Di1Csd],
          ['OC1\'s CSD', 'DI1\'s CSD'])

Tables.limits('limpar',
             [BASE.Oc1CsdParUp, BASE.Di1CsdParUp],
             [BASE.Oc1CsdParLo, BASE.Di1CsdParLo],
             ['OC1\'s CSD', 'DI1\'s CSD'],
             par = True)

Graph.series([BASE.Oc1Csd, BASE.Oc1CsdParUp, BASE.
   ↪ Oc1CsdParLo],
        ['CSD', 'Upper Limit', 'Lower Limit'],
        'CSD',
        'Parametric Limits for OC1\'s CSD',
```

```
        'oclimpar')

Graph.series([BASE.Di1Csd, BASE.Di1CsdParUp, BASE.
    ↪ Di1CsdParLo],
        ['CSD', 'Upper Limit', 'Lower Limit'],
        'CSD',
        'Parametric Limits for DI1\'s CSD',
        'dilimpar')

oc_out_par = Tables.outside('ocparout',
                        BASE,
                        'Oc1',
                        'Oc1Csd',
                        ['Oc1CsdParUp', 'Oc1CsdParLo'],
                        di = False,
                        non = False)
Tables.outside('diparout',
                        BASE,
                        'Di1',
                        'Di1Csd',
                        ['Di1CsdParUp', 'Di1CsdParLo'],
                        di = True,
                        non = False)

#    4_2_5 NON PARAMETRIC
    ↪ ----------------------------------------------

Tables.limits('limnon',
            [BASE.Oc1CsdNonUp, BASE.Di1CsdNonUp],
            [BASE.Oc1CsdNonLo, BASE.Di1CsdNonLo],
            ['OC1\'s CSD', 'DI1\'s CSD'],
            par = False)
```

```
Graph.series([BASE.Oc1Csd, BASE.Oc1CsdNonUp, BASE.
    ↪ Oc1CsdNonLo],
        ['CSD', 'Upper Limit', 'Lower Limit'],
        'CSD',
        'Non Parametric Limits for OC1\'s CSD',
        'oclimnon')

Graph.series([BASE.Di1Csd, BASE.Di1CsdNonUp, BASE.
    ↪ Di1CsdNonLo],
        ['CSD', 'Upper Limit', 'Lower Limit'],
        'CSD',
        'Non Parametric Limits for DI1\'s CSD',
        'dilimnon')

oc_out_non = Tables.outside('ocnonout',
                        BASE,
                        'Oc1',
                        'Oc1Csd',
                        ['Oc1CsdNonUp', 'Oc1CsdNonLo'],
                        di = False,
                        non = True)
Tables.outside('dinonout',
                        BASE,
                        'Di1',
                        'Di1Csd',
                        ['Di1CsdNonUp', 'Di1CsdNonLo'],
                        di = True,
                        non = True)

# RESULTS

a = Tables.noticia_para_cada_dia('parnews', oc_out_par,
    ↪ noticias_relevantes)
```

```
b = Tables.noticia_para_cada_dia('nonnews', oc_out_non,
    ↪ noticias_relevantes)

#      ____________________________________________________

#os.system('cd latex')
#os.system('pdflatex cic-tc')
```

8.2 Modules

8.2.1 Scrapping Spider

```
"""

Nome: Spider G1
Objetivo: Coletar informaeoes -titulo, texto e data - para
    ↪ cada uma
das noticias sonbre politica presentes no site do G1
Autor: Bernardo Paulsen
Data: 31/03/2019
Versao: 1.0.0
Detalhes versao: Tudo certo


O q vai fazer
    Entrada: "https://g1.globo.com/politica/"
    Saida: arquivo de texto com informacoes (titulo, data e
        ↪ link)
    sobre todas as noticias publicadas no site de entrada.
    Processamento: classe .Spyder vai buscar pelas
        ↪ informacoes
Planejamento de codigo:
```

```
    Procurar, no site, os links para ir para as paginas das
       ↪ noiticas
    publicadas, e tambem para ir ate a proxima pagina de
       ↪ noticias.
    Nas paginas das noticias, coletar titulo, data e link.
       ↪ Na
    proxima pagina de noticias, repetir o processo. Parar
       ↪ quando
    houver mais uma proxima pagina.


