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# Political Events and their impact on Financial Markets: A Case Study in Turkey

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# Political Events and their impacts on financial markets

## Abstract

This study investigates and compares major political events impacts on financial markets in Turkey including the stock and exchange markets. Different type of events are investigated and their influence on the two markets are compared to define what type of political event move the markets. The study also compares the stock market with the exchange market and tries to identify whether they follow similar patterns for the same events, additionally, it identifies the better investment market for investors that are risk-averse. It particularly focuses on data from the Turkish market. Specifically, uses two different datasets: firstly, daily BIST100 index return over the period of 01/2007-12/2018 and secondly, daily USD/TRY exchange rates for over the same period. In the study, BIST 100 Index stock market and TRY/USD exchange rates volatilities are modeled by using ARMA-ARCH modeling process. The study took the benefit of logarithmic values of market returns to measure the fluctuations by making use of 3126 observations for the stock market and 3130 observations for the exchange market. Data set for the exchange market was obtained from the Central Bank of Turkey electronic data distribution system while the BIST 100 Index values were extracted from Yahoo Finance. Eviews 10 version is used to conduct the analyses. ARCH effect in the return of both markets was discovered present. This indicates the direct effect between news that enters the market and the level of volatility in the chosen markets. Therefore, both of the markets follow semi-strong form of market proposed by Fama. Moreover, volatility clustering and persistence is found in the financial return series. But, BIST100 Index is more volatile than the exchange market. Accordingly, exchange rates are better investment tools for risk-averse investors. However, speculators can get higher returns from the stock returns which are riskier.

Furthermore, the asymmetry effects are investigated by using special ARCH tests. Accordingly, the most appropriate model for BIST100 and exchange rates return series are TARCH(1) and EGARCH(1,1), consecutively. Test results showed that, for both markets positive events have slightly more impact than negative ones, however, shocks last longer for the exchange rates and it lasts a short period of time for the stock market.

Finally, 10 events are chosen after careful examination of the movements they generate in the market returns through volatility analysis and the effect they cause in GDP growths. Events study method is used to measure whether there is an extreme deviation from the average returns on the stock and exchange market before and after the events date. 15 days before and after the events is defined as the event window. Average-adjusted method is used to calculate the abnormal returns showing deviations from the average yield for both markets and for each event. Consequently, gezi park protests, attempted military coup and the sanctions are found to generate the highest plummet in the BIST100 index for the chosen period. As for the exchange rates, the trade sanctions that are imposed by Trump administration is concluded to have created a historical plunge in the Lira rates.

# Table of Contents

Abstract.....	iii
<b>1 Introduction</b>	
1.1 Purpose of the Study.....	2
1.2 Study Limitation.....	3
1.3 Contribution.....	4
1.4 Thesis Organization.....	5
<b>2 Literature Review</b>	
2.1 Individual Papers Review.....	6
2.1 Review of the Studies conducted in Turkey.....	9
<b>3 Theoretical Framework</b>	
3.1 Event Study.....	11
3.2 Stationarity Analysis.....	13
3.2.1 Introduction to Time Series Analysis.....	13
3.2.2 Concept of Stationarity.....	13
3.2.3 Unit Root Tests.....	14
3.2.3.1 Augmented Dickey Fuller Test.....	15
3.2.3.2 Philips-Perron Test.....	16
3.2.3.3 KPSS.....	16
3.2.3.4 ADF-GLS Test.....	17
3.3 Arma-Arch Econometric Models.....	17
3.3.1 Arma Models.....	19
3.3.1.1 Box Jenkins Methodology.....	19
3.3.1.2 Model Identification.....	20
3.3.1.3 Model Estimation.....	20
3.3.1.4 Diagnostic Check.....	20
3.3.2 Arch-Garch Model.....	21
<b>4 Methodology</b>	
4.1 Research Question and Research Hypothesis.....	24
4.2 Stationarity Assumptions.....	25
4.3 Arma Model.....	25

4.4 Event Selection .....	26
4.4.1 Volatility Analysis .....	27
4.5 Arch Models.....	27
4.6 Event Study .....	28
4.7 Research Step.....	28
5 Data and Analysis	
5.1 Data.....	32
5.2 Empirical Results for Stock Market.....	33
5.3 Empirical Results for Exchange Market.....	44
5.4 Event Dates and the volatilities.....	55
5.4.1 2007 General Elections .....	56
5.4.2 2009 Local Elections.....	57
5.4.3 2011 Local Elections.....	58
5.4.4 Gezi Park Protests .....	58
5.4.5 2015 General Elections .....	59
5.4.6 2016 Coup D'état Attempts .....	60
5.4.7 2017 Constitutional Referandum .....	62
5.4.8 2018 Parliamentary Elections .....	63
5.4.9 2018 Sanctions Imposed by US Administration.....	63
5.5 Event Study.....	64
5.5.1 Empirical Findings for the event study for BIST100 Index .....	66
5.5.2 Empirical Findings for the event study for USD/TRY exchange rates .....	72
6 Conclusion and Discussions	
Bibliography	
Appendix	

# Chapter 1

## Introduction

During the last decades movement of asset prices and the financial sector has been heavily affected by the political and financial uncertainties worldwide. Elections, coups, strikes, civil unrest, wars and sanctions are examples. Political risk is an important component that affects the stock markets particularly in emerging countries in the semi-strong form of market. Semi-strong form of market is the market that reflects public information announced immediately in the stock prices (Fama, 1970). Political crisis first affect investor behavior because they are sensitive to news that are an outlook of the future economies which can affect their portfolios in a negative direction. However, it is difficult to determine the impact of political instabilities on investor behavior and the stock prices. Generally, prices should increase if the news leads to upward revision of investor's expectation and should decrease if investors respond to news in an opposite way (Tan and Gannon, 2002).

In the past, researchers used different approaches to test the relation between the political news and stock market volatilities. Cutler et. Al. (1989), Bittlingmayer (1988), Kim and Mei (2001) took political risk into account in accordance with the stock market fluctuations. Beaulieu, Cosset and Essaddam (2006) researched the influence of the 1995 Quebec referendum on the common stock returns of Quebec firms while Chandra (2014) examined the results of 2014 Indonesian national elections on the stock prices. Mean and Kammoun (2015) considered the Arab spring and concluded that it affected the stock market in a negative direction. Jeribi et Al. (2015) conducted a study about the Tunisian Revolution and its impact on TUNINDEX, the Tunisian Stock Exchange Market.

Political events does not only affect the stock market but also have an important influence on the foreign exchange markets. Several studies have been conducted to state the political risk factor on the financial industries. They examine the way that elections, political alliances and the political incertitude affecting the evolution and fluctuations of exchange rates. According to the existing economic literature political risk plays an important role in the market movements (Pulbar, 2012). Laakkonen (2007) researched the macroeconomic news impact on the euro-dollar exchange rate surges for a 5 year period and discovered that negative news have higher influence on the euro-dollar fluctuations. While, Beetsma et. Al. (2012) studied political events on the exchange-rate fluctuations, Kumar and Ghalke (2006) studied relationship between parliamentary sessions and capital market.

## **1.1 Purpose of the study**

Developing from the previous studies this study will investigate major political events impact on financial markets in Turkey including the stock and exchange markets. Different type of events will be investigated and their influence on the two markets will be compared to define what type of political event move the markets. The study will also compare the stock market with the exchange market and will try to identify whether they follow similar patterns for the same events, additionally, it will identify the better investment market for investors that are risk-averse. For this purpose, a time period from 2007 until 2018 has been defined. The selection of this timeline can be justified by the existence of important political decisions and conflicts in Turkey in this period. The political events occurred in Turkey that the study mainly deals are the gezi park protests, military coup attempt, constitution referendums, several elections, and lastly heavy sanctions imposed by US administration that resulted in the historical exchange rate crisis in 10 August 2018. The study will examine these particular events and compare how these events have influenced the exchange rates and the stock prices behaviour whether these two markets follow a similar pattern on their reflection to the similar

events. The reason behind choosing these two markets is because the FOREX and Stock markets are the two primary sources for investors to make profits and to speculate. Thus, this arises the question on which market is more volatile and riskier while which one provides better and more safe investment opportunities. Moreover, it is also researched whether these two markets move in the same direction as a result of similar events.

This thesis particularly focuses on data from the Turkish market. Specifically, it uses two different datasets: firstly, daily BIST100 index returns over the period of 01/2007-12/2018 and secondly, daily USD/TRY exchange rates for over the same period.

For the empirical methods firstly, ARIMA-ARCH model process will be used in order to identify whether events that occur have direct influence on the markets. ARCH effect will be investigated in the return of the markets which indicates a direct relation between news that enters the market and the level of volatility. After defining whether the markets follow the semi-strong form of market hypothesis proposed by Fama, event study will be used to gauge the effect of a chosen event on stock prices and exchange rates. The aim of this type of a study is to detect the effects, direction and magnitude of unanticipated events (Sitthipongpanich, 2010). The events will be chosen based on their impacts on fluctuations on markets during that year. For this purpose, the graphs of stock and exchange rate returns will be examined carefully by considering the event dates in order to find a fluttered pattern. Moreover, macroeconomic variables such as: unemployment rates and GDP growths will also be taken into consideration in the event choosing process.

## **1.2 Study Limitations**

Limitations of the study arises from the impossibility of aggregating primary daily data from the exchange and stock markets for the past periods. Thus, there is no possibility to aggregate the past data on a primary basis. Therefore, the research will be based on the secondary data extracted from sources such as Yahoo Finance and the Central Bank of

Republic of Turkey. Accordingly, the past news can not be collected on a daily scale. Thus, the events will be selected by past resources.

### **1.3 Contribution**

Although researches on political events on Turkish stock markets have been conducted for the past decades, studies about the politic-exchange rate structure in Turkey are limited. The existent studies about the exchange rate are about the relation between terrorism news and the exchange rate volatility. However, their result were not conclusive, therefore, calling for a further study.

Furthermore, there are no studies that are researching this two markets simultaneously. There are a number of studies that researched these two markets on a different scale. These are studies about political events and the scale of their effects on Turkish stock market or relation between terrorism news and the exchange rate volatility; however, this study will compare and contrast the patterns of the market movements before and after the occurrence of a certain event. Therefore, this study would provide an interesting and distinguishing perspective by incorporating the stock and exchange markets in Turkey

Additionally, the studies that are conducted in Turkey are outdated and most of them are from late 90's or early 2000's. Turkey is an emerging country that is situated between Europe and Asia and has borders with Syria, Iraq and Iran. Accordingly, Turkey is in one of the most unsteady places on the planet. What happens in Europe have a direct effect on Turkey, also the events coming from the east such as Syrian war that resulted in tensions and a huge influx of refugees into the country shapes country's economic outlook. Therefore, Turkey straddling the continents of Europe and Asia has a strategic important location. Therefore, it is only natural for Turkish politics to be very intense and rapidly changing. It is important to study the current events which haven't been researched. For instance, 2018 Sanctions that was imposed by the Trump administration and has caused a historical crush in Turkish Lira. Or, the 2017

Referendums that accepted 18 amendments that accepted a more authoritarian presidential system that has caused high criticism by western media and most importantly, the 2016 military coup attempt that shocked Turkish citizens. Consequently, this research focuses on contemporary political events.

Besides, the existent researches are limited to a one type of event. Such as elections or referendums. However, the aim of this study is to research what type of political event moves the markets and compare it for both markets. I include 5 type of events in my study and these are, elections, protests, referendum, military coup and sanctions. The reason for including these events are because these have had high effects in Turkish economy.

#### **1.4 Thesis Organization**

This thesis is structured as follows. In chapter two, relevant background information about the studies conducted in Turkey will be explained and the literature review will be described. Chapter 3 will discuss relevant theories such as ARMA-ARCH model structure and event study. Chapter 4 will describe the methodology, the research methods that are used, will state the research questions, research hypotheses and statistical hypotheses. Chapter 5 will present information on the data and descriptive statistics and the empirical findings will be presented. In the following chapter the results will be summarized discussed and concluded.

# Chapter 2

## Literature Review

### 2.1 Individual Papers Review

In general, it is difficult to link political events with the financial industries; however, previous literature has provided evidences between the political changes and economic growth. The literature that exists links these two concept with event study which is an analysis of the impact of a specific piece of news related to a company and its stock or the impact of the specific news to the stock indexes. It can also be used as a macroeconomic tool to analyse the impact of an event on overall market (Investopedia). Accordingly, there is a wide range of papers that analyses political events impact on stock markets and exchange rate returns. Consequently, this literature review includes articles and journals about the political events impacts on the stock and exchange markets around the world as well as existing case studies in Turkey.

Niederhoffer (1971) examines the effects of world events on stock market. His study investigates the relationship of world events with S&P 500 index. World events are selected from leading newspapers in US based on the magnitudes of their headlines and reliability. The results of this study reports that world events affects the fluctuations of the S&P 500 Index. Results shows returns following world events tend to be larger in absolute value than returns on other days.

Cutler, Poterba and Summers (1989) conduct a similar study and analyse market responses that follow specific 49 events that has been selected. He selects these events by examining large changes in the share prices and relating them to news development. He makes a list that constitute 50 largest one-day returns on S&P Composite Stock Index. Accordingly,

He finds the average absolute value of returns on event and non-event days and concludes that returns on event days are more volatile than returns on non-event days.

Kim and Mei (1994) examine the fluctuations in the Hong Kong stock market and how they are affected by the political events. They use an event-study methodology and find that political developments have a prominent impact on stock prices. Finally, they conclude the variation in volatility as a function of political events.

Similarly, Bittlingmayer (1992) researches the causal relationship between stock prices and political environment in Germany. He asks whether the political environment affect the stock market. He explains political environment as the force of the democratic institutions and existence of elections. In his study, he extracts data from German Stock Exchange and conclude that uncertainties about the future government policies can increase stock volatility. According to the research that he conducted, revolution, war race, overthrowing of governments, violent uprising against authority and strikes results in higher fluctuations in the German stock market returns. Moreover, he asserts that political instability has drawbacks on the industrial production.

Zach (2003) examines increased activity on the peace process between Israel and its Arab neighbours and how the news related to these events influence Tel Aviv Stock Exchange Index. He proceeds a short window event study and selects the news by Dow Jones News Retrieval Service (DJNRS) for the articles in the Wall Street Journal, the New York Times, the Washington Post and Los Angeles Times for the happening of prominent events in Middle East during the period 1993-1997.

Kaddour (2011) investigates Financial sector reaction to the special events that occurred after January 14, 2011 Revolution in Tunisia. He classifies the news that he aggregated as political, economic, social and terrorism events. He bases his studies to 3 variables which are: Sectoral Index of performance of Tunisian banks, Index of Tunisian Stock Market and the

exchange rate Euro/Dinar. By using autoregressive conditional heteroscedasticity specification (ARCH) of Engel, he researches the volatility of financial variables. To understand the effect of bad and good news separately he further carries his study by using asymmetric GARCH, EGARCH model tests. He concludes that the Tunisian stock market is most affected by terrorism and political events while the fluctuations in the exchange rate and the performance of the banking sector is mainly defined by the economic uncertainty.

Dangol (2008) similarly carries a study that searches for the market reaction to announcements of unexpected political news in the Nepalese stock market. He defines semi-strong form of market first identified by Fama(1970) as a type of market in which stock prices reflects all the available information. He bases his study on the secondary data that incorporate the daily share price and the NEPSE Index and collects political announcements from daily newspapers. Similar with the previous studies he also uses event study methodology to measure the political effects on the stocks markets. Moreover, he bases his market research on a (CAPM) capital assets pricing model which is used for identifying the relationship between risk and expected return for stocks (Investopedia). Finally, He concludes by asserting that Nepalese Stock markets are insufficient with regards to semi-strong level but a strong bond between political uncertainty and common stock returns is apparent.

Suleman (2012) choses to study the effects of political uncertainty on the Pakistan's stock exchange market. Different from other studies, he classifies the political news in two category as good and bad news. He imports daily data from the Karachi Stock exchange market to observe the impact on the fluctuations of the stocks. He applies univariate asymmetric GARCH model by using e-views and finalizes as good news having positive affect on the returns of the KTSE100 index. Additionally, he finds bad news having approximately double effect on the stocks compared to good news. Furthermore, he searches the political instability impacts on

the other sectors. His results displays most of the sectors having similar patterns with the KTSE Index.

Cristi and Mihai (2012) tries to capture the influence of political and economic events on the Romanian exchange rates by using volatility tests. They find that political news positively affects exchange rate fluctuations.

## **2.2 Review of the studies conducted in Turkey**

In 2016, Samet Gunay conducts a study about the internal political risk on the Turkish stock market for the period of 2001-2014. He researches the possible risks that arises from political events and the scale of their effects on Turkish stock market by using a Kapetanios unit root test. He finds out that the stock market was more stable during 2011-2014 regime compared to the last regime and concludes as the Turkish stock market being responsive to the political uncertainties; however, the magnitude of the response having declined compared to the past. Aktas (2006), searches whether Turkish stock market follows the Efficient Market Hypothesis or not. The empirical results that he put forward does confirm that BIST follows Efficient Market Hypothesis.

Studies about the politic-exchange rate structure in Turkey are limited. However, there are research about the relation between terrorism news and the exchange rate volatility. The research by Martha, Mustofa and Gok Ugur (2017) reveals that terrorism does have reverse impacts on the exchange rate in Turkey; nevertheless, the magnitude of the shocks are small both in the short and long run. Another type of research conducted by Ganbold, Akram and Lubis aims to model and forecast Turkish Lira volatility.

# Chapter 3

## Theories

The main theory of the framework of this research is event study analysis which is used to check the impact of various events on financial markets and ARMA-GARCH econometric model process to assess the time varying volatility of stock and exchange markets that is caused by an event.

### 3.1 Event Study

Event study is a method that is used to gauge the effect of an event on stock prices. The aim of this type of a study is to detect the effects, direction and magnitude of unanticipated events on stock prices (Sittipongpanich, 2010). Thus, this method helps to measure how market trends are going on before happening of an event and what changes occur after. (Bhagat et. al, 1985). There are 5 steps to conduct an event study.

**Step 1:** The identification of the event that the study will investigate and determination of the samples

In this step the date of the event should also be defined as the ‘day 0’ which corresponds to the announcement day when the information is made public.

**Step 2:** Identification of the timeline of the event

The researcher identifies the test period (TP) and the estimation period (EP). The test period corresponds the event window in which the stock price behaviour is investigated. Many investigators uses short event windows which sets the estimation period as 2-3 days. However, there are also long term event windows that cover months or years. The estimation period

corresponds the period that expected return of the stocks are estimated and the event period is not included in the estimation period (McKinlay, 1997).

**Step 3:** Estimation of expected return for all the sample stock

The expected return (price) of the stocks are estimated by using capital asset pricing model (CAPM).

^

$$E(R_{i,t}) = R_{f,t} + \beta_i (R_{m,t} - R_{f,t})$$

$E(R_{i,t})$ : Expected returns

$R_{f,t}$  : Risk free rate

^

$\beta_i$  : Beta of the security

$R_{m,t}$  : Expected return on market

**Step 4:** Computation of excess returns (abnormal) returns by taking the difference between actual return time (t) and expected return of an individual stock.

$$AR_{i,t} = R_{i,t} - E(R_{i,t})$$

**Step 5:** Testing the significance of excess (abnormal) returns.

T-statistics, sign test or rank test can be applied to test the significance of excess errors.

(Sitthipongpanich, 2010)

## 3.2 Stationarity Analysis

### 3.2.1 Introduction to Time Series Analysis

Time series is a series of data points that are indexed in time order. Most commonly, a time series is a sequence taken at successive equally spaced points in time. The daily stock prices from BIST100 index and the exchange rates can be an example of this type of data. The procedure of fitting a time series to a proper model is termed as Time Series Analysis. It comprises methods to understand the nature of the series in order to extract meaningful statistics and other characteristics of the data, also it is often useful for identifying the nature of the phenomenon represented by the sequence of observations. (Adhikari, 2013)

### 3.2.2 Concept of Stationarity

The concept of stationarity of a stochastic process can be visualized as a form of statistical equilibrium. The statistical properties such as mean and variance of a stationary variance do not depend upon time. It is a necessary condition for building a time series model. There are two types of stationarity. A process is  $\{x(t), t = 0, 1, 2, \dots\}$  is strongly stationary or strictly stationary if the joint probability distribution function of  $\{x_{t-s}, x_{t-s+1}, \dots, x_t, \dots, x_{t+s-1}, x_{t+s}\}$  is independent of  $t$  for all  $s$ . Thus, for a strong stationary process the joint distribution of any possible set of random variables from the process is independent of time (Adhikari, 2013).

However, the strong stationarity assumption is not always needed. A stochastic process is said to be weakly stationary of order  $k$  if both the mean of  $r_t$  and the covariance between  $r_t$  and  $r_{t-1}$  are time variant. In practice, suppose having examined  $T$  data points  $\{r_t | t = 1, \dots, T\}$ . The weak stationarity implies that the time plot of the data would show that the  $T$  values fluctuate with constant variation and around a fixed level.

Consequently, in strict stationarity probability distribution of the random variable is exactly the same along the time and in weak stationarity mean, correlation and covariance of the random variables are invariant to time shift. There are certain tests to detect stationarity. These tests are called as unit root tests.

### 3.2.3 Unit Root Tests

Many economic and financial time series exhibit trending behaviour or non-stationarity in the mean. Asset prices, exchange rates or level of macroeconomic aggregates like GDP are good examples. It is an important task to identify whether a series is stationary or not as it is a pre-condition to use ARMA, ARIMA and GARCH models. For this end, the trend in the series must be determined and removed.

Two trend removal procedures are first differencing and time trend regression. First differencing is appropriate for I (1) type of series while time-trend regression procedures can be used for I (0) time series. And, unit root tests can be used to determine if the trending data should be first differenced or regressed on deterministic functions of time to render the data stationary.

To understand the econometric issues, consider the stylized trend-cycle decomposition of a time series series  $y_t$ :

$$y_t = \tau D_t + z_t \tau D_t$$

$$= \kappa + \delta t$$

$$z_t = \phi z_{t-1} + \epsilon_t, \epsilon_t \sim WN(0, \sigma^2)$$

(Washington, 2006)

where  $TDt$  is a deterministic linear trend and  $z_t$  is an AR (1) process. If  $|\phi| < 1$  then  $y_t$  is  $I(0)$  about the deterministic trend  $TDt$ .

Autoregressive unit root tests are based on testing the null hypothesis that  $\phi = 1$  (difference stationary) against the alternative hypothesis that  $\phi < 1$  (trend stationary). They are called unit root tests because under the null hypothesis the autoregressive polynomial of  $z_t$ ,  $\phi(z) = (1 - \phi z) = 0$ , has a root equal to unity.

Stationarity tests accept the null hypothesis stating that  $y_t$  is trend stationary. Then the first difference for  $y_t$  is taken and the series becomes:

$$\Delta y_t = \delta + \Delta z_t$$

$$\Delta z_t = \phi \Delta z_{t-1} + \varepsilon_t - \varepsilon_{t-1}$$

(Washington, 2006)

There are various tests to identify the stationarity but the one that is most commonly used in large samples of data is Augmented Dickey-Fuller Test which is developed by Denis Sargan and Alok Bhargava. This paper also utilizes other tests such as: Philips-Perron, KPSS and ADF-GLS tests.

### 3.2.3.1 Augmented Dickey Fuller Test

In statistics Augmented Dickey Fuller test the null hypothesis the unit root is present in a time series sample. The alternative hypothesis is generally stationarity to trend-stationarity and the data needs to be differenced to make it stationary.

ADF test is applied to the following model:

$$\Delta z_t = \theta z_{t-1} + \alpha_1 \Delta z_{t-1} + \alpha_2 \Delta z_{t-2} + \dots + \alpha_p \Delta z_{t-p} + a_t$$

The number of lags is determined by minimizing the Schwartz Bayesian Information Criterion and the Akaike Information Criterion. Lags are dropped until the last lag is statistically significant.

### 3.2.3.2 Philips-Perron Test

Philips and Perron(1998) developed a number of Unit Root tests that differ from the ADF tests in mainly how they deal with serial correlation and heteroscedasticity in the errors. ADF tests use parametric autoregression while PP tests ignore serial regression in the test regression

PP test is applied through the following model:

$$\Delta y_t = \beta_0 D_t + \pi y_{t-1} + u_t$$

(Washington, 2006)

### 3.2.3.3 KPSS Test

In econometrics, Kwiatkowski-Philips-Shin tests are used for testing a null hypothesis that observable time series is stationary around a deterministic trend against the alternative of a unit

root (Nielsen, 2005). Different from the other stationarity test KPSS test assumes null hypothesis to be stationary. Additionally, these tests are mostly used for yield curves, intraday prices, volume curves and most relevantly the volatilities (Kokozska, 2017).

The test statistic is given by the following model:

$$KPSS = 1/T^2 \cdot \sum S^2t/\sigma^2$$

(Nielsen, 2005)

### **3.2.3.4 ADF-GLS Test**

ADF-GLS test is one of the unit root tests in an economic time series sample. It was developed by Elliot, Rotthenberg and Stock (ERS) in 1992 as a modification of Augmented Dickey Fuller (ADF) test using a generalized least square rationale (Cheung, 2015). This test has the best overall performance in terms of small size and power.

## **3.3 Arma-Arch Econometric Models**

This paper uses an Arma-Garch error model to capture the ARCH effect present in daily streamflow series, as well as to preserve seasonal variation in variance in the residuals. The ARMA-GARCH model combines an ARMA model for modelling a mean behaviour and a GARCH model for modelling the variance behaviour of the residuals from ARMA model (Wang, 2005).

The first part of the model comprises of two subsets: AR and MA. Autoregressive (AR) models were first introduced by Yule in 1926 than they were supplemented by MA schemes by Slutsky (1937). However, Wold (1938) combined AR and MA schemes and showed that ARMA processes can be used to model stationary time series by using appropriate order of  $p$  for AR and  $q$  for MA terms. In other words, a general series  $X_t$  can be modelled by using past

$X_t$  and past  $\epsilon_t$  error values (Syros, 1997). However, the utilization of the model suggested by Wold became possible in the mid-1960's when computers became capable of performing the required applications.

Box and Jenkins (1976) popularized ARIMA model usage through (1) providing guidelines for making the series stationary in its mean and variance, (2) bringing ACF and PACF usage for determining the appropriate  $p$  and  $q$  values, (3) providing computer programs to help users to identify appropriate values for  $p$  and  $q$  and estimate the parameters, (4) diagnostic check to determine whether the residuals or  $\epsilon_t$  are white noise, to determine the order of the model as final (Original edition, 1970).

The second part of the model ARCH uses the homoscedasticity condition of Ordinary Least Squares Model which assume that square of the expected value of residuals should be equal for different points in a regression. This condition seems more likely for regressions that cluster information about similar groups. However, data in which variances of the error terms are not equal are defined as heteroskedastic and the regression is said to be biased. However, regression coefficients for ordinary least squares regression are still unbiased but the standard errors and confidence intervals will be too acute. In this case of heteroskedasticity ARCH Autoregressive conditional heteroskedasticity and GARCH generalized autoregressive conditional heteroskedasticity models are used for the variance of each error term (Engle). In other words, these methods enable conditional variance to alter over time as a function of past errors leaving the unconditional variance constant (Bollerslev, 1986). These models provide us with the opportunity to gauge the time-varying volatility which can be beneficial for financial decisions concerning risk analysis (Engle).

Before ARCH model Rolling standard deviation, model was used to define the variances in the heteroskedasticity case. Accordingly, the model would gauge the standard deviation of the most recent data and predict tomorrow as equally weighted average of the squared residuals

from the last time period. However, corresponding equally weights for every day does not seem rational as the closer days would have more impact on today's data. Therefore, ARCH model proposed by Engle (1982) suggests this weight to be parameters for the mean and variances of the regression to be estimated. This model permits data to forecast the best fit for variance. (Engle, 1982).

### 3.3.1 Arma Models

The Box-Jenkins approach to modelling ARMA (p, q) models was first described by George Box and Gwilym Jenkins in 1970. Autoregressive Moving average (ARMA) models provide a parsimonious description of a weakly stationary stochastic process in terms of two polynomials, one for the autoregression (AR) and the moving average (MA). AR part involves regressing the variable on its own lagged (past) values and MA part involves modelling the error terms as a linear combination of error terms occurring contemporaneously and at various times in the past. It is a model for understanding and predicting the future values of the series.

#### 3.3.1.1 Box Jenkins Methodology

Box Jenkins methodology presents a method to construct an ARMA (p, q) model. It involves a preliminary data transformation analysis such as obtaining a stationary series. To determine whether a series is stationary the unit root tests are used and the graphs of the series are examined. Thus, stationarity is a pre-condition for conducting an ARMA model. In the data transformation process the increasing variability of the series is tried to be stabilized through Box-Cox Transformation:

$$y_t = (x_t^\lambda - 1) / \lambda \quad \text{if } \lambda \neq 0$$

$$\log(x_t) \quad \text{If } \lambda=0$$

The parameter  $\lambda$  is chosen by the analyst and the popular choices are 0 and 1/2.

After rendering the data stationary an appropriate model is fit to the data and Box Jenkins methodology follows 3 stages that involves model identification, estimation and checking (Triacca, 2017)

### **3.3.1.2 Model Identification**

Before estimating the ARMA (p, q) model an appropriate order p and q order for AR and MA polynomials should be selected. For this end, the Sample Autocorrelation Function (ACF) and the Sample Partial Autocorrelation Functions must be (PACF) examined. Identification of pure AR or MA processes are straightforward using ACF and PACF functions; however, for ARMA (p, q) processes with p and q both non-zero it is more difficult to interpret the orders using these functions. For this reason, AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) are used. Among a set of models, the values that minimizes the AIC and BIC are chosen to identify the order of p and q. (Triacca, 2017)

### **3.3.1.3 Model Estimation**

After choosing the suitable orders for p and q the next stage is to estimate the coefficients that are fitted by least square regression to find the values of the parameters which minimize the error term. In order to find the best fit for the data it is a good practice to look for the smallest values of p and q.

### 3.3.1.4 Diagnostic Check

Once the model is identified and estimated the candidate ARMA models, the adequacy of the selected models to the data should be assessed. This involves a parameter and a residual analysis. First of all, if the fitted model is right than the residuals should be white noise. The residuals are checked to find whether they have zero mean or if they are uncorrelated. For this purpose, the coefficients of the sample in the ACF and PACF are checked to find whether they are close to zero. Secondly, the usual t-statistics to test the statistical significance of the AR and MA parameters should be carried out to check if the model is over specified (Box and Jenkins, 1976)

### 3.3.2 Arch-Garch Model

ARCH and GARCH model proposed by Engle:

Take  $\sigma_t^2$  to be the conditional variance of  $\epsilon_t$

$$\epsilon_t = \sigma_t z_t$$

$z_t$  is i.i.d. with

$$E(z_t) = 0, \text{ Var}(z_t) = 1, \text{ and}$$

$$\sigma_t^2 = \sigma^2 (\epsilon_{t-1}, \epsilon_{t-2}, \dots, t, X, b)$$

$$= \sigma^2 (\sigma_{t-1} z_{t-1}, \sigma_{t-2} z_{t-2}, \dots, t, X, b)$$

(Nelson, 1991)

Any model of the form above is called as an Arch model. Arch models are used to describe a changing, possibly volatile variance. They are used to investigate the changes in the volatility that is caused by an event. Later in 1986 Bollerslev proposed GARCH model which

is broadly used for modelling financial time series that exhibit time varying volatility and volatility clustering.

Arch and Garch Model proposed by Engle (1982) and Bollerslev (1986), respectively, that makes the  $\sigma^2_t$  value

$$(1.1) \quad \sigma_t^2 = w + \sum_{j=1}^p \alpha_j Z_{t-j}^2 \sigma_{t-j}^2$$

$$(1.2) \quad \sigma_t^2 = w + \sum_{j=1}^q \beta_j Z_{t-j}^2 \sigma_{t-j}^2 + \sum_{j=1}^p \alpha_j Z_{t-j}^2 \sigma_{t-j}^2$$

(Nelson, 1991)

For the models above  $w$ ,  $\alpha_j$  and  $\beta_i$  are nonnegative.

However, GARCH model illustrated above ignores the direction of error. But, the direction of the shock is actually a prominent information. Especially, in stock and bond indices the market decreases forecasts higher volatility than market enhancements. Therefore, the distinction between positive and negative shocks are an important factor to be included in the model to gauge the volatility. Therefore, to make the distinction in between Nelson (1991) have introduced the EGARCH model which is more suitable for modelling conditional variances in asset returns. Today, this model enable us to identify asymmetry in other words helps us to track the differences between good and bad news effects on the stock volatilities.

EGARCH model that was proposed by Nelson (1991):

$$(1.3) \quad \text{Ln}(\sigma_t^2) = \alpha_t + \sum_{k=1}^{\infty} \beta_k g(Z_{t-k})$$

$\{\alpha_t\}_{t=-\infty, \infty}$  and  $\{\beta_k\}_{k=1, \infty}$  are real non stochastic, scalar sequences.

To entrench the asymmetric between stock returns and volatility changes

$g(Z_t)$  must be a function of magnitude and sign of  $Z_t$ . One choice is to make  $g(Z_t)$  a linear combination of  $Z_t$  and  $|Z_t|$

$$(1.4) \quad g(Z_t) = \theta Z_t + \gamma [ |Z_t| - E |Z_t| ]$$

(Nelson, 1991)

$\{g(Z_t)\}_{t=-\infty, \infty}$  has zero mean i.i.d. random sequence by construction, mean of both  $\theta Z_t$  and  $\gamma [ |Z_t| - E |Z_t| ]$  are zero. In the range  $0 < Z_t < \infty$ ,  $g(Z_t)$  is linear with slope

$\theta + \gamma$  and in the range,  $-\infty < Z_t \leq 0$   $g(Z_t)$  is linear with slope  $\theta - \gamma$ . Therefore, in this model the conditional variance  $\{\sigma^2\}$  can respond asymmetrically to the rises and falls in the stock price. (Nelson, 1991)

# Chapter 4

## Methodology

### 4.1 Research Question and Research Hypothesis

Based on the discussed theories and literature review the research questions of this study are: What political event affected the Turkish financial markets and how they affected stock and exchange market for the period of 2007/01-2018/12?

How and why the political events affect Turkish financial markets and to what extend is it a semi strong form of an efficient market?

Based on previous research the author of this paper develops the following hypotheses:

. H<sub>0</sub>: Gezi Park protests have not caused highest plummet in the BIST100 Index for the past 11 years

. H<sub>1</sub>: Gezi Park protests have caused the highest plummet in the BIST100 Index for the past 11 years

. H<sub>0</sub>: Sanctions have not caused highest TRY/USD Dollar exchange rate plunge for the past 11 years

. H<sub>1</sub>: Sanctions have caused highest TRY/USD exchange rate plunge for the past 11 years

And a concluding hypothesis:

H<sub>0</sub>: Turkish financial markets does not follow semi strong form of efficient market proposed by Fama

H<sub>1</sub>: Turkish financial markets follow semi strong form of efficient market proposed by Fama

The hypotheses respond to the need to explore which political event influences Turkish financial markets the most for the chosen period and to the need to determine the magnitude of these effects. The final hypothesis addresses to the theory proposed by Fama which states the public information available in emerging countries are reflected in the asset prices or not. During my research, I will try to reject all the null hypotheses.

## **4.2 Stationarity Assumptions**

Pre-assumption to conduct an ARMA model is that the data is stationary, which is not often the case in financial time series. Stationarity means that the series has a constant mean, constant variance, and constant auto-covariance structure (Brooks, 2008). Therefore, the research first will define the stationarity of the time series data for daily BIST100 index returns and USD/TRY exchange returns. This process will be conducted through unit root tests. The tests that will be used include the Augmented Dickey Fuller, Philips Perron, ADF-GLS and KPSS tests. If the series are not stationary, the original series will be differentiated to have stationarity in the series.

## **4.3 ARMA Model**

To answer the research question, it is good to start from building the simplest univariate model that will give help to identify whether the Turkish financial markets follow semi-strong form of efficient market in other words whether the events cause immediate movements in the markets. For this end, a Unit root test along with an ARMA-ARCH model process will be conducted. Following Box and Jenkins Methodology (1976) for modeling time series with

ARMA, the first step is model identification (ACF, PACF and Information Criteria, (AIC and SIC)) will be used in identifying the appropriate model. Second step will be to perform parameter estimation (using maximum likelihood). Third step will be to check the model using residual diagnostics and overfitting. Additionally, diagnostic checks will be used to measure the model accuracy.

### 4.3.1 General Model Description for ARMA

ARMA(p,q) model:

$$x_t = \phi_1 x_{t-1} + \phi_2 x_{t-2} + \dots + \phi_p x_{t-p} + \epsilon_t + \theta_1 \epsilon_{t-1} + \dots + \theta_q \epsilon_{t-q}$$

by using lag polynomial ARMA model can be generalized as follows:

$$\phi(L)x_t = \theta(L)\epsilon_t$$

### 4.4 Event Selection

A qualitative analysis will be conducted for choosing the events. Qualitative data analysis is the classification and interpretation of linguistic (or visual) material to make statements about implicit and explicit dimensions and structures of meaning-making in the material and what is represented in it. The aim of the qualitative data analysis is to describe a phenomenon, compare several cases and develop a theory (Flick, 2013). Accordingly, the qualitative data analysis that I will use for this research is selection and aggregation of important political events from research papers.

#### **4.4.1 Volatility Analysis**

The events will be selected according to their importance and international recognition and their effect on the volatilities of the stock and exchange markets as well as the macroeconomic aggregates such as GDP growth and unemployment rates. Later, the graphs of the stock and exchange returns will be carefully analysed for each year. As the market becomes volatile whenever big events occur, it might take some time for the market to digest the news and these causes volatility clustering. Volatility clustering is a volatile period that is followed by another volatile period. Accordingly, these clustering will be matched with the events. For this purpose, 10 events under the category of elections, referendums, protests, coup attempts and sanctions will be selected. Log differences of the BIST100 index and exchange rates will be calculated to investigate the daily stock and exchange rate returns.