"""

import scrapy

n = 1

class news3(scrapy.Spider):
    name = 'g1'
    start_urls = ['https://g1.globo.com/politica/']

    def parse(self, response):
        global n
        # follow links to news pages
        for page in response.xpath('//div/div[2]/div/div/a/
           ↪ @href').getall():
            yield response.follow(page, self.parse_noticia)

        # follow pagination links
        n += 1
        if n <= 2000:
            next_page = ("https://g1.globo.com/politica/
               ↪ index/feed/pagina-%d.ghtml" % (n))
            yield response.follow(next_page, self.parse)
```

```
    def parse_noticia(self, response):
        yield {
            'data': response.xpath('//time/text()')[0].get
              ↪ (),
            'titulo': response.xpath('//h1/text()')[2].get
              ↪ (),
            'link': response.url,
            }
```

8.2.2 Manipulation of News Data

```
class News():

    '''THIS CLASS HAS METHODS TO MANIPULATE NEWS'''

    def __init__(self):

        self.init = 'OK'

    # fazer lista com noticias do arquivo json
    def noticias(arq):
        arquivo = open(arq)
        lista = []
        i = 0
        for linha in arquivo.readlines():
            lista.append(linha[1:-3])
        lis = lista[1:-1]
        return(lis[::-1])
        arquivo.close()
```

```
    # arrumar lista das noticias, deixando bonitinho
    def arrumar(notic):
        lista = []
        for noticia in notic:
            lista.append('data: {}; hora: {}; titulo: {};
                ↪ link: {}'.format(noticia[10:20],
                                   noticia[21:26],
                                   noticia[noticia.find('titulo')+10:
                                      ↪ noticia.find('link')-4],
                                   noticia[noticia.find('link')+8:]))
        return(lista)
    # Criar lista com datas do ano
    def datas_do_ano():
        ser = pd.DataFrame(index = pd.date_range('
           ↪ 2016-09-26', periods=964))
        return(ser)
    #
    #
    # faz lista de todas as datas do ano, usado para
       ↪ colocar noticia no dia seguinte
    def lista_datas(poxa):
        datas = []
        for coisa in poxa:
            data = str('{}/{}/{}'.format(coisa[8:10], coisa
               ↪ [5:7], coisa[:4]))
            if data not in datas:
                datas.append(data)
        return(datas)
    #
    #
    #
    #
    # lista de noticias com dia para o qual a noticia vale
    def proximodia(noticis, datas):
```

```
    completa = list()
    for noticia in noticis:
        data_noticia = noticia[6:16]
        hora_noticia = noticia[24:26]
        minuto_noticia = noticia[27:29]
        titulo_noticia = noticia[noticia.find('titulo')
            ↪ +8:noticia.find('link')-2]
        link_noticia = noticia[noticia.find('link')+6:]
        ja_achou = False
        for i in range(len(datas)-1):
            data = datas[i]
            if ja_achou == False:
                if str(data_noticia) == str(data):
                    o = i
                    if int(hora_noticia) >= 18:
                        o += 1
                    completa.append('data: {}; hora:
                        ↪ {}; minuto: {}; dia: {};
                        ↪ titulo: {}; link: {}'.format(
                        ↪ data_noticia,
                hora_noticia,
                minuto_noticia,
                datas[o],
                titulo_noticia,
                link_noticia))
                    ja_achou = True
    return(completa)
#
#
# Retorna lista com dia do ano e dia de cupom cambial
    ↪ correspondente
def corrigir(datas, serie):
    e = []
    for i in range(len(datas)):
```