#### **4.5 ARCH Model**

ARCH processes are used in Finance to model asset price volatility over time, to develop volatility tests for market efficiency and to estimate the time varying systematic risk. In the past it has been used for measuring term structure of i-rates, examining how information flows over time, examining the relationship between exchange rate uncertainty and trade and characterizing the relationship between macroeconomy and the stock market (Bera, 1993). In this paper ARCH models are used to identify the volatility nature both in the Exchange rate and BIST100 Index returns.

#### **4.6 Event Study**

The event study approach will be used to explore how the stock and exchange markets are performing before the chosen events and what changes occur after the events. The event

window that is chosen for the study is 15 days. Accordingly, markets will be examined 15 days prior and after the event. This study will also help me to explore what type of political news causes bigger changes in the financial markets. Whether protests, elections, referendums, coups or sanctions have had bigger effect in the financial markets for the past 11 years.

#### **4.7 Research Steps**

(I) Data will be extracted to find the daily BIST100 Index and USD/TRY exchange rates

(II) Log differences of the data will be calculated in order to find the return rates. The

following formula will be used to determine the daily returns for both markets

$$R_t = \text{Log} (p_t/p_{t-1})$$

(III) Stationarity will be checked for the financial return series for both markets by using the following Unit Root Tests:

- Augmented Dickey Fuller Test
- KPSS
- Philips-Perron
- ADF-GLS

(IV) The first difference of the data will be taken in case of non-stationarity of the return series.

(V) After obtaining stationarity in the time series, Box Jenkins Methodology will be used to generate the models that will give the most appropriate p and q orders for ARMA (p, q) model which will give the best mean for the ARMA-ARCH process

- ACF and PACF functions will be examined to determine the p, q orders
- AIC and SIC of the generated models will be used to choose the best model

(VI) ARCH-EGARCH econometric models introduced by Engle and Nelson (1991) will be used to investigate the fluctuations in the stock and exchange markets. I will conduct these tests by using BIST100 Index data for the stock market, Central Bank exchange rates and EViews econometrics software. The equation that I will use are the ARCH and EGARCH Model introduced by Engle and Nelson:

$$(1.1) \quad \sigma_t^2 = w + \sum_{j=1}^p \alpha_j z_{t-j}^2 \sigma_{t-j}^2$$

( Nelson, 1991 )

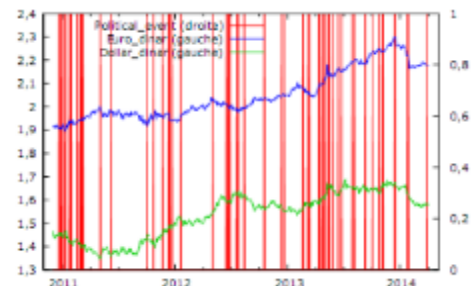
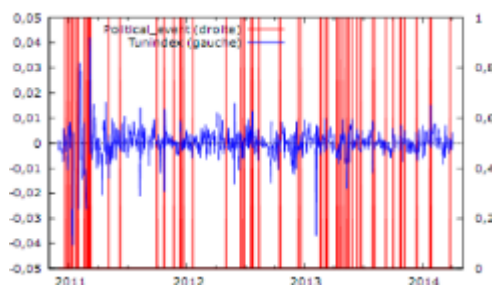
$$(1.2) \quad \sigma_t^2 = w + \sum_{i=1}^q \beta_i \sigma_{t-i}^2 + \sum_{j=1}^q \alpha_j z_{t-j}^2 \sigma_{t-j}^2$$

(Nelson, 1991)

(VII) Political events will be linked with the stock and exchange volatilities in relation to the time of the event.

- Graphs will be made to illustrate both the political event and the volatilities.

Examples of the similar graphs can be found in the following:



(Kaddour, 2011)

- (VIII) 10 major political event that occurred between 2007-2018 will be selected according to their effects in the stock and exchange market volatilities, GDP growth and unemployment rates
- (IX) An event study will be conducted to analyse how the chosen events affect the stock prices and exchange rate behaviour before and after the events.
- (X) Conclusion on which political event had the largest effect on the stock and exchange markets in Turkey for the chosen period (2007-2018). Comparison of exchange market with the stock markets whether Turkish financial industries are more fragile to strikes, elections, coups, referendums or sanctions will be defined. In addition, the patterns that the exchange rate and stock markets have shown before and after these events will be analysed in detail.

# Chapter 5

## Analytical Analysis and Empirical Results

### 5.1 Data

In the study, BIST 100 Index stock market and USD/TRY exchange rates volatilities were modeled by using ARCH, GARCH, EGARCH and TARCH models for 2007.01.01-2018.12.31 period. The study took the benefit of logarithmic values of BIST100 Index to measure the volatiles for the stock market and took benefit of logarithmic values of USD/TRY rates for the exchange market, making use of 3126 observations and 3130 observations for the stock and exchange markets, consecutively. Data set for the exchange market was obtained from the Central Bank of Turkey electronic data distribution system while the BIST 100 Index values are extracted from Yahoo Finance. EViews 10 version is used to conduct the analyses.

The return series were used to analyze evaluated by taking the difference of closing prices. The purpose of taking the logarithmic differences is to make the data stationary (Miralles-Marcello & Miralles-Quiros, 2002). The logarithmic differences for 3126 observations for the stock market is as follows:

$$R_t = \text{Log} (p_t/p_{t-1})$$

**$R_t$**  = Return of BIST 100 Index between two closing time on day t.

**$p_t$**  = Closing price of BIST 100 Index on day t

**$p_{t-1}$**  = Closing price of BIST 100 Index on day t-1

## 5.2 Empirical Results for Stock Market

Before modelling the stock market, descriptive statistics were initially calculated to have information on the general characteristics of the series the descriptive statistics of return series for the stock market are displayed in Figure 1.

**Figure 1: Descriptive Statistics for BIST 100 Index Return**

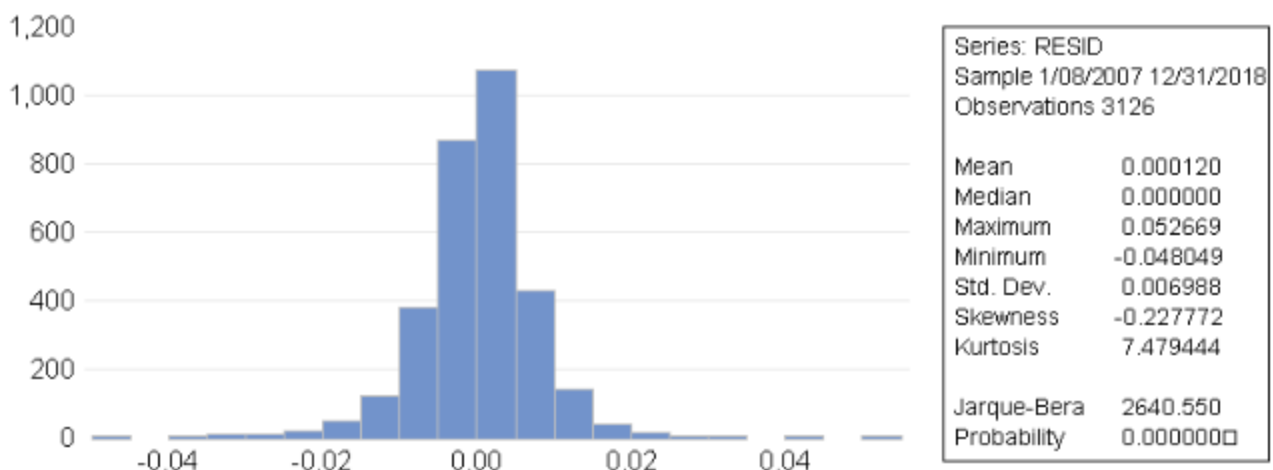
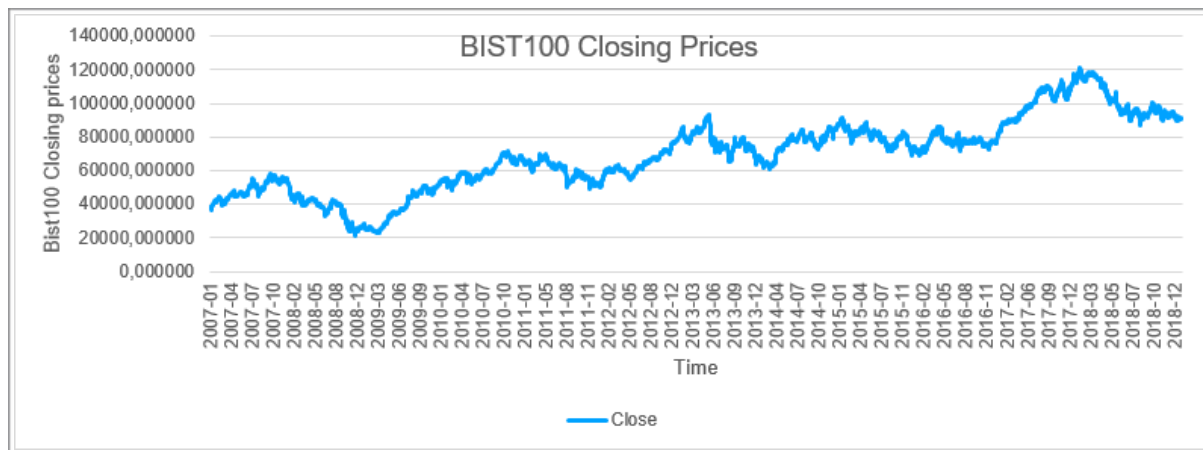
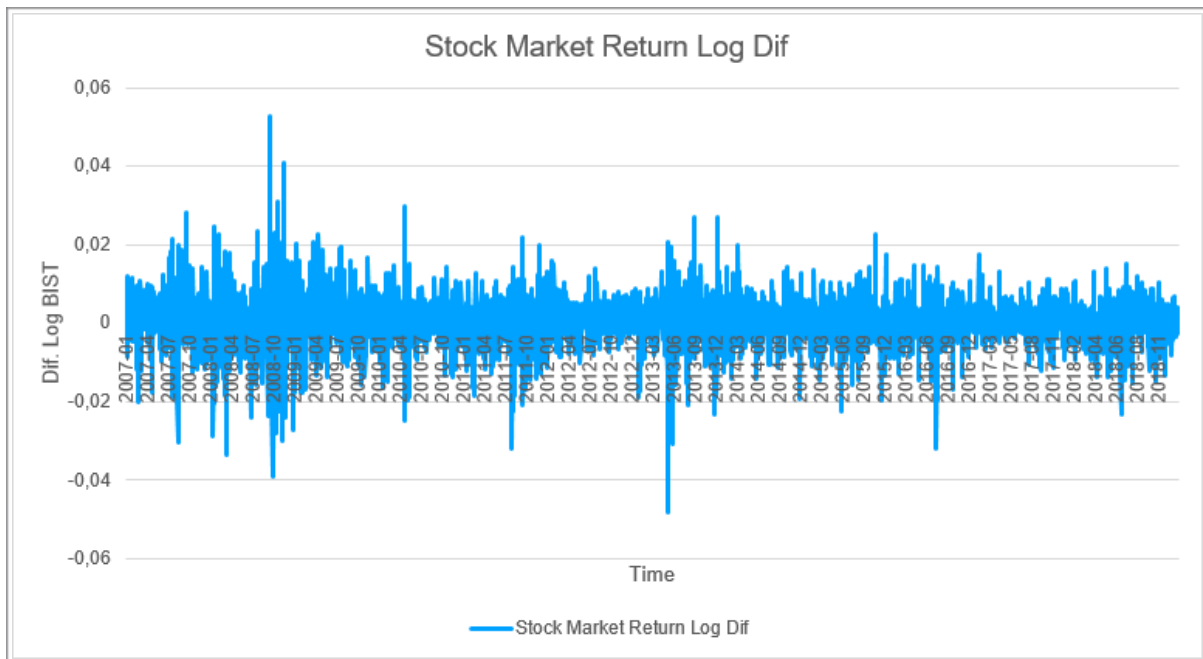
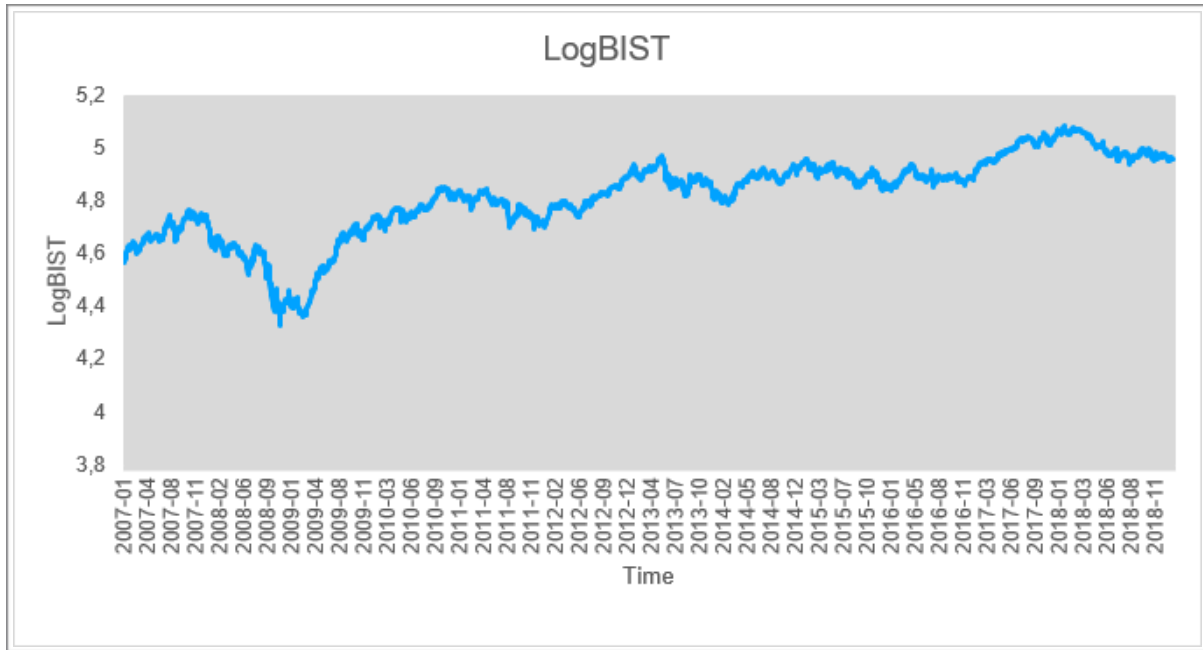


Figure 1 demonstrates that the average daily observations of BIST100 is 0.00012 which shows there were gains across the period of the study, also the standard deviation is .006. There is a substantial gap between the max (.052) and the min (-0.04) which supports the high variability of price changes. In a normally distributed series skewness must be 0 and kurtosis must be around 3, regarding our results the skewness is (-.22) negatively skewed which implies that the distribution has a long-left tail and a deviation from normality. In addition, the BIST 100 Index returns are leptokurtic caused by large kurtosis statistics of 7.47 that exceeds normal value of 3 indicating that the return is fat tailed. Regarding Jarque and Bera test for normality, it is consistent with the outcome provided by both statistics of kurtosis and skewness since the

JB test is significant at 1% level, that means to reject null hypothesis and accept the hypothesis which states that; returns are not normally distributed. Consequently, all the pre-mentioned statistical analysis gives more support to the suitability of applying ARCH/GARCH model for our data gathered from Bursa Istanbul, since the selected observations can be described as leptokurtic, fat tailed and not normally distributed. After the examination of the descriptive statistics of the series, it was considered beneficial to analyze the time path graph of the series prior to unit root analysis. Figure 2 displays the time path graphics for BIST-100 series.

**Figure 2. Time Path Graphics for BIST 100 Return Series**





BIST-100 return series time path graphic in Figure 2 illustrates an upward progress meaning that it is a non-stationary series. In other words, series had an upward increasing trend. Figure 2 also demonstrates in the time path graphic of the differenced series that the series was distributed around the average. Thus, the series can possibly have a unit root. Moreover, the

graph represents volatility clustering meaning that higher volatilities are followed by higher volatilities while lower volatilities are followed by lower volatilities. There is a possibility of simple serial correlation existence in square return which is the variance of the returns. The graph above illustrates volatility clustering in 2008, 2010, 2011, 2013, 2016 and 2018. This paper will investigate the reasons behind these clustering.

But, it was not possible to be sure of the existence of ARCH effect. To make sure, unit root tests should be conducted on the series and a decision should be reached whether the series was stable. It was necessary to analyze correlograms i.e. autocorrelation (ACF) and partial correlation (PACF) coefficients. Figure 3 displays ACF and PACF for BIST-100 return series.



the first level difference was taken on the contrary, the series became stable. However, it is known that the most accurate way to determine whether a series is stable in time series analysis is to apply unit root analysis. Thus, ADF, Philips Perron (PP), KPSS and ADF-GLS unit root tests for BIST-100 return series were conducted.

**Table 1: Unit Root Test Results for BIST-100 Return Series**

	Intercept	Trend and Intercept	None
ADF Test	-1.482670	-2.850539	0.465471
PP Test	-1.463454	-2.847665	0.491611
KPSS Test	5.899563	0.156840	—
ADF-GLS Test	-0.087894	-2.852606	—

Critical Values for ADF test ( 1 % ) 1st column: -3.43 2nd column: -3.96 3rd Column: -2.56 , Related Hypothesis:

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values for PP Test (1%) : 1st column: -4.90 , 2nd column: -4.56, 3rd column: -4.32 for  $\lambda=0.5$  Related Hypothesis

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values For KPSS Test (%1) 1st column: 0.739, 2nd column: 0.216 Related Hypothesis

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values for ADF-GLS Test for (%1): 1st column: -2.58, 2nd column: -3.46 Related Hypothesis Ho: unit root exist in series and H1: unit root does not exist in series.

Table 1 shows that Ho Hypothesis was accepted for ADF, PP and ADF-GLS Tests results, while Ho hypothesis was rejected for the KPSS test. Thus, it was observed that BIST 100 return series was not stable based on ADF Test, Philips Perron Test and ADF-GLS Test Results. Therefore, the same unit root test was applied again after taking the first differences

of the series and this time it was observed that the series became stable. Then, it was necessary to determine the most suitable method by using the stable series. Thus, ARMA Models which contain different latency lengths suitable for the different structure of the series, were used. Model determination phase was designed on the basis of Box Jenkins Methodology (1976). Table 2 demonstrates the results for predicted alternative models for BIST 100 based on the following criteria: (1) significance of the parameters; (2) high determination coefficient ( $R^2$ ); (3) as low as possible AIC and SIC information criteria; (4) significant F statistics of the model ( Kanalıcı Akay and Nargeleçekenler, 2006 ). F statistics were found to be significant in all models. Table 2 shows other selection criteria for the models.

**Table 2: Suitable Model Selection Results for BIST-100 Return Series**

	$R^2$	AIC	SIC
AR(1)	0.000202	-7.087816	-7.082012
AR(2)	0.000360	-7.087335	-7.079596
AR(3)	0.000112	-7.087087	-7.079596
AR(4)	0.000389	-7.086723	-7.077051
MA(1)	0.000197	-7.087811	-7.082007
MA(2)	0.000355	-7.087330	-7.079591
MA(3)	0.000390	-7.086725	-7.077052
MA(4)	0.000413	-7.086108	-7.074500
ARMA(1,1)	0.000324	-7.087298	-7.079560
ARMA(1,2)	0.000383	-7.086717	-7.077045
ARMA(2,1)	0.000381	-7.086716	-7.083244
<b>ARMA(2,2)</b>	<b>0.008839</b>	<b>-7.092721</b>	<b>-7.081113</b>
ARMA(3,2)	0.004454	-7.089455	-7.075913

	$R^2$	AIC	SIC
ARMA(2,3)	0.004454	-7.089455	-7.078206
ARMA(3,3)	0.005227	-7.089588	-7.074111
ARMA(1,3)	0.000395	-7.086090	-7.074483
ARMA(3,1)	0.000390	-7.086085	-7.074478

Table 2 demonstrates that the most suitable model according to the above mentioned criteria are (1) significance of the parameters; (2) high determination coefficient ( $R^2$ ); (3) as low as possible AIC and SIC information criteria, (4) significant F statistics of the model, it was ARMA (2,2)

**Table 3: ARMA (2,2) Model Predictions**

Parameters	
$\delta$	0.000120
$\phi_1$	1.799038
$\phi_2$	-0.999218
$\theta_1$	-1.797965
$\theta_2$	1.000000
$R^2$	0.008839
Adjusted $R^2$	0.007251
AIC	-7.092721
SIC	-7.081113
SSE	0.006963
OLB	11091.92
F-statistics	5.564910

F statistics above was found significant as 5%  $F_{crit}$  value is 3.84, therefore, the null hypothesis is rejected meaning that F statistics is significant in a 95% of confidence interval. Therefore, ARMA (2,2) model can be used for the return series.

After building the ARMA model for estimating the mean, the volatility will be modeled by using the ARCH, GARCH, TARARCH and EGARCH models. For this purpose, correlograms of the square of the return series were investigated and accordingly, a very significant probability (0.00) was found as the probabilities were less than 0.05 level. Therefore, it can be concluded that serial correlation exists.

**Figure 4: Correlograms of the square of Stock Returns**

Date: 03/15/19 Time: 12:14  
Sample: 1/08/2007 12/31/2018  
Included observations: 3126

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		1	0.113	0.113	39.664*	0.000
		2	0.144	0.133	104.39	0.000
		3	0.172	0.148	197.37	0.000
		4	0.175	0.135	293.50	0.000
		5	0.112	0.053	332.90	0.000
		6	0.094	0.026	360.69	0.000
		7	0.045	-0.027	367.16	0.000
		8	0.098	0.042	397.49	0.000
		9	0.127	0.085	448.46	0.000
		10	0.099	0.056	479.26	0.000
		11	0.137	0.090	537.97	0.000
		12	0.071	-0.001	553.79	0.000
		13	0.120	0.046	599.03	0.000
		14	0.107	0.031	634.93	0.000
		15	0.122	0.055	681.88	0.000
		16	0.059	-0.007	692.93	0.000
		17	0.125	0.059	742.45	0.000
		18	0.086	0.018	765.72	0.000
		19	0.091	0.016	791.56	0.000
		20	0.095	0.027	819.87	0.000
		21	0.072	0.001	836.14	0.000
		22	0.089	0.021	860.93	0.000
		23	0.088	0.020	885.11	0.000
		24	0.087	0.021	909.21	0.000
		25	0.069	0.004	924.27	0.000
		26	0.057	-0.018	934.44	0.000
		27	0.056	-0.006	944.38	0.000
		28	0.053	-0.017	953.39	0.000
		29	0.106	0.063	989.18	0.000
		30	0.070	0.019	1004.8	0.000
		31	0.101	0.049	1036.7	0.000
		32	0.077	0.008	1055.7	0.000
		33	0.108	0.034	1092.4	0.000
		34	0.039	-0.042	1097.3	0.000
		35	0.096	0.028	1126.5	0.000
		36	0.063	0.007	1139.0	0.000

**Figure 5: ARCH-GARCH Test Results**

$$\text{GARCH} = C(6) + C(7) \cdot \text{RESID}(-1)^2 + C(8) \cdot \text{GARCH}(-1)$$

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.000375	0.000107	3.491653	0.0005
AR(1)	0.583709	0.330730	1.764911	0.0776
AR(2)	-0.557370	0.349446	-1.595012	0.1107
MA(1)	-0.584128	0.327026	-1.786182	0.0741
MA(2)	0.571665	0.344270	1.660516	0.0968
Variance Equation				
C	1.23E-06	1.81E-07	6.790164	0.0000
RESID(-1)^2	0.081780	0.005999	13.63176	0.0000
GARCH(-1)	0.893868	0.007960	112.2987	0.0000
R-squared	0.000006	Mean dependent var		0.000125
Adjusted R-squared	-0.001276	S.D. dependent var		0.006987
S.E. of regression	0.006992	Akaike info criterion		-7.254798
Sum squared resid	0.152478	Schwarz criterion		-7.239313
Log likelihood	11339.99	Hannan-Quinn criter.		-7.249240
Durbin-Watson stat	1.970778			

The figure above signifies an ARCH-LM test. The first part signifies the mean equation and the second part is for the variance. Resid(-1)<sup>2</sup> shows the reaction of the volatility towards returns Garch(-1) is the volatility term. According to p value test the variance C, Resid and Garch is found significant, therefore, there is an ARCH effect in the return of BIST 100 and, this indicates that there is a direct effect between news that enters the market and the level of volatility in the BIST 100. Moreover, there is volatility clustering in the financial return series. In other words, volatility from previous periods has a power on explaining the current volatility condition. Thus, the sum of coefficients Resid(-1)<sup>2</sup> and Garch(-1) in Arch model is a measure of the persistence in the shocks, if the result is close to 1 then the more persistent is the shock

to conditional variance. It appears from the results that  $(\text{Resid}(-1))^2 + \text{Garch}(-1)$  is around 0.97 meaning that BIST return series have both attributes; volatility and persistence.

As the return exhibits ARCH effect, it was concluded that BIST100 series should be predicted using special ARCH models. Table 5 demonstrates the prediction results for Arch, Garch, Tarch and Egarch models on BIST-100 series.

**Table 4: Alternative, Arch, Garch, Tarch and Egarch prediction Results for BIST-100 Return Series**

	ARCH (1)	ARCH (2)	GARCH (1,1)	GARCH (2,1)	GARCH (1,2)	GARCH (2,2)	TARCH (1)	EGARCH (1,1)
AIC	-7.124211	-7.174341	-7.254798	-7.258458	-7.254180	-7.253838	<b>-7.270271</b>	-7.269208
SIC	-7.110661	-7.158856	-7.239313	-7.241038	-7.236760	-7.234482	<b>-7.252851</b>	-7.251787
OLB	11135.02	11214.32	11339.99	11346.71	11340.03	11340.50	<b>11365.16</b>	11363.50

The most suitable model for BIST 100 return series based on AIC, SIC and OLB criteria was TARCH (1). To observe whether ARCH effect has disappeared in this model ARCH-LM test was repeated and since the probability value of F statistic for the test was over 5% it was concluded that there was no ARCH effect left in TARCH (1). Results are displayed in the following figure.

**Figure 6: ARCH-LM Test Results**

Heteroskedasticity Test: ARCH

F-statistic	1.702018	Prob. F(1,3121)	0.1921
Obs*R-squared	1.702180	Prob. Chi-Square(1)	0.1920

There is an increase in the level of risks and uncertainties because of political events that affect the markets for both investors and policymakers, especially in emerging markets. This is called as the volatility in financial economics and has effects on investment decisions. In order to capture the availability of asymmetric behavior and the existence of leverage effect in financial return of BIST the study applies TAR(1) in order to detect the leverage effect (asymmetric).

**Figure 7: TAR(1) Tests Results**

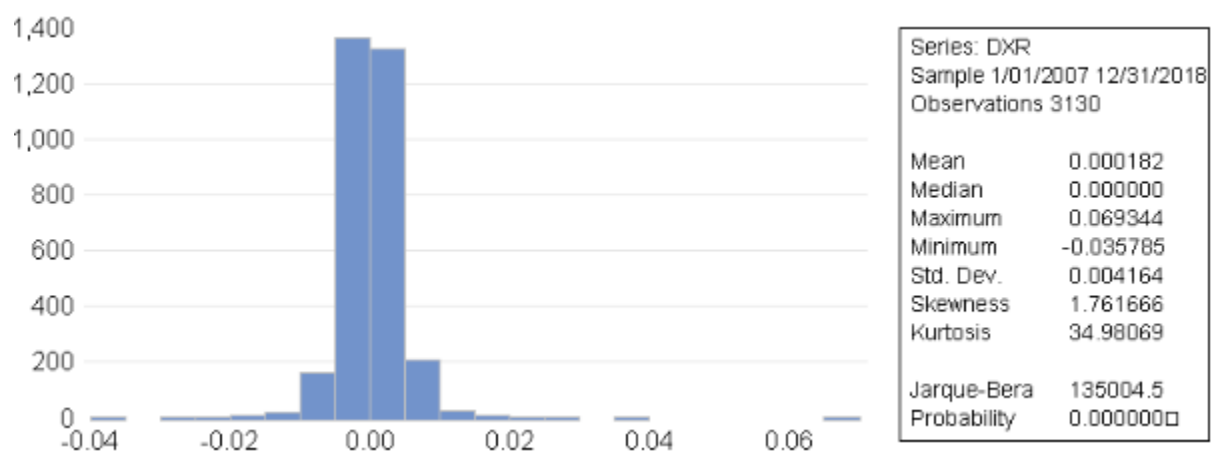
C	1.65E-06	1.98E-07	8.301573	0.0000
RESID(-1)^2	0.041064	0.007966	5.154638	0.0000
RESID(-1)^2*(RESID(-1)<0)	0.087922	0.009572	9.185126	0.0000
GARCH(-1)	0.879155	0.008564	102.6573	0.0000

RESID(-1) ^2\*(RESID(-1) < 0) stands for the asymmetry or leverage effect in financial modeling. 0.08 means that positive events have more impact on volatility than negative news effects on volatility in the Turkish stock markets. However, the shocks will be forgotten in a short period of time.

### 5.3 Empirical Results for Exchange Market

Figure reports the statistical description for daily exchange rates of USD/TRY retrieved from the Turkish Central Bank during the period of 01-01-2007 until 31-12-2018 that contains mean, median, max, min, skewness, kurtosis and Jarque and Bera test results.

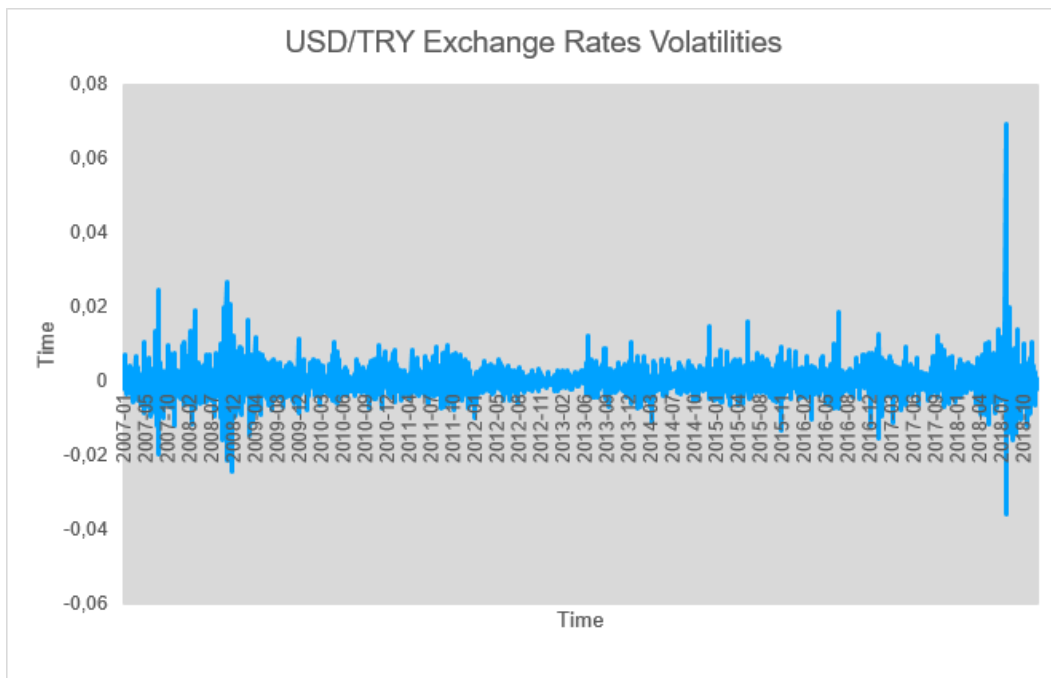
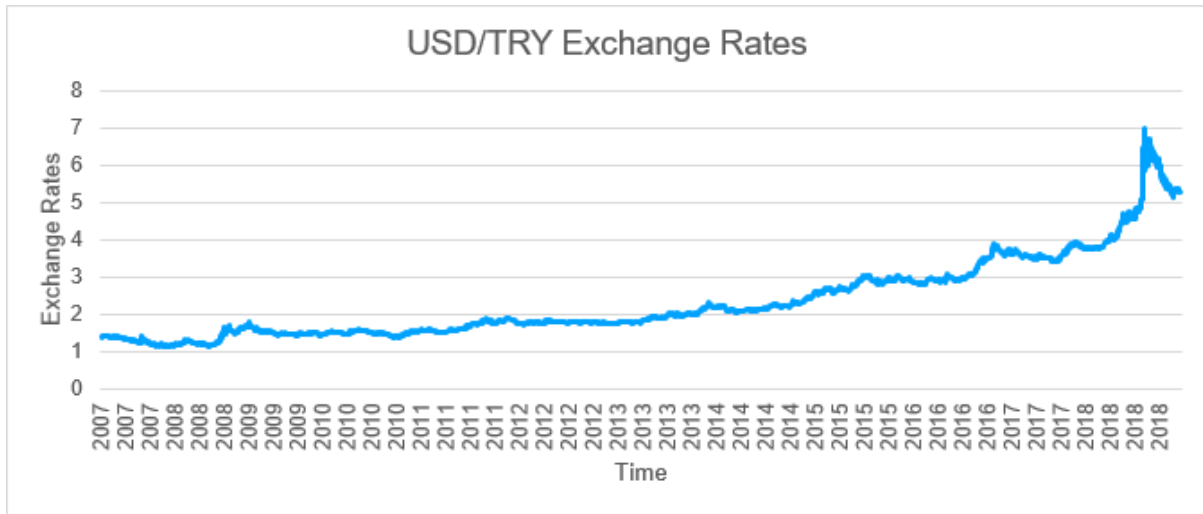
**Figure 1: USD/TRY Exchange Rates Return Distribution Statistics**



The positive average daily observations of exchange rates is 0.000182, which indicates that there were gains across the period of the study and standard deviation is .004. The difference between the max (0.07) and min (-0.035) point out that the exchange rates are fluctuating. Regarding our results skewness is 1.76 which shows that the distribution has a long right tail and a deviation from normality. In addition, exchange rate returns are leptokurtic coming from the Kurtosis which is 34.9 normally, it should be 3 representing that the returns have fat tail. Regarding Jarque and Bera Test results it is consistent with the outcome provided by both statistics of kurtosis and skewness, since the JB test is significant at 1% level which means to reject the null hypothesis and accept that the returns are not normally distributed. As a result, ARMA-ARCH model process can be performed for our return series.

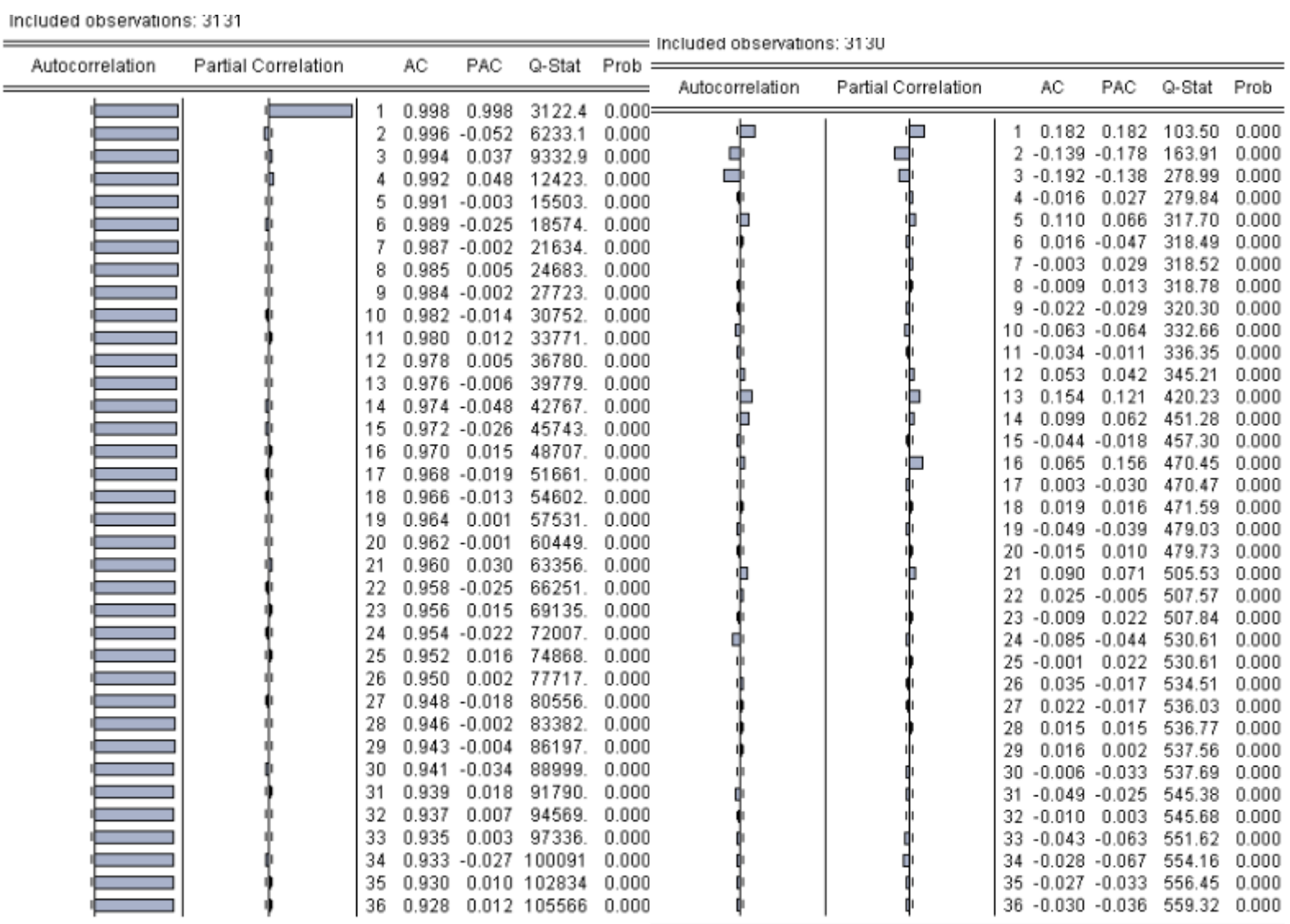
After the examination of the descriptive statistics of the series, the time path graphics of the series were examined prior to a unit root analysis.