```
            t = True
            n = i
            o = 0
            while t == True:
                if (datas.index[n] in serie.index) == True:
                    e.append('{} --- {}'.format(datas.index
                        ↪ [i], datas.index[n]))
                    t = False
                else:
                    n += 1
                    if n > (len(datas)-1):
                        t = False
        return(e)
    # pega as noticias e coloca antes delas a data de cupom
        ↪ com a qual ela    relacionada
    def juntar(eita, noti):
        opa = []
        for noticia in noti:
            ja = False
            data = noticia[45:55]
            for dia in eita:
                if ja == False:
                    date = '{}/{}/{}'.format(dia[8:10], dia
                        ↪ [5:7], dia[:4])
                    cup = '{}/{}/{}'.format(dia[32:34], dia
                        ↪ [29:31], dia[24:28])
                    if data == date:
                        ja = True
                        opa.append('cupom: {} // {}'.format
                            ↪ (cup, noticia))
        return(opa)
    # separa as noticias que interessam
    def separar_noticias(arq, palavras):
        lista = []
```

```
        for linha in arq:
            achou = False
            for palavra in palavras:
                if achou == False:
                    if (palavra.lower() in linha.lower()[:
                    ↪ linha.find('link')]) == True:
                        lista.append(linha)
                        achou == True
        return(lista)
    # transforma o formato do texto para o normal
    def transformar(lista):
        final = []
        asci = ['$', ';', '%', '\\u00f4', '\\u00f5', '\\
        ↪ u00e1', '\\u00e0', '\\u00e3', '\\u00e2', '\\
        ↪ u00e9', '\\u00ea', '\\u00ed', '\\u00f3', '\\
        ↪ u00fa', '\\u00e7']
        utf = ['\\$', ',', '␣por␣cento', ' ', ' ', ' ',
        ↪ ' ', ' ', ' ', ' ', ' ', ' ', ' ', ' ', '
        ↪ ', ' ']
        for noticia in lista:
            a = noticia
            ja = False
            for i in range(len(asci)):
                if ja == False:
                    a = noticia.replace(asci[i], utf[i])
                    ja = True
                else:
                    a = a.replace(asci[i], utf[i])
            final.append(a)
        return(final)
```

8.2.3 Importing of Time Series from BACEN-SGS

```
# IMPORT PACKAGES
import numpy as np # api - array used for series and
    ↪ dataframe data structures
                    # fundamental package for scientific
                        ↪ computing
import pandas as pd # api - series and datagrame data
    ↪ structues & various
                      # data structures and data analysis
                          ↪ tools

class ImportBacen():

    '''THIS CLASS HAS METHODS TO IMPORT DATA FROM BACEN SGS
        ↪ API'''

    def __init__(self):

        self.init = 'OK'

    def create(names = list(), # names to be assign to
        ↪ series
                numbers = list(),
                initial_date = str(),
                final_date = str()): # series' numbers on
                    ↪ SGS

        '''CREATES DATAFRAME FROM BACEN-SGS SERIES'''

        for i in range(len(names)):
            name = str(names[i])
            url = 'http://api.bcb.gov.br/dados/serie/bcdata
                ↪ .sgs.{}/dados?formato=csv&&dataInicial
                ↪ ={}&dataFinal={}'.format(numbers[i],
```

```
            ↪ initial_date, final_date)
        df = pd.read_csv(url, sep = ';', index_col = 0,
            ↪ parse_dates = [0], infer_datetime_format
            ↪ = True, decimal = ',')
        if i == 0:
            DF = pd.DataFrame({name: df.valor},
                              index = df.index)
        else:
            DF[name] = df.valor

    return(DF)

def append(self, # DataFrame to append Series
           names = list(), # names to be assign to
               ↪ Series
           numbers = list(),
           initial = str(),
           final = str()): # series' numbers on SGS

    '''APPENDS BACEN-SGS SERIES TO DATAFRAME'''

    for i in range(len(names)):
        name = str(names[i])
        url = 'http://api.bcb.gov.br/dados/serie/bcdata
            ↪ .sgs.{}/dados?formato=csv&&dataInicial
            ↪ ={}&dataFinal={}'.format(numbers[i],
            ↪ initial_date, final_date)
        df = pd.read_csv(url, sep = ';', index_col = 0,
            ↪ parse_dates = [0], infer_datetime_format
            ↪ = True, decimal = ',')
        self[name] = df.valor
```

8.2.4 Useful Calculations on Time Series

```
# IMPORT PACKAGES

#import numpy as np # api - array used for series and
    ↪ dataframe data structures
                    # fundamental package for scientific
                        ↪ computing
#import pandas as pd # api - series and datagrame data
    ↪ structues & various
                      # data structures and data analysis
                          ↪ tools

from arch import arch_model
from scipy import stats

class Calculations():

    '''THIS CLASS HAS METHODS TO EXECUTE CALCULATIONS IN
        ↪ TIME SERIES'''

    def __init__(self):

        self.init = 'OK'

    def exchange_coupon(self, # DataFrame containing the
        ↪ Series for the exchange coupon
                        dol = int(), # column number of
                            ↪ exchange rate Series
                        rs = list(), # columns numbers for
                            ↪ interest rates Series (min 1
                            ↪ number, if > 1 then more than
```

```
                    ↪ one measure of exchange coupon
                    ↪ is generated)
                names = list()): # names for exchange
                    ↪  coupons

    '''APPENDS EXCHANGE COUPON TO DATAFRAME'''

    usd = self[self.columns[dol]]
    for e in range(len(rs)):
        r = self[self.columns[rs[e]]]
        name = names[e]
        arr = np.array(list())
        for i in range(len(usd)):
            if i == 0:
                arr = np.append(arr, np.NaN)
            else:
                arr = np.append(arr, ((1 + r[i-1]/100)
                    ↪ /(usd[i]/usd[i-1])-1))
        self[name] = arr

def garch(self, # DataFrame containing the Series
          cols = list()): # columns numbers of Series

    '''APPENDS GARCH'S CSD AND RESIDUALS TO DATAFRAME
       ↪ '''

    for i in range(len(cols)):
        name = self.columns[cols[i]]
        fitted_model = arch_model(self[name][1:]).fit()
        self['{}Csd'.format(name)] = fitted_model.
            ↪ conditional_volatility
        self['{}Res'.format(name)] = fitted_model.resid

def limits(self, # DataFrame containing the Series
```

```
        cols = list()): # columns numbers of Series

    '''APPENDS PARAMETRIC AND NON PARAMETRIC LIMITS TO
       ↪ DATAFRAME'''

    def create_par(up = True):

        '''RETURNS ARRAY OF PARAMETRIC LIMIT (UPPER OR
           ↪ LOWER)'''

        mean = series.mean()
        std = series.std()
        if up == True:
            value = mean + stats.norm.ppf(q = 0.975) *
               ↪ (std)
        else:
            value = mean - stats.norm.ppf(q = 0.975) *
               ↪ (std)
        arr = np.array(list())
        for i in range(len(series)):
            if i == 0:
                arr = np.append(arr, np.NaN)
            else:
                arr = np.append(arr, value)
        return(arr)

    def create_non(up = True):

        '''RETURNS ARRAY OF NON PARAMETRIC LIMIT (UPPER
           ↪ OR LOWER)'''

        mean = series.rolling(window = 63, min_periods
           ↪ = 0, center = True).mean()
```

```
        std = series.rolling(window = 63, min_periods =
            ↪ 0, center = True).std()
        arr = np.array(list())
        for i in range(len(mean)):
            if up == True:
                value = mean[i] + stats.norm.ppf(q =
                    ↪ 0.975) * (std[i])
            else:
                value = mean[i] - stats.norm.ppf(q =
                    ↪ 0.975) * (std[i])
            if i == 0:
                arr = np.append(arr, np.NaN)
            else:
                arr = np.append(arr, value)
        return(arr)

    for e in range(len(cols)):
        name = self.columns[cols[e]]
        series = self[name]
        # PARAMETRIC
        # ----UPPER
        self['{}ParUp'.format(name)] = create_par(up=
            ↪ True)
        # ----LOWER
        self['{}ParLo'.format(name)] = create_par(up=
            ↪ False)
        # NON PARAMETRIC
        # ----UPPER
        self['{}NonUp'.format(name)] = create_non(up =
            ↪ True)
        # ----LOWER
        self['{}NonLo'.format(name)] = create_non(up =
            ↪ False)
```

8.2.5 Output of Graphs