**Figure 2: Time Path Graphics for USD/TRY Exchange Rate Returns**



USD/TRY return series time path graphic in Figure 2 shows an upward progress. In other words, series had an upward increasing trend. When the log difference of the series was taken the series was distributed among the average. Thus, the series could probably have a unit root. But, to be sure a unit root test had to be conducted on the series in order to reach a conclusion on whether the series were stationary or non-stationary. The first step to determine whether the series possessed a Unit Root, was to analyze correlograms, ACF and PACF coefficients.

**Figure 3: Correlogram of the level and fist difference of the exchange rates return series**



Level correlograms of exchange rate return series in Figure 3 demonstrates that the series did not have a stable structure. The p values for all the coefficients in the level were below 0.05 indicating the existence of significant autocorrelation. The lags in PAC were very significant. In PAC, the first lag was very significant while the following lags were not which is an indication of stationarity. When, the difference of the series was taken there was a big difference. In the first lags, the autocorrelation was significant while from the second lag there was an exponential decay, from the 4th lag the autocorrelation cut off to zero. Moreover, if the

pattern of the PAC and AC are the same it can be concluded that the series follow an ARMA model. From the level difference figure, it can be observed that AC and PAC lags follow the same pattern. However, the most accurate way to determine the stationarity of the series is to apply unit root analyses. Thus, ADF, Phillips Perron (PP), KPSS and ADF-GLS unit root tests were conducted to determine whether the exchange rate return series were stable. Table 1 demonstrates unit root tests for exchange rate return series.

**Table 1: Unit Root Tests Results for Exchange Rate Return Series**

	Intercept	Trend and Intercept	None
ADF Test	0.451223	-1.858457	1.627332
PP Test	1.218365	-1.175559	2.422808
KPSS Test	5.711935	1.201942	—
ADF-GLS Test	1.325423	-1.226183	—

Critical Values for ADF test (1 %) 1st column: -3.43 2nd column: -3.96 3rd Column: -2.56, Related Hypothesis:

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values for PP Test (1%): 1st column: -4.90, 2nd column: -4.56, 3rd column: -4.32 for  $\lambda=0.5$  Related Hypothesis

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values For KPSS Test (%1) 1st column: 0.739, 2nd column: 0.216 Related Hypothesis

Ho: unit root exist in series and H1: unit root does not exist in series. Critical values for ADF-GLS Test for (%1): 1st column: -2.58, 2nd column: -3.46 Related Hypothesis Ho: unit root exist in series and H1: unit root does not exist in series.

Table1 shows that Ho hypothesis was accepted for ADF, PP and ADF-GLF tests results while it was rejected for the KPSS test results. It was examined that the exchange rate returns for the USD/TRY were not stationary accordingly, the first differences of the series were taken

and like the BIST 100 Index it was seen that they became stable. This, all confirms, the non-existence of the autocorrelation.

However, since the series are stationary Auto Regressive Moving Average (ARMA) model was applied to determine the best fitting mean equation to choose the best course in modeling the conditional mean. The model determination was designed on the basis of Box-Jenkins methodology. Similar with the BIST 100 Index following criteria's were taken into consideration in order to choose the best model:

- (1) Significance of the parameters
- (2) High determination coefficients ( $R^2$ )
- (3) As low as possible AIC and SIC information criteria
- (4) Significant F statistics of the model

(Eryilmaz, 2015)

**Table 2: Suitable Model Selection Results for Exchange Rates Return Series**

	R2	AIC	SIC
AR(1)	0.004275	-8.127464	-8.121666
AR(2)	0.009470	-8.132053	-8.124323
AR(3)	0.013681	-8.135670	<b>-8.126007</b>
AR(4)	0.014704	-8.136067	-8.124472
MA(1)	0.004907	-8.128098	-8.122301
MA(2)	0.008047	-8.130618	-8.122888
MA(3)	0.013747	-8.135737	<b>-8.126074</b>
MA(4)	0.014352	-8.135711	-8.124116
ARMA(1,1)	0.005864	-8.128421	-8.120691
ARMA(1,2)	0.010419	-8.132372	-8.122709
ARMA(2,1)	0.011487	-8.133450	-8.123788
ARMA(2,2)	0.013527	-8.134875	-8.123280
<b>ARMA(3,2)</b>	<b>0.015027</b>	<b>-8.135754</b>	<b>-8.122227</b>
ARMA(2,3)	0.014476	-8.135198	-8.121670
ARMA(3,3)	0.015706	-8.135804	-8.120344
ARMA(1,3)	0.014190	-8.135547	-8.123952
ARMA(3,1)	0.014685	-8.136048	-8.124453

According to the 4 selection criteria proposed by Box Jenkins models the most appropriate model was found to be ARMA (3,2) models. Prediction results for ARMA (3,2) models are displayed in Table 2.

**Table 3: ARMA (3,2) model prediction results**

Parameters	
$\delta$	0.000182
$\phi_1$	-0.537525
$\phi_2$	0.139012
$\phi_3$	-0.113170
$\theta_1$	0.606542
$\theta_2$	-0.167409
$R^2$	0.015027
Adjusted $R^2$	0.013135
AIC	-8.135754
SIC	-8.122227
SSE	-8.130899
OLB	12739.46
F-statistics	7.940806

$\delta$  represent the constant term for the model,  $\phi_1$ ,  $\phi_2$  and  $\phi_3$  are autoregressive parameters;  $\theta_1$  and  $\theta_2$  are moving average parameters;  $R^2$  is the determination coefficient, adjusted  $R^2$  is the corrected determination coefficient. According to the above-mentioned criteria ARMA (3,2) results were found to be the best fit. After determining the best mean equation through ARMA models LM-ARCH test was used to model the volatility in the exchange rates.

**Figure 4: ARCH-GARCH Tests Results**

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	9.54E-05	5.38E-05	1.772447	0.0763
AR(1)	-1.648533	0.120589	-13.67067	0.0000
AR(2)	-0.760239	0.107114	-7.097451	0.0000
AR(3)	-0.001509	0.022601	-0.066762	0.9468
MA(1)	1.672176	0.118465	14.11533	0.0000
MA(2)	0.793888	0.107511	7.384220	0.0000
Variance Equation				
C	1.72E-07	3.55E-08	4.842110	0.0000
RESID(-1)^2	0.105475	0.005413	19.48658	0.0000
GARCH(-1)	0.891003	0.006426	138.6536	0.0000
R-squared	0.003040	Mean dependent var	0.000183	
Adjusted R-squared	0.001443	S.D. dependent var	0.004166	
S.E. of regression	0.004163	Akaike info criterion	-8.524364	
Sum squared resid	0.054077	Schwarz criterion	-8.506957	
Log likelihood	13336.84	Hannan-Quinn criter.	-8.518116	
Durbin-Watson stat	1.912452			
Inverted AR Roots	-.00	-.82+.28i	-.82-.28i	
Inverted MA Roots	-.84+.31i	-.84-.31i		

ARCH-LM test is displayed on the figure above. The first part signifies the mean equation and the second part stands for the variance. Resid(-1)<sup>2</sup> shows the reaction of the volatility towards returns Garch(-1) is the volatility term. According to p value test the variance C, Resid and Garch is found significant, therefore, there is an ARCH effect in the return of BIST100 it also indicates that there is a direct effect between news that enters the market and the level of volatility in the BIST 100. Moreover, there is volatility clustering in the financial return series. In other words, volatility from previous periods has a power on explaining the current volatility condition. Thus, the sum of coefficients Resid(-1)<sup>2</sup> and Garch(-1) in Arch model is a measure of the persistence in the shocks, if the result is close to 1 then the more persistent is the shock to conditional variance. It appears from the results that (Resid(-1)<sup>2</sup>+ Garch(-1)) is around 0.89 meaning that BIST return series have both attributes; volatility and persistence.

**Table 4: Alternative, Arch, Garch, Tarch and Egarch prediction Results for Exchange Rate Return Series**

	ARCH (1)	ARCH (2)	GARCH (1,1)	GARCH (2,1)	GARCH (1,2)	GARCH (2,2)	TARCH (1)	EGARCH (1,1)
AIC	-8.339851	-8.388162	-8.524364	-8.523800	-8.522273	-8.526254	-8.533022	<b>-8.538498</b>
SIC	-8.324378	-8.370756	-8.506957	-8.504459	-8.502932	-8.504979	-8.513681	<b>-8.519158</b>
OLB	13047.36	13123.89	13336.84	13336.96	13334.57	13341.80	13351.38	<b>13359.94</b>

Table 4 demonstrates that the best fit model for exchange rate returns based on AIC, SIC and OLB selection criteria was EGARCH(1,1) model. In order to observe whether the ARCH effect has disappeared ARCH-LM test was conducted.

**Figure 5: ARCH-LM Test Results**

Heteroskedasticity Test: ARCH

F-statistic	0.039912	Prob. F(1,3124)	0.8417
Obs*R-squared	0.039937	Prob. Chi-Square(1)	0.8416

According to the results displayed above, there is no ARCH effect in the EGARCH (1,1) model. The residuals were also checked and there was no serial correlation. Therefore, this is a good model to use.

**Figure 6 : EGARCH(1,1) Test Results**

$$\text{LOG}(\text{GARCH}) = \text{C}(6) + \text{C}(7) * \text{ABS}(\text{RESID}(-1) / \sqrt{\text{GARCH}(-1)}) + \text{C}(8) * \text{RESID}(-1) / \sqrt{\text{GARCH}(-1)} + \text{C}(9) * \text{LOG}(\text{GARCH}(-1))$$

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	-1.655602	0.104363	-15.86381	0.0000
AR(2)	-0.766142	0.093697	-8.176813	0.0000
AR(3)	0.005725	0.021895	0.261452	0.7937
MA(1)	1.688989	0.102731	16.44084	0.0000
MA(2)	0.813546	0.094792	8.582480	0.0000
Variance Equation				
C(6)	-0.405347	0.041679	-9.725333	0.0000
C(7)	0.184935	0.012333	14.99555	0.0000
C(8)	0.063920	0.006836	9.350733	0.0000
C(9)	0.976704	0.003333	293.0629	0.0000
R-squared	0.002373	Mean dependent var		0.000183
Adjusted R-squared	0.001094	S.D. dependent var		0.004166
S.E. of regression	0.004163	Akaike info criterion		-8.535219
Sum squared resid	0.054114	Schwarz criterion		-8.517812
Log likelihood	13353.81	Hannan-Quinn criter.		-8.528971
Durbin-Watson stat	1.927805			
Inverted AR Roots	.01	-.83-.29i	-.83+.29i	
Inverted MA Roots	-.84-.32i	-.84+.32i		

In order to capture the availability of asymmetric behavior and the existence of leverage effect in the Turkish exchange rate returns Egarch(1,1) model was applied. Figure 5 represents the EGARCH output. All estimated parameters were found significant at 1% level. c (9) parameter stands for the asymmetric volatility which is positive and significant. This result implies that shocks including good and bad news that may impact the exchange rates that will affect the volatility for a quiet time in the future, and it is not expected to be forgotten in a short period of time because c(9) value is 0.97 which is very close to 1.

## 5.4 Event Dates and the volatilities

We define major political events as the events that occur in an international or national sphere and has major impact in Turkish economy. These events were chosen according to the volatility that they have caused in the stock market and exchange rate returns during the year that they occurred moreover, the evolution of the GDP growth have been taken into consideration while choosing the events. Additionally, the existence of other Major Political Events were searched for before and after 15 days of the event. This search was conducted by using search engines such as Googles top Searches and Yahoos Top Searches. For instance, for 2016 Turkish military coup it was observed that the word coup was ranked as number one in world searches which justifies the event big influence in the politics. Accordingly, no other major political event was found present in the before and after 15 days period for the following events.

After observing the event dates and the movements that they have caused during that year the following events were chosen.

Events	Dates
2007 General Election	22 July 2007
2009 Local Elections	29 March 2009
2011 General Elections	12 June 2011
Gezi Park Protests	28 May 2013
2015 General Elections	7 June 2015
2015 General Elections	1 November 2015
2016 Turkish coup d'état attempt	15 July 2016
2017 Constitutional Referendum	16 April 2017
2018 Parliamentary Election	24 June 2018
Sanctions imposed by US	10 August 2018

### **5.4.1 2007 General Elections**

2007 Turkish General Elections were held on July 22, 2007 in order to elect 550 members to the Grand National Assembly.

The volatility graphs were searched and accordingly, fluctuations in the markets were spotted following the elections. Therefore, the reason for choosing this event can be justified by the influence it has on the markets.

### **5.4.2 2009 Local Elections**

Turkey held local elections on 29 March 2009 and the winner was the Justice and Development Party although, the party saw a decline on in its votes compared to the previous elections. Accordingly, there were movements present in the exchange rates prior to the elections. While, stock index became unstable following the elections. The clustering on the 1st and 2nd month of the year for the index can be explained by the prevailing financial crisis at that time.

### **5.4.3 2011 Local Elections**

Turkey held general elections on 12 June 2011 to elect 550 members for the Grand National Assembly. Consequently, a movement on the markets arose.

#### **5.4.4 Gezi Park Protests**

Gezi Park protests arose in Turkey on 27 May 2013 when a small group of environmental campaigners began a sit-in in Gezi Park, Istanbul against the modernization works planned for the Park near Taksim Square. The events that ensued between the protesters and the government led to protests across Turkey (Tastan, 2013). The character of the protests evolved with time from an environmental protest to a political demonstration towards against the government because of the police repression (Gokay, 2013). In addition to ecological concerns, the protests also revealed the discontent of marginalized communities including Armenians, Kurds and LGBT identified persons (Fischer Onar 2009; Walton 2015: 49). Three and a half million of people are estimated to have taken part in the protests and 22 of them were killed while 8000 were injured (Philips, 2013). The scale of the protests died in summer and human chains were organized for peace and the events ended on 20 August 2013 (Hurriyet, 2013).

According to the graphs below and the Arch tests conducted previously volatilities were spotted during the occurrence of the event therefore, it was necessary to research the patterns of the movements further.

#### **5.4.5 2015 General Elections**

Two general elections were held in Turkey. The first one took place on 7 June 2015 and the second one on 1 November 2015. The reason behind this was the hung parliament in which no particular political party had absolute majority of the seat in the parliament. There were several attempts to form a coalition government but, it was unsuccessful. These attempts lead to a snap general election which resulted as the Justice and Development Party regaining the

majority of the votes and forming a government. These political uncertainties were also observed in the markets.

There were movements in the exchange rates during the elections; however, BIST100 Index seemed stagnant compared to other elections.

#### **5.4.6 2016 Coup d'état Attempts**

The attempted coup took place on 15 July 2016 against the state institutions, including the government and President Recep Tayyip Erdogan. The coup was organized by a small faction within the Turkish Military Forces (Holland, 2016). They put forward erosion of secularism, elimination of democratic rule, disregard for human rights, and Turkish loss of credibility in the international arena as reasons for the coup (Pearson, 2016). The faction tried to seize the control in several cities like Ankara and Istanbul but was unsuccessful after loyal forces to the state defended him (Holland, 2016). Reactions to the event were largely against the coup. NATO, European Union and several neighboring countries stood for the respect of the Turkish leaders who were chosen by democracy. During the coup over 300 people were killed (Holland, 2016) while there were more than 2100 injured. Moreover, Turkish Parliament and the Presidential Palace were bombed from the air (State Agency, 2016). Later, the coup attempt was associated with the Gulen movement (Holland, 2016) who is considered as a terrorist organization by the Republic of Turkey which is led by Fetullah Gulen a Turkish cleric that lives in Pennsylvania in USA (Fox News, 2016). Following the attempted coup over 10.000 soldiers, 2.745 judges, 15.000 education staff were arrested and the licenses of 21.000 teacher was revoked (CNN, 2016).

Following the event there were huge instabilities in the Turkish exchange and stock markets, therefore, it is beneficial to observe in more detail the event windows through event study.

#### **5.4.7 2017 Constitutional Referendum**

A constitutional referendum was held through Turkey in 16 April 2017. The referendum was held whether to approve 18 proposed amendments to the Turkish constitution that was brought forward by the Justice and Development Party (AKP) and the Nationalist Movement Party (MHP). The amendments abolished the office of the Prime Minister and existing parliamentary system were replaced by executive presidency accordingly, a new presidential system was designed (Reuters, 2017). The number of the seats in the Parliament were also raised from 550 to 600. Another change proposed by the amendments were to give the president more control over appointments to the Supreme Board of Judges and Prosecutors (HSYK) (Bloomberg, 2017). The referendum was conducted after the military coup attempt when the state was still under the state of emergency.

According to the graphs below there was a gradual change in the exchange market while the BIST 100 Index was leveled off. However, the change in the constitution was a prominent event that had wide coverage both in national and international media. Thus, it was necessary to conduct a detailed study.

#### **5.4.8 2018 Parliamentary Elections**

The parliamentary elections that were held on 24 June 2018 did not cause zig-zag in the exchange rates but caused larger surges in the stock market.

#### **5.4.9 2018 Sanctions imposed by US Administration**

Turkey have faced a significant currency crisis as the lira has fallen, by about 40% of its value against the US dollar since the beginning of 2018. Accordingly, Turkey's creditworthiness began to alter. Investors started to question the sustainability of the Turkish expansionary monetary and fiscal policies just before the 2018 parliamentary elections. Moreover, tensions increased between Turkey and US because of Turkish cabinet ministers detaining and prosecuting an American pastor that Trump has asked for his release. On August 10, 2018, President Trump alluded to concerns about Lira's depreciation when he announced in Twitter a doubling of the steel and aluminum tariffs on Turkish imports invoke under Section 232 for national security concerns. Almost immediately, after the President's tweet lira markedly dropped even further and lost about 25% of its value in the first 2 weeks of August (Nelson, 2018).

#### **5.5 Event Study**

In the second part of the methodology the event study method was used. This method is used to measure whether there is an extreme deviation from the average returns on the stock market shortly before and after this date. It was thought that this method is the most suitable to study how the markets are being affected by the events. 15 days before and after the events has been selected as the event window (-15th to the 15th day) (Mandacı, 2003). The reason behind choosing the event window as 15 days is to examine the direct impact of the events on the markets. Moreover, Turkish politics is very intense and there are many incident occurring therefore, in order to capture the direct effects a short window study was conducted. The method used in the calculation of the abnormal returns was the mean-adjusted return method.

This method assumes that the expected returns do not deviate significantly from the average of the historical returns in other words it is assumed that the expected returns are equal to the average of the historical returns. In this study, I have used average-adjusted return method rather than the market-adjusted return because market-adjusted return is generally used to compare the stock volatilities with the Index. However, in this study, the effects of the elections were tried to be measured not on a stock basis but on the basis of the index, therefore, the calculation of the abnormal returns of the index was considered to be sufficient consequently, mean-adjusted return method was used.