```
# IMPORT PACKAGES

#import numpy as np # api - array used for series and
    ↪ dataframe data structures
                    # fundamental package for scientific
                        ↪ computing
#import pandas as pd # api - series and datagrame data
    ↪ structues & various
                      # data structures and data analysis
                          ↪ tools

from matplotlib import pyplot as plt
import matplotlib.dates as mdates

import statsmodels.tsa.stattools as stat

class Graph():

    def __init__(self):

        self.init = 'OK'

    def series(series = list(), # list with Series to be
        ↪ plotted
                legends = list(), # legends for Series. if
                    ↪ empty, legends are not included
                y_axis = str(), # name of y axis
                title = str(), # title of graphic in LaTeX
                label = str()): # label to use in LaTeX

        '''GRAPH FOR ONE OR MULTIPLE SERIES'''
```

```
        lines = ['solid', 'dashed', 'dashdot', 'dotted']

        for i in range(len(series)):
            ax = series[i].plot(figsize = (8,5), color = '
               ↪ black', linestyle = lines[i])
        if len(legends) > 0:
            ax.legend(legends)
        ax.grid(axis = 'x')
        ax.xaxis.set_major_locator(mdates.YearLocator())
        ax.xaxis.set_major_formatter(mdates.DateFormatter('
           ↪ %m-%Y'))
        plt.gcf().autofmt_xdate()
        plt.xlabel('Date')
        plt.ylabel(y_axis)
        plt.savefig('latex/graphs/{}'.format(label), dpi =
           ↪ 200)
        plt.show()

        a = open('latex/graphstext/{}.txt'.format(label), '
           ↪ w')
        a.write('''\\begin{{figure}}[H]
\\caption{{{0}}}
\\label{{fig:{1}}}
\\centering
\\includegraphics[width=\\textwidth]{{graphs/{1}.png}}
\\end{{figure}}'''.format(title, label))
        a.close()

    def acf_pacf(serie, # Series
                 title,
                 label,
                 pacf = False): # IF FALSE, RETURNS ONLY
                    ↪ ACF GRAPH
```

```
    '''GRAPH FOR ACF ND PACF'''

    cima = []
    baixo = []
    for i in stat.acf(serie[1:], alpha = .05)[1]:
        cima.append(i[0])
        baixo.append(i[1])
    va = {'cima': baixo}
    a = pd.DataFrame(va)
    vb = {'baixo': cima}
    b = pd.DataFrame(vb)

    serieum = pd.Series(stat.acf(serie[1:], alpha =
    ↪ .05)[0])
    serieum.plot(figsize = (8,5), kind = 'bar', color =
    ↪  'black')
    plt.plot(a, color = 'black', linestyle = 'dashed')
    plt.plot(b, color = 'black', linestyle = 'dashdot')
    plt.xlabel('Lag')
    plt.ylabel('ACF')
    plt.legend(('97.5%', '2.5%'))
    plt.savefig('latex/graphs/{}acf'.format(label))
    plt.show()

    if pacf == True:
        cima = []
        baixo = []
        for i in stat.pacf(serie[1:], alpha = .05)[1]:
            cima.append(i[0])
            baixo.append(i[1])

        va = {'cima': baixo}
        a = pd.DataFrame(va)
```

```
            vb = {'baixo': cima}
            b = pd.DataFrame(vb)