The equation that is used to calculate the abnormal returns showing deviations from the average yield can be expressed as follows:

$$AR_t = R_t - R_i$$

$AR_t$  (abnormal return), signifies the abnormal return on day  $t$  and  $R_t$  is the stock index return on day  $t$ , considering that  $I$  signifies each event,  $R_i$  represent the average of index returns covering the period between 15 and 360 days from the date of the election. For example, for the 2007 Turkish general elections that were held on 22 July 2007, I have calculated the average of BIST100 Index from 15th to the 360th day before the elections.

To explain the formula, the abnormal return of the BIST100 Index on any day  $t$  is calculated by subtracting the average index returns of the period before the elections (-15, -360) from the index return on day  $t$ . This difference was then standardized by using the formula below.

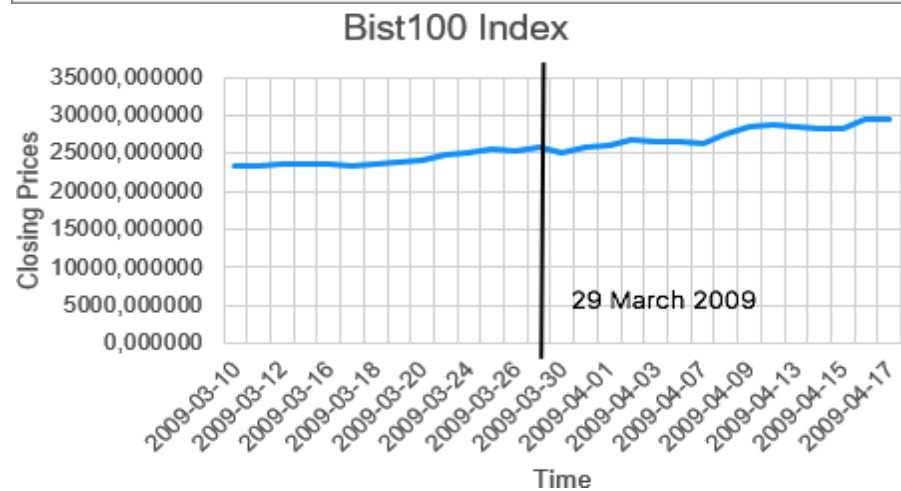
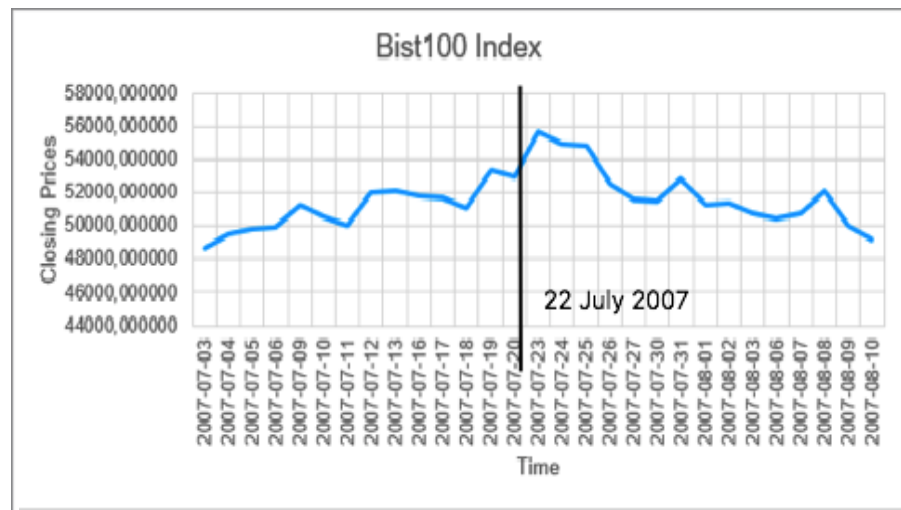
$$AR_t = (R_t - R_i) / \sigma(R_i)$$

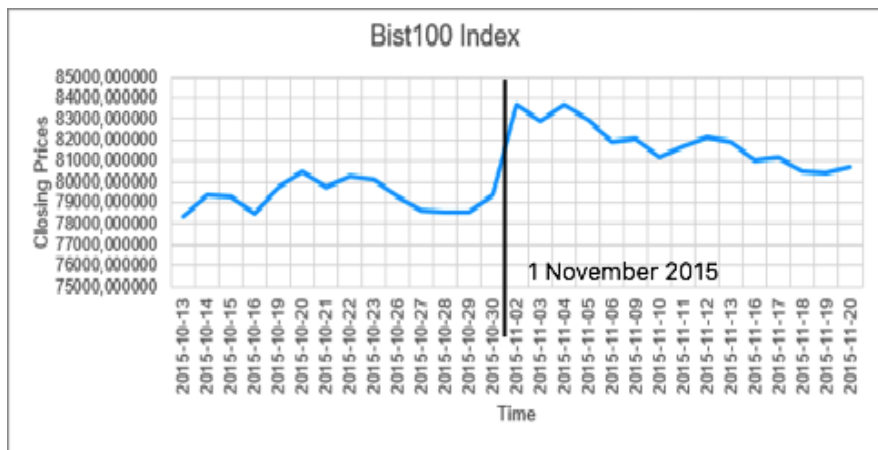
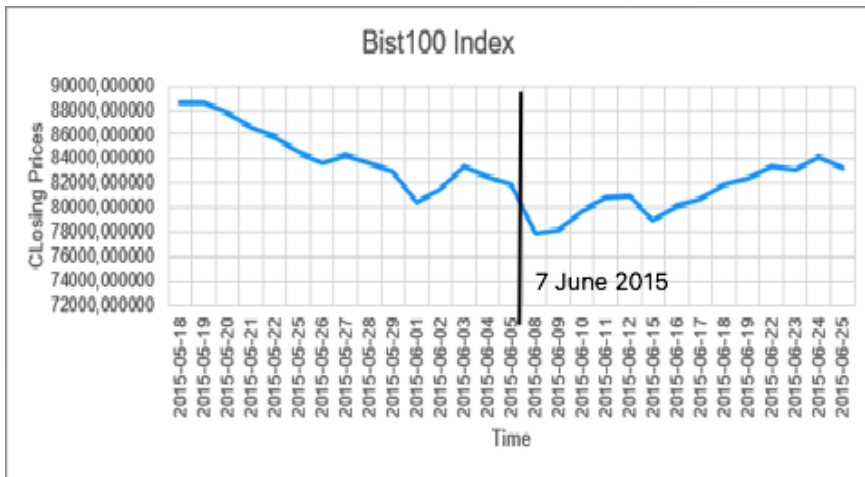
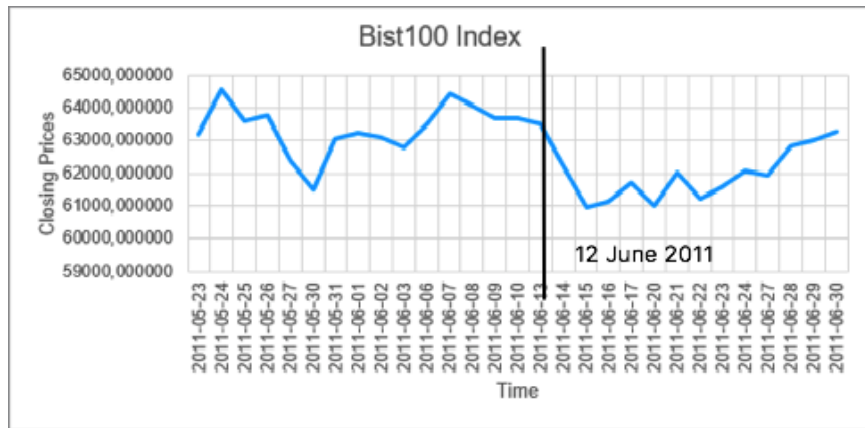
### 5.5.1 Empirical Findings for the Event Study in the Stock Markets

Firstly, the charts of BIST100 Index were examined for 60 days before and after the political events and then the abnormal returns for the stock markets were calculated.

The graphs below represent the stock market volatilities before and after 15 days for the 2007, 2009, 2011 and 2015 elections. Accordingly, the graphs and the abnormal returns were examined simultaneously.

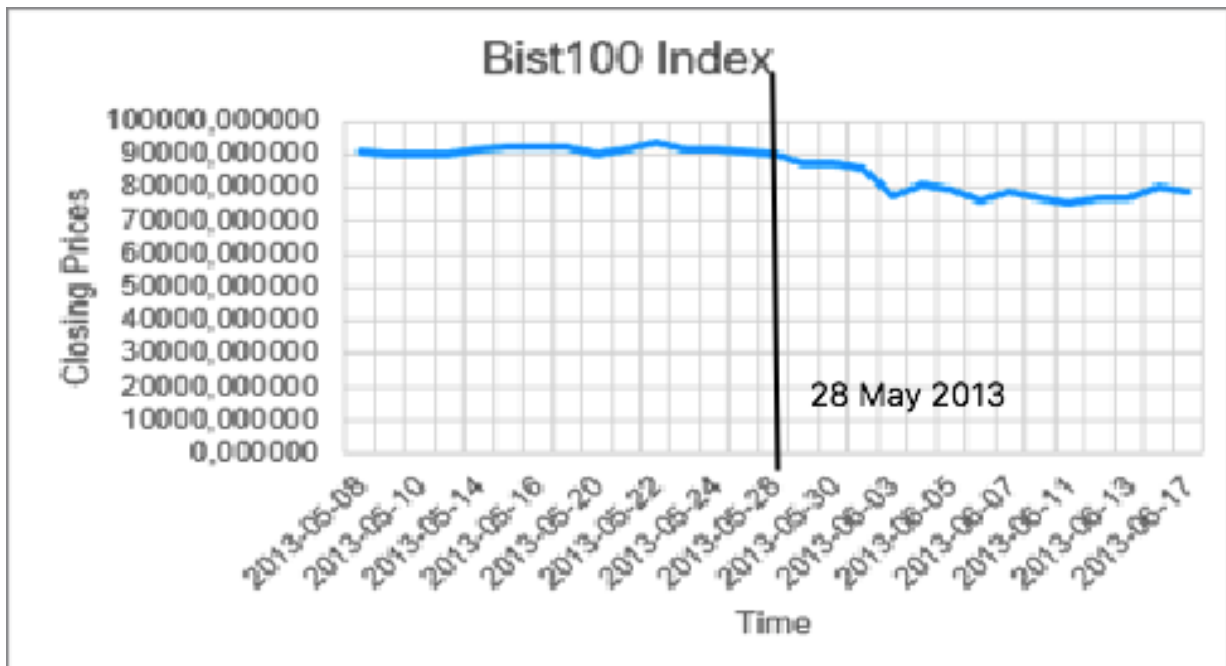
#### 2007-2009-2011-June 2015-November 2015 Elections





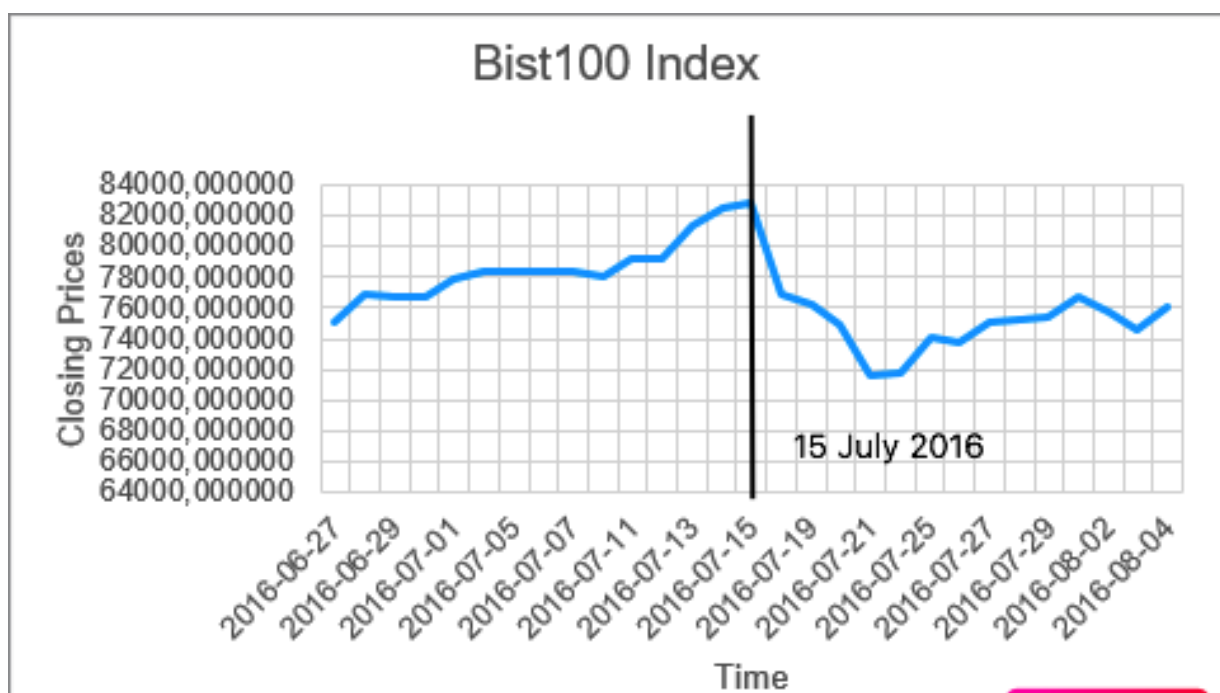
As it can be defined from the graphs above Turkish stock markets are very volatile both before and after the elections. However, a pattern structure was identified for the BIST 100 Index. BIST 100 Index tend to fall or have negative returns after the elections for a few days. For 2009, stock market prices fell for 1 day while for 2011 the elections brought a sharp plunge for 3 days. However, for June 2015 elections, a decline trend started two days before the event. This might be because of distrust on the government and the citizens wanting a change in the government. Accordingly, following the election one party could not come into power and a coalition government could not be formed which has led to the renewal of the elections in the same year on November. When we examine the abnormal returns of November 2015 we observe a sharp increase following the results that is because of Development and Justice Party winning the elections again and coming into power as the sole party to govern. Following this day there is a one day plunge and rise which continues with a falling trend. Additionally, we can observe a similar pattern for the 2007 elections with abnormal returns rising the following days. This result from the elections results which promised the formation of a stable one party government. Consequently, in the elections when there is uncertainty about the formation of a sole party government such as in 2007 and November 2015 the stocks starts to rise prior to the event and reach a peak at the 1st day than have a tendency to fall back. However, on other terms where the results are predicted, the markets fall following days and start to climb after a few days.

## 2013 Gezi Park Protests



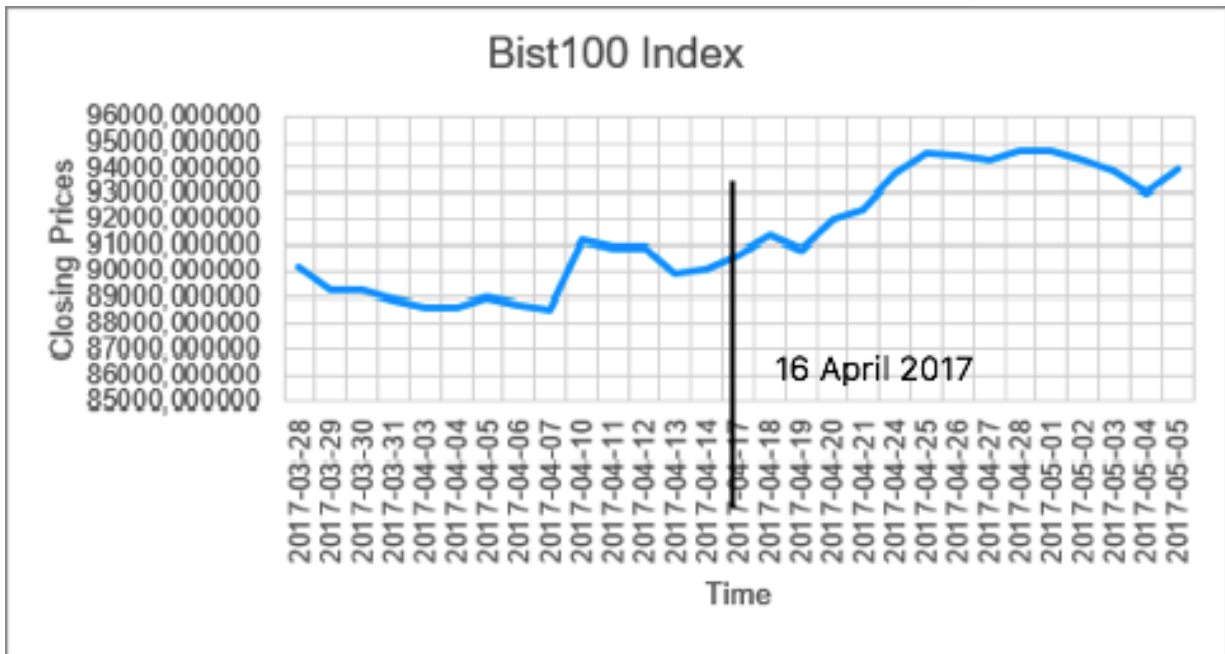
Gezi Park protests have started against the modernization of a park in Taksim square accordingly, the stock market had negative returns until the 5th day of the event. Following 1st and 2nd day of the event the negative returns have increased until the 5th day. This might be because of the protests starting to grow and supporting strikes taking place across Turkey. In the 5th day of the event positive returns started to be observed. Later on, BIST 100 Index was volatile on a daily basis until 17th of June. The values for the index was 91287 for 14 April and it was 75041 on 11 June. The stock market lost almost 17000 in a month and 15000 since the event day.

## 2016 Military Coup Attempt



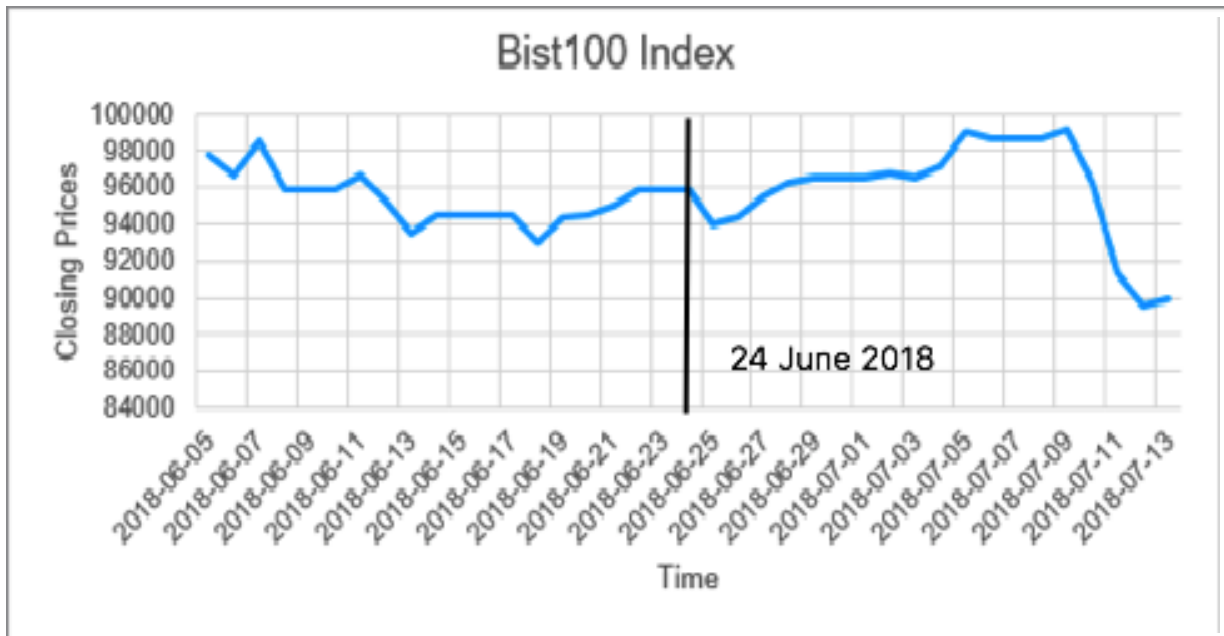
According to the event study conducted there were an upward trend in the graph for 4 days and the abnormal returns were positive from 12 days prior till the event day with only -5th day being negative. However, this upward trend was replaced by a continuous drop for 4 days after the military coup attempted by a small unit inside the Turkish military force. The markets hit a low off 71595 almost 11.000 lost was present from 15th July. However, the market start to rise on the 5th date although, it does not increase up to its previous levels.