            serieum = pd.Series(stat.pacf(serie[1:], alpha
                ↪ = .05)[0])
            serieum.plot(figsize = (8,5), kind = 'bar',
                ↪ color = 'black')
            plt.plot(a, color = 'black', linestyle = '
                ↪ dashed')
            plt.plot(b, color = 'black', linestyle = '
                ↪ dashdot')
            plt.xlabel('Lag')
            plt.ylabel('PACF')
            plt.legend(('97.5%', '2.5%'))
            plt.savefig('latex/graphs/{}pacf'.format(label)
                ↪ )
            plt.show()

        a = open('latex/graphstext/{}acf.txt'.format(label)
            ↪ , 'w')
        a.write('''\\begin{{figure}}[H]
\\caption{{Auto-Correlation Funcion for {0}}}
\\label{{fig:{1}acf}}
\\centering
\\includegraphics[width=\\textwidth]{{graphs/{1}acf.png}}
\\end{{figure}}'''.format(title, label))
        a.close()

        if pacf == True:
            a = open('latex/graphstext/{}pacf.txt'.format(
                ↪ label), 'w')
            a.write('''\\begin{{figure}}[H]
\\caption{{Partial Auto-Correlation Funcion for {0}}}
\\label{{fig:{1}pacf}}
```

```
\\centering
\\includegraphics[width=\\textwidth]{{graphs/{1}pacf.png}}
\\end{{figure}}'''.format(title, label))
            a.close()
```

8.2.6 Output of Tables

```
# IMPORT PACKAGES
#import numpy as np # api - array used for series and
    ↪ dataframe data structures
                    # fundamental package for scientific
                        ↪ computing
#import pandas as pd # api - series and datagrame data
    ↪ structues & various
                        # data structures and data analysis
                            ↪ tools
import statsmodels.tsa.stattools as stat # adf, kpss,
    ↪ shapito white
import statsmodels.stats.diagnostic as dig #ljung box

class Tables():

    '''THIS CLASS HAS METHODS TO EXPORT TABLES'''

    def __init__(self):

        self.init = 'OK'

    def des(title = str(), # series names for input in
        ↪ table's title
```

```
            label = str(),
            series = list(),
            names = list()):

        '''TABLE WITH DESCRIPTIVE STATISTICS'''

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Descriptive Statistics for {}}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | c | c | }}
\\hline
Series & Mean & Standard Deviation & Minimum Value &
   ↪ Maximum Value \\\\
\\hline \\hline'''.format(title, label)
        for i in range(len(series)):
            var = series[i]
            a += '\n{0} & {1:.3f} & {2:.3f} & {3:.3f} &
               ↪ {4:.3f} \\\\'.format(names[i],
```

```
            a += '\n\\hline'
        a += '''\n\\end{tabular}
    \\end{table}'''
        b.write(a)
        b.close()

    def adf(label = str(),
            series = list(),
            names = list()):

        '''TABLE FOR AUGMENTED DICKEY-FULLER TEST'''

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Augmented Dickey-Fuller Test}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | }}
\\hline
Series & Test Statistic & Critical Value at 5\% Level \\\\
\\hline \\hline'''.format(label)
        for i in range(len(series)):
            adf = stat.adfuller(series[i][1:])
```

```
            a += '\n{0} & {1:.3e} & {2:.3e} \\\\'.format(
                ↪ names[i],
                                                        adf
                                                            ↪ [0],
                                                            ↪
                                                        adf
                                                            ↪ [4][
                                                            ↪ '
                                                            ↪ 5%
                                                            ↪ '
                                                            ↪ ])
                                                            ↪
            a += '\n\\hline'
        a += '''\n\\end{tabular}
\\end{table}'''
        b.write(a)
        b.close()

    def kpss(label = str(),
             variables = list(),
             names = list()):

        '''TABLE FOR KWIATKOWSKI-PHILLIPS-SCHMIDT-SHIN TEST
            ↪ '''

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{ K w i a t k o w s k i PhillipsSchmidtShin  Test}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | }}
\\hline
Series & Test Statistic & Critical Value at 5\% Level \\\\
\\hline \\hline'''.format(label)
```