## 2017 Constitutional Referendum



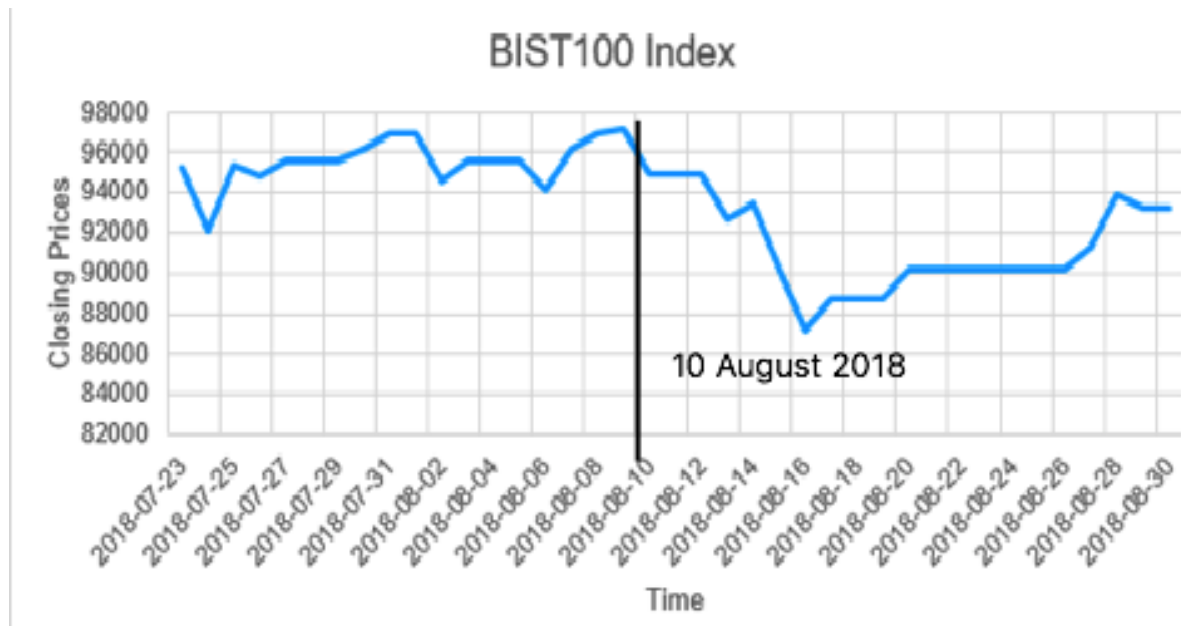
Abnormal returns were found positive from 1 day prior until 3rd day and continues positively until the 8th day after the event occurrence. Overall, the market have an increasing trend meaning that the referendums did not have a huge impact on the BIST Index.

## 2018 Parliamentary Elections



The markets follow a surge from -4 until the first days of the event and has a slight decline on the next day of the event. However, this upward surge continues the following days with BIST100 Index arriving a peak on 9 July 2018 at 99253. Following that day the stock markets have had a sharp fall. This is because on that day Turkey have officially changed its regime to executive presidential system with Erdogan becoming the first executive president of the new system. The Turkish, abolished the office of the Prime Minister and existing parliamentary system was replaced by executive presidency. This had a negative influence in the western media with thoughts of Turkey becoming more and more authoritarian. This might have resulted in foreign investors leaving their investments and selling their Turkish bonds. Moreover, the markets bottom out at 89571 at 12 July 2018.

## 2018 Trade Sanctions

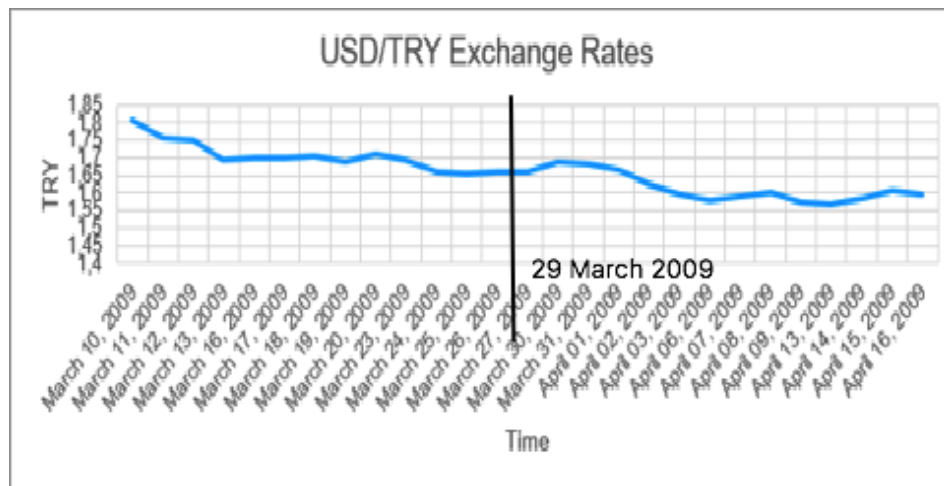
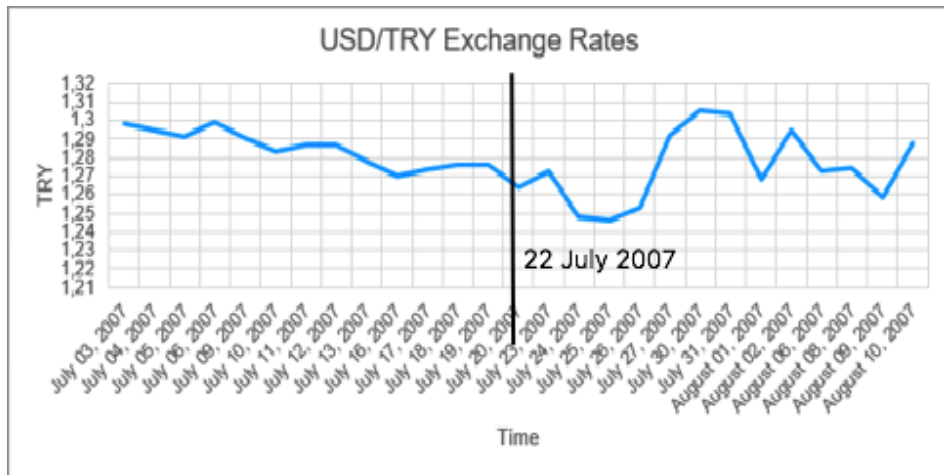


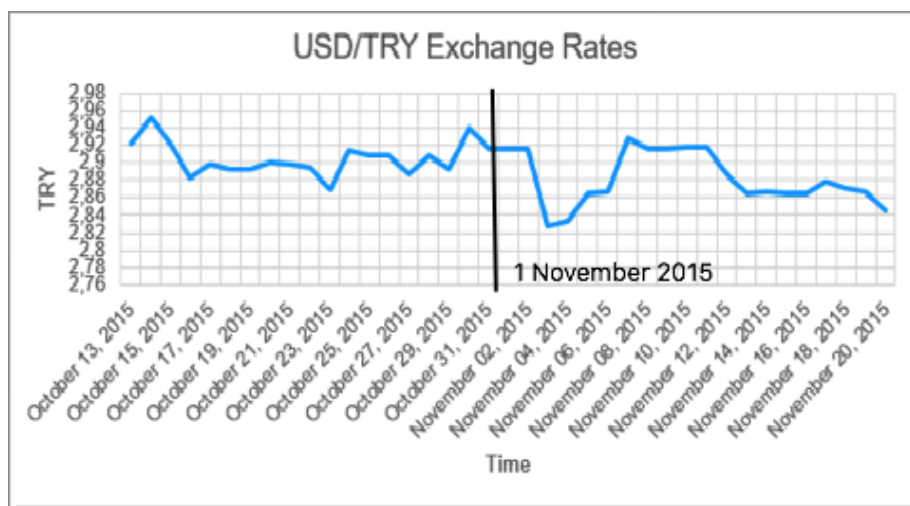
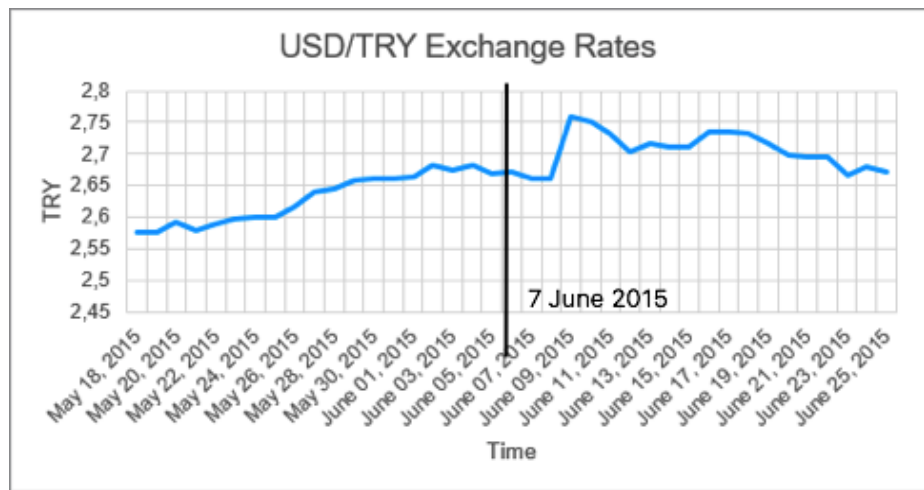
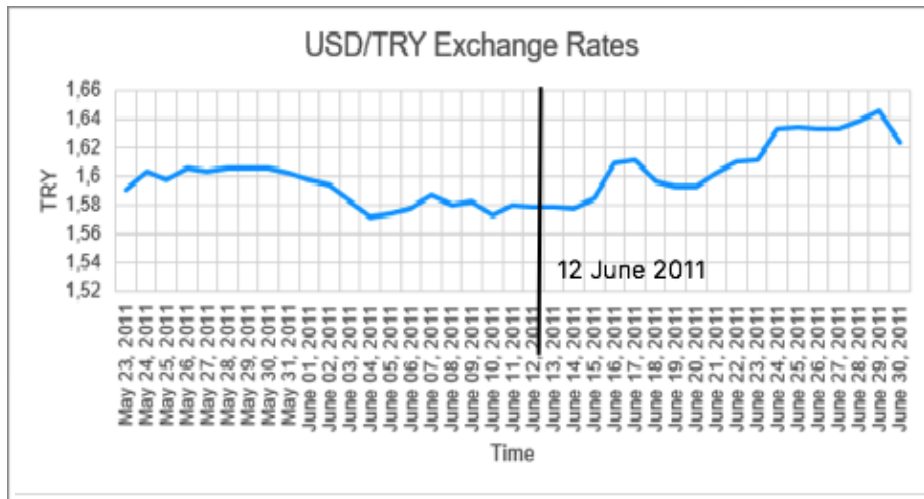
Markets fall until the following 5th days of the event. Prior the events stock market hits a peak of 97185 on the 9th of August and starts to decline with Trump administration imposing sanctions on Turkish imported goods such as aluminum. This trend continues until 16th of August where the index shows 87143 almost 8.000 lower (94940) than a week before. From 16th of August the abnormal returns were found positive until the 13th day of the event 28th of August. Thus, there is an increase level but the increase does not cover the sharp fall.

## 5.5.2 Empirical Findings for the Event Study in the Exchange

### Markets

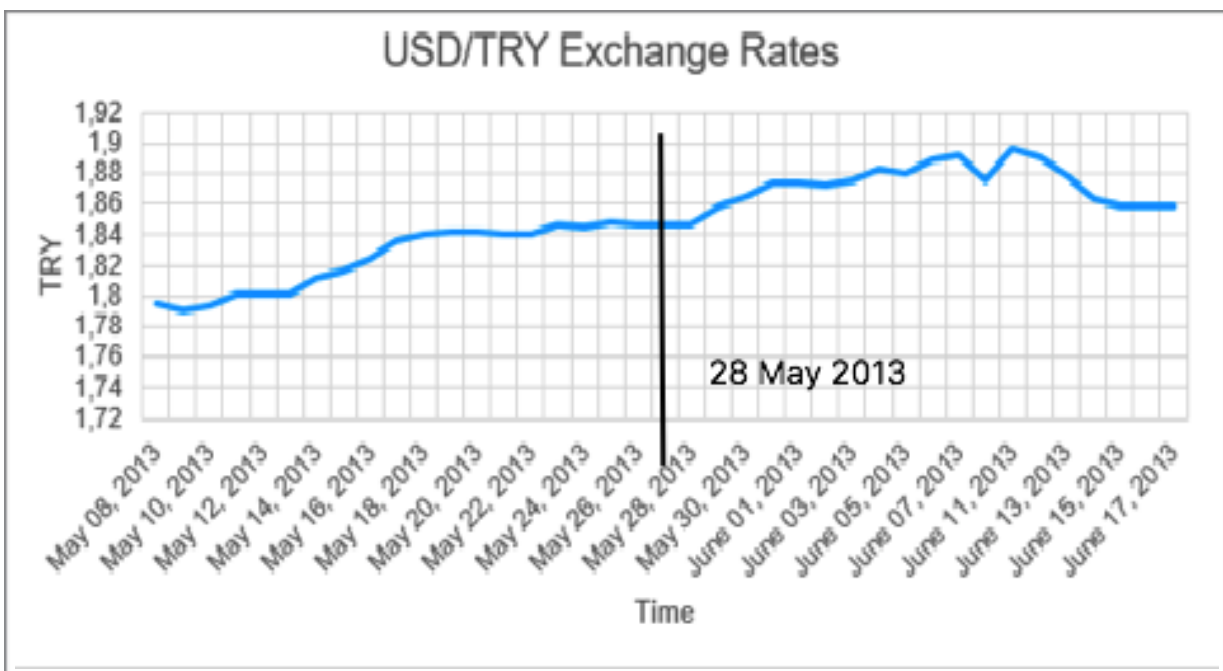
#### 2007-2009-2011-June 2015-November 2015 Elections





Following the event study, for 2007-2009 elections, a slight decline in the Turkish lira value was observed. However, after the first day lira started to gain back its value. While the lira lost its value after 3rd day for 2007 it followed a more stable trend on 2009 appreciating. In 2011, TRY depreciated following the 2nd day and kept a depreciating pattern. A similar pattern was identified for June 2015 which is related with Justice and Development Party losing the majority of the votes and the stability of the government being questioned. However, Lira value was slightly recovered after November elections which was a result of the Justice and Development Party gaining more votes than before.

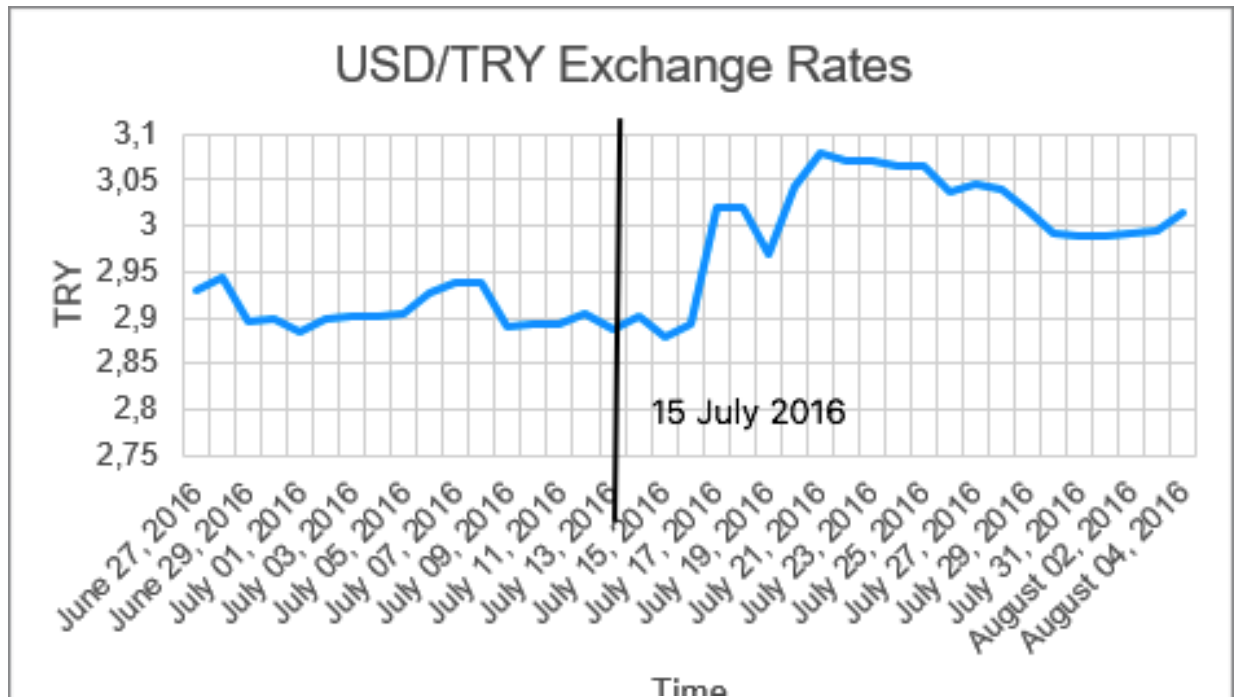
### 2013 Gezi Park Protests



The currency depreciated from the first day when the protests started and it hit a low level of 1.88 TRY = 1 USD on the 12th day after the start of the protests. The depreciation continued with the protests starting to grow and supporting strikes taking place across Turkey. But, the

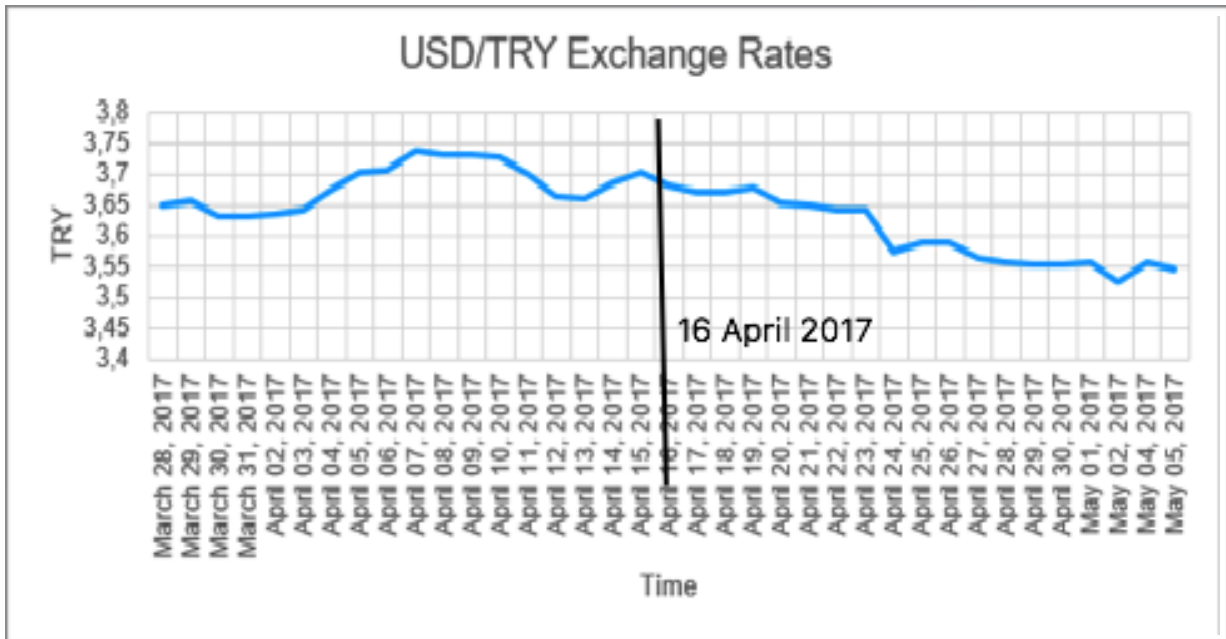
lira rate started the recover in the following days. When the abnormal returns were examined it was found out that there are losses in the Lira rates until the 10th day with only the 6th and 9th day having positive returns.