```
        for i in range(len(variables)):
            kpss = stat.kpss(variables[i][1:])
            a += '\n{0} & {1:.3e} & {2:.3e} \\\\'.format(
                ↪ names[i],
                                                        kpss
                                                            ↪ [0],
                                                            ↪
                                                        kpss
                                                            ↪ [3][
                                                            ↪ '
                                                            ↪ 5%
                                                            ↪ '
                                                            ↪ ])
                                                            ↪

            a += '\n\\hline'
        a += '''\n\\end{tabular}
    \\end{table}'''
        b.write(a)
        b.close()

    def ljung_shapiro(label = str(),
                      variables = list(),
                      names = list()):

        '''TABLE FOR LJUNG-BOX AND SHAPIRO-WILK TESTS'''

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Ljung-Box Test and Shapiro-Wilk Test}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | }}
\\hline
```

```
Series & P-value for Ljung-Box Test & P-value for Shapiro-
    ↪ Wilk Test \\\\
\\hline \\hline'''.format(label)
        for i in range(len(variables)):
            var = variables[i][1:]
            a += '\n{0} & {1:.3e} & {2:.3e} \\\\'.format(
                ↪ names[i],
                                                    dig
                                                        ↪ .
                                                        ↪ acorr_lju
                                                        ↪ (
                                                        ↪ var
                                                        ↪ )
                                                        ↪ [1][39],
                                                        ↪
                                                    stats
                                                        ↪ .
                                                        ↪ shapiro
                                                        ↪ (
                                                        ↪ var
                                                        ↪ )
                                                        ↪ [1])
                                                        ↪
            a += '\n\\hline'
        a += '''\n\\end{tabular}
\\end{table}'''
        b.write(a)
        b.close()

    def shapiro(label = str(),
                variables = list(),
                names = list()):

        '''TABLE FOR SHAPIRO-WILK TEST'''
```

```
        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Shapiro-Wilk Test}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | }}
\\hline
Series & P-value \\\\
\\hline \\hline'''.format(label)
        for i in range(len(variables)):
            var = variables[i][1:]
            a += '\n{0} & {1:.3e} \\\\'.format(names[i],
                                               stats.
                                                   ↪ shapiro
                                                   ↪ (var)
                                                   ↪ [1])
            a += '\n\\hline'
        a += '''\n\\end{tabular}
\\end{table}'''
        b.write(a)
        b.close()

    def limits(label = str(),
               upper_limits = list(),
               lower_limits = list(),
               names = list(),
               par = True):

        '''TABLE WITH LIMITS'''

        if par == True:
            title = 'Parametric'
            up = 'Upper Limit'
```

```
            lo = 'Lower Limit'
        else:
            title = 'Non Parametric'
            up = 'Mean of Upper Limits'
            lo = 'Mean of Lower Limits'

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Limits from {} Analysis}}
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | c | c | }}
\\hline
Series & {} & {} \\\\
\\hline \\hline'''.format(title, label, up, lo)
        for i in range(len(upper_limits)):
            upper = upper_limits[i]
            lower = lower_limits[i]
            a += '\n{0} & {1:.3f} & {2:.3f} \\\\'.format(
                ↪ names[i],
                                                        upper
                                                            ↪ .
                                                            ↪ mean
                                                            ↪ ()
                                                            ↪ ,
                                                            ↪
                                                        lower
                                                            ↪ .
                                                            ↪ mean
                                                            ↪ ()
                                                            ↪ )
                                                            ↪
            a += '\n\\hline'
        a += '''\n\\end{tabular}
```

```
\\end{table}'''
        b.write(a)
        b.close()

    def outside(label = str(),
                df = pd.DataFrame(),
                ec = str(),
                csd = str(),
                limits = list(),
                di = False ,
                non = False):

        '''TABLE WITH DAYS WITH ABNORMAL VOLATILITY'''

        exc_cou = df[ec]
        con_std = df[csd]
        upp_lim = df[limits[0]]
        low_lim = df[limits[1]]

        dias = []
        if di == False:
            cupom = 'OC1'
        else:
            cupom = 'DI1'

        if non == False:
            anal = 'Parametric'
        else:
            anal = 'Non_Parametric'

        b = open('latex/tables/{}.txt'.format(label), 'w')
        a = '''\\begin{{table}}[H]
\\caption{{Days with Abnormal Returns for {} Exchange
   ↪ Coupon by {} Analysis}}
```

```
\\label{{tab:{}}}
\\centering
\\begin{{tabular}}{{ | c | c | c | c | c | c |}}
\\hline
& Date & Exchange Coupon & CSD & Lower Limit & Upper Limit
    ↪ \\\\
\\hline \\hline '''.format(cupom, anal, label)
        n = 0
        for i in range(len(con_std.index)):
            if con_std[i] > upp_lim[i] or con_std[i] <
                ↪ low_lim[i]:
                poxa = con_std.index[i]
                date = '{}/{}/{}'.format(str(poxa)[:4], str
                    ↪ (poxa)[5:7], str(poxa)[8:10])
                n += 1
                dias.append(upp_lim.index[i])
                a += '\n{0} & {1} & {2:.3f} & {3:.3f} &
                    ↪ {4:.3f} & {5:.3f} \\\\'.format(n,
```

```
                a += '\n\\hline'
        a += '''\n\\end{tabular}
\\end{table}'''
        b.write(a)
        b.close()
        return(dias)

    def noticia_para_cada_dia(refName, dias, noticias, np =
        ↪ False):
        diass = list()
        for poxa in dias:
            diass.append('{}/{}/{}'.format(str(poxa)[8:10],
                ↪ str(poxa)[5:7], str(poxa)[:4]))

        lista = list()
        if np == False:
            anal = 'Parametric'
        else:
            anal = 'Non Parametric'

        b = open('latex/tables/{}.txt'.format(refName), 'w'
            ↪ )
        a = '''\\begin{{longtable}}{{ | c | c | c | c | }}
\\caption{{Political News in Days of Abnormal Volatility by
    ↪ {} Analysis}}
\\label{{tab:{}}}
```

```
\\hline \\multicolumn{{1}}{{|c|}}{{\\textbf{{}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{Ab. Vol.}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{News Time}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{Headline}}}} \\\\
    ↪ \\hline \\hline
\\endfirsthead
\\multicolumn{{4}}{{c}}%
{{{{\\bfseries \\tablename\\ \\thetable{{}} -- continued
    ↪ from previous page}}}} \\\\
\\hline \\multicolumn{{1}}{{|c|}}{{\\textbf{{}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{Ab. Vol.}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{News Time}}}} & \\
    ↪ multicolumn{{1}}{{c|}}{{\\textbf{{Headline}}}} \\\\
    ↪ \\hline \\hline
\\endhead
\\hline \\hline \\multicolumn{{4}}{{| r |}}{{{{Continued on
    ↪  next page}}}} \\\\ \\hline
\\endfoot
\\hline \\hline \\multicolumn{{4}}{{| r |}}{{End of table}}
    ↪  \\\\ \\hline
\\endlastfoot'''.format(anal, refName)
        n = 0
        for dia in diass:
            for noticia in noticias:
                if (dia in noticia[7:17]):
                    data_cupom = '{}/{}/{}'.format(noticia
                        ↪ [13:17], noticia[10:12], noticia
                        ↪ [7:9])
                    data_hora_noticia = '{}/{} {}:{}'.
                        ↪ format(noticia[30:32], noticia
                        ↪ [27:29], noticia[45:47], noticia
                        ↪ [57:59])
                    n += 1
```

```
                    a += '\n{} & {} & {} & {}[...] \\\\'.
                        ↪ format(n, data_cupom,
                        ↪ data_hora_noticia, noticia[
                        ↪ noticia.find('titulo')+8:noticia.
                        ↪ find('titulo')+49])
                    a += '\n\\hline'
                    lista.append(noticia)
        a += '''\n\\end{longtable}'''
        b.write(a)
        b.close()
        return(lista)
```

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