### 2016 Military Coup Attempt



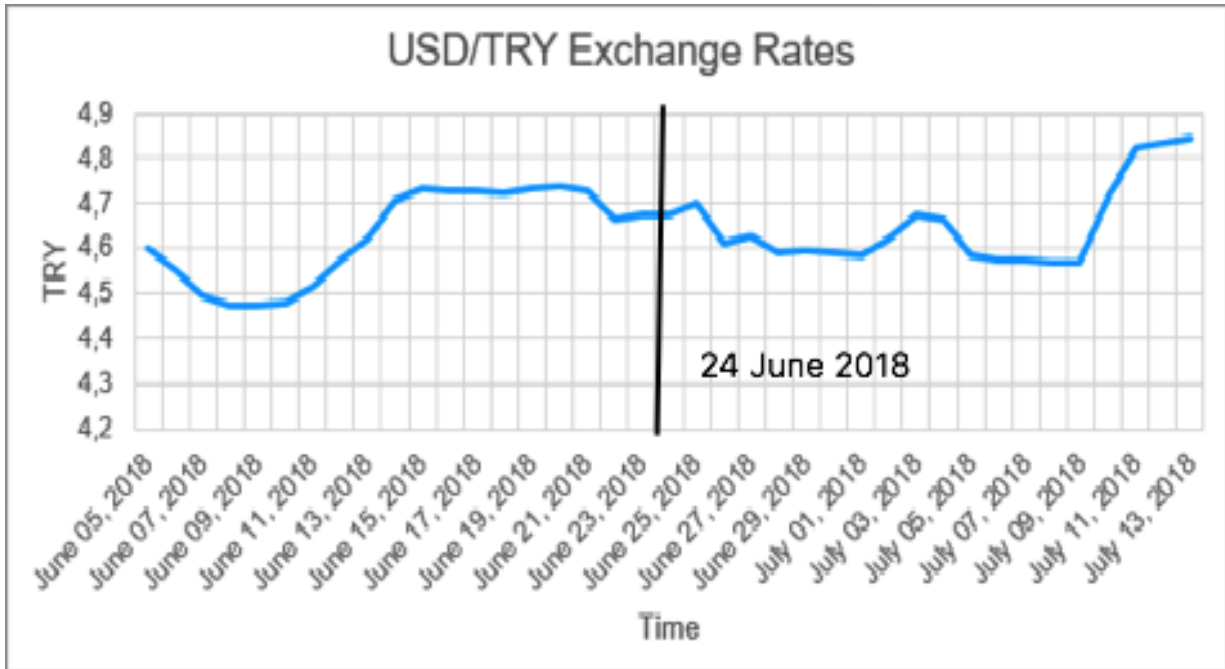
The value of TRY depreciated following the attempted coup incident. It reached its lowest level on 21st July 2016 which is after 6 days of the incident. Later on, the currency rate started to improve. In this case, no pattern was identified for the abnormal returns but it follows a mixture of positive and negative returns the second day bringing losses.

## 2017 Constitutional Referendum



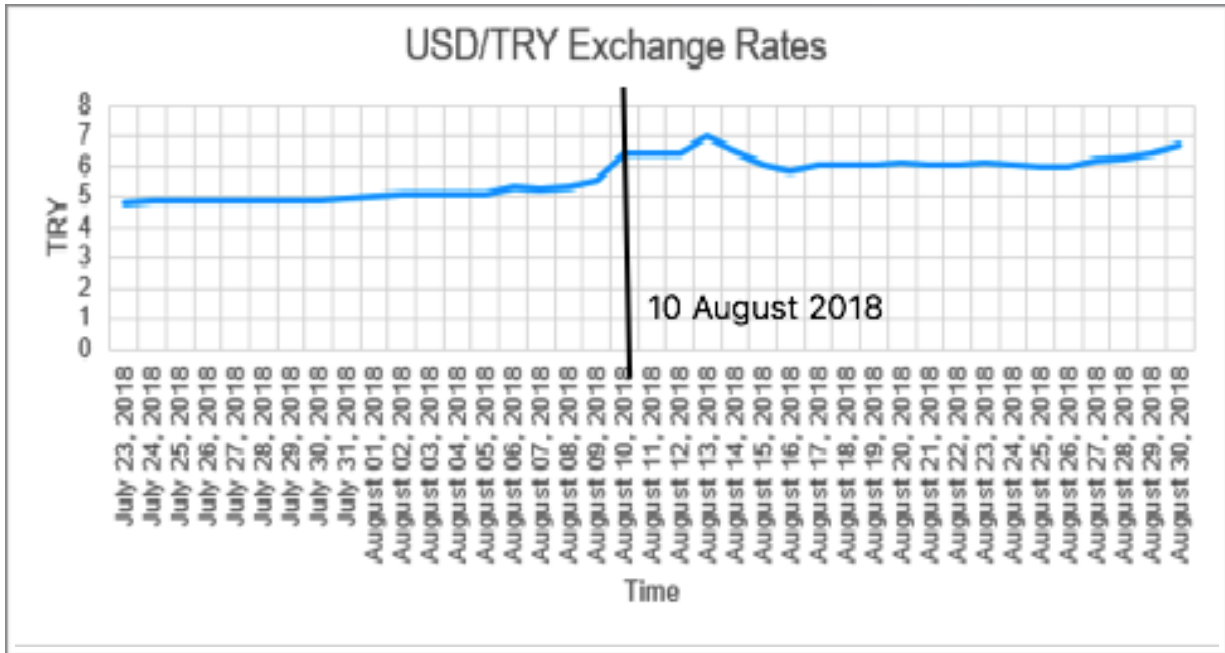
After the referendums, the currency appreciated for one day and it hit its higher level and continued to depreciate until 24th of April which was 4 day after the event.

## 2018 Parliamentary Elections



Parliamentary elections caused one day depreciation which was followed by 4 days appreciation of lira. However, this surge did not continue because of high volatile nature of the Turkish exchange rates. Markets followed a pattern of a business cycle and kept depreciating and appreciating.

## 2018 Trade Sanctions



The trade sanctions that was imposed by Trump administration have caused historical fall in the Lira rates. On 10 August 2018, Trump have announced that he has imposed tariffs on Turkish imports. This led Turkish lira to depreciate and reach a level of 7.0081 = 1USD which is the lowest value that Turkish currency have plummeted for decades. The currency started to recover on the 5th day. Accordingly, abnormal returns brought losses until the 5th day and followed a mixture of positive and negative returns in the following days. The reason behind the plummet in the lira rates starting before the event might be because Turkey increasing its inflation level from 15.4 to 15.9 on 3rd of August and the president Erdogan speech that resulted in markets hope that the Turkish government were willing to tighten monetary policy or begin economic reform (Financial Times, 2018).

# Chapter 6

## Conclusion and Discussions

Studies on national financial markets demonstrate a continuous increase in risks due to various political reasons that affect the markets for both investors and policy makers, especially, in emerging markets like Turkey. This situation is called as volatility in financial economics literature and it is vital to measure and model the volatility in order to leverage and assess investment decisions for a large number of investors that are risk averters. Thus, it is important to know the volatility nature of a market and how certain events affects the movements in order to make the best profits. Therefore, this study was conducted for investors and economists that wants to know more about Turkish stock market and exchange rate behaviors. And accordingly the following questions were examined throughout the study ‘Which political event affected the Turkish financial markets and how they affected the markets for the period of 2007/01-2018/12?

How and why the political events affect Turkish financial markets and to what extend is the Turkish financial markets follow a semi strong form of an efficient market?

This study has two aims. The first aim is to model the volatility of stock market returns of BIST100 index and USD/TRY exchange rate returns for the period 01-01-2007 and 31-12-2018 in order to find whether Turkish financial markets follow a semi-strong form of efficient market proposed by Fama. For this end, ARCH, GARCH, TARARCH, EGARCH models were used. ARCH effect in the return of both markets was found present. This indicates that there is a direct effect between news that enters the market and the level of volatility in the BIST 100. Therefore, we can accept that both of the markets follows semi-strong form of market hypothesis. Moreover, volatility clustering was found present in the financial return series.

And, Garch(-1)) is around 0.97 for BIST 100 return series and 0.89 for the exchange rate returns. Consequently, both markets are volatile and persistent but, BIST 100 Index is more volatile than the exchange market. Accordingly, exchange rates are better investment tools for risk-averse investors. However, speculators can get higher returns from the stock returns which are riskier.

Furthermore, the asymmetry or leverage effects were investigated by using special ARCH tests. Accordingly, the most appropriate model for BIST 100 return series was TARCH (1). TARCH results showed that positive events have more impact on the volatility than negative events effect in the news for Turkish stock market; however, the shocks last for a short period of time. Meanwhile, the most suitable model for the exchange rates was EGARCH (1,1). On the contrary to stock returns, the results for exchange market implied that shocks including good and bad news that impact the exchange rates will affect the volatility for a quiet time in the future, and it is not expected to be forgotten in a short period of time. To sum up, for both markets positive events have slightly more impact than negative ones; however, shocks last longer for the exchange rates and it lasts a short period of time for the stock market.

The second aim was to find out which political effect had the highest impact in the Turkish financial markets for the period 01-01-2007 and 31-12-2018. Accordingly, the volatilities for each year between the chosen period was investigated and 10 events were chosen in accordance with the volatility they cause in the markets and their effect in GDP growth. For this end, the GDP growth rates and the volatility clustering around the dates were examined carefully. Accordingly, the following events were chosen: 2007,2009,2011 and 2015 elections and 2013 Gezi park protests, 2016 military coup attempt, 2017 constitutional referendums, 2018 parliamentary elections and 2018 trade sanctions imposed by the Trump administration. The reason for investigating 2018 elections differently from other elections is that the nature of 2018 election is different because it occurred after Turkey have changed it's regime into

executive presidency. In order to research how these events affected the markets events study method was used to measure whether there is an extreme deviation from the average returns on the stock and exchange market before and after the events date. 15 days before and after the events has been chosen as the event window. The reason behind choosing a short event window is because of Turkish politics being very intense and the direct effects on the markets wants to be investigated. Therefore, by using average-adjusted method abnormal returns showing deviations from the average yield for both markets and for each event were calculated. Accordingly, Gezi park protests, attempted military coup and the sanctions were found to have caused the most effect in the BIST100 index falls.

Gezi Park protests caused the stock market to have negative returns until the 5th day of the event. Following 1st and 2nd day of the event the negative returns have increased until the 5th day. Negative returns have kept increasing from -0.014 in the first day to -0.048 the 4th day. The values for the index was 91287 for 14 April and it was 75041 for 11 June. The stock market lost almost 17000 in a month and 15000 since the event day. As for the attempted military coup, there were an upward trend in the graph before the event for 4 days and the abnormal returns were positive from 12 days prior to the events with only -5th day being negative. However, this upward trend was replaced by a continuous drop for the following 4 days. The markets hit a low off 71595 almost 11.000 were lost in 4 days. However, the market started to rise on the 5th date even tough, it did not increase up to its previous levels. Lastly, sanctions caused the index to fall until the following 5th days of the event. Prior the events, stock market hit a peak of 97185 on the 9th of August and started to decline with Trump administration imposing sanctions on Turkish imported goods such as aluminum. This trend continued until 16th of August where the index showed 87143 almost 8.000 lower (94940) than a week before. Consequently, after aggregating the 4 day for each event Gezi Park protests were found to cause a 7.5% fall in the BIST 100 index followed by 5.1% attempted coup and

3.3% trade sanctions. Therefore, we can reject the null hypothesis and accept that Gezi Park protests have caused the highest fall in the stock markets.

As for the exchange rates, the trade sanctions that was imposed by Trump administration have created historical fall in the Lira rates. On 10 August 2018, Trump have announced that he has imposed tariffs on Turkish imports. This led Turkish lira to depreciate from the beginning of August 4.8 TRY=1 USD to 6.44 on the event day to 7.0081 = 1USD which is the lowest value that Turkish currency have plummeted for decades. The currency started to recover on the 5th day. However, after almost 1 year it has yet not been recovered to its levels before the incident. Therefore, it can be accepted that sanctions have caused highest falls in the exchange markets for the researched period.

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# APPENDIX

## Abnormal Returns for Stock Market

	AR2007
-15	0.00486155905511811
-14	0.00758555905511811
-13	0.00607255905511811
-12	0.00229755905511811
-11	-0.00057744094488189
-10	0.0109325590551181
-9	-0.00714944094488189
-8	-0.00530644094488189
-7	0.0156285590551181
-6	-0.00029644094488189
-5	-0.00358344094488189
-4	-0.00206844094488189
-3	-0.00546644094488189
-2	0.0174385590551181
-1	-0.00415544094488189
1	0.0205525590551181
2	-0.00642944094488189
3	-0.00175344094488189
4	-0.0197424409448819
5	-0.00890444094488189
6	-0.00183744094488189
7	0.0104045590551181
8	-0.0136984409448819
9	-0.00017344094488189
10	-0.00673244094488189
11	-0.00343144094488189

AR2007	
12	0.00141855905511811
13	0.0105425590551181
14	-0.0188134409448819
15	-0.00787744094488189

	AR2009	AR2011	AR2013
-15	-0.00226727530364372	-0.000863772357723577	-0.00192808502024291
-14	0.00570772469635628	0.00893322764227642	0.00601891497975708
-13	0.000218724696356276	-0.00670677235772358	-0.00511608502024292
-12	0.00559572469635628	0.000741227642276423	-0.00244308502024292
-11	0.00222372469635628	-0.00953577235772358	0.000260914979757085
-10	0.000923724696356276	-0.00667477235772358	0.00661091497975709
-9	-0.00226127530364372	0.0105862276422764	0.00321691497975708
-8	0.00165072469635628	0.000974227642276423	-0.00147108502024291
-7	0.00945972469635628	-0.00102477235772358	-0.000793085020242915
-6	0.00209772469635628	-0.00236377235772358	-0.00908408502024292
-5	0.0164507246963563	0.00462622764227642	0.00422291497975708
-4	0.00226172469635628	0.00616822764227642	0.00867691497975709
-3	0.0100217246963563	-0.00293177235772358	-0.00929208502024292
-2	-0.00132827530364372	-0.00295477235772358	-0.00228608502024292
-1	0.00571472469635627	-0.000048772357723577	-0.00293608502024292
1	-0.00862827530364372	-0.00146377235772358	-0.0141390850202429
2	0.0114287246963563	-0.00949777235772358	-7.1E-04

	AR2009	AR2011	AR2013
3	0.00383272469635628	-0.00904977235772358	-0.00661008502024291
4	0.0144677246963563	0.00101022764227642	-0.0487390850202429
5	-0.00144927530364372	0.00398822764227642	0.0199629149797571
6	0.00114972469635628	-0.00527277235772358	-0.00662808502024291
7	-0.00364327530364373	0.00698522764227642	-0.0215890850202429
8	0.0213457246963563	-0.00599977235772358	0.0130379149797571
9	0.0146307246963563	0.00237522764227642	-0.0116180850202429
10	0.00524672469635628	0.00313522764227642	-0.00840608502024292
11	-0.00510327530364372	-0.00108977235772359	0.00982791497975708
12	-0.00356127530364372	0.00577222764227641	-0.00291008502024292
13	0.00334372469635628	0.00101422764227641	0.0188639149797571
14	0.0188337246963563	0.00157822764227641	-0.00650708502024292
15	0.0188337246963563	-2.9E-04	-0.00738108502024291

	AR2015_1	AR2015-2	AR2017
-15	0.00516710569105691	0.000533373983739837	-0.00330169918699187
-14	0.0000071056910569105	-0.00512062601626016	0.00236530081300813
-13	-0.00423089430894309	0.00569237398373984	-0.00439869918699187
-12	-0.00610089430894309	-0.000573626016260163	7.6E-05
-11	-0.00382789430894309	-0.00422762601626016	-0.00161669918699187
-10	-0.00629889430894309	0.00693437398373984	-0.00134369918699187

	AR2015_1	AR2015-2	AR2017
-9	-0.00473089430894309	0.00419737398373984	-0.00026369918699187
-8	0.00333110569105691	-0.00389662601626016	0.00209330081300813
-7	-0.00373089430894309	0.00272937398373984	-0.00173669918699187
-6	-0.00306189430894309	-0.000643626016260163	-0.00087569918699187
-5	-0.0135588943089431	-0.00463362601626016	0.0132733008130081
-4	0.00532610569105691	-0.00323262601626016	-0.00158669918699187
-3	0.0104081056910569	-0.000630626016260163	0.00024330081300813
-2	-0.00467689430894309	0.0000663739837398374	-0.00517969918699187
-1	-0.00292789430894309	0.00486537398373984	0.00094730081300813
1	-0.0224968943089431	0.0228893739837398	0.00285130081300813
2	0.00190510569105691	-0.00399862601626016	0.00345130081300813
3	0.00881810569105691	0.00408237398373984	-0.00270069918699187
4	0.00594210569105691	-0.00373062601626016	0.00588330081300813
5	0.00050010569105691	-0.00533562601626016	0.00182630081300813
6	-0.0107798943089431	0.000701373983739837	0.00644730081300813
7	0.00673410569105691	-0.00459562601626016	0.00385130081300813
8	0.00286510569105691	0.00296637398373984	-0.00050169918699187
9	0.00651810569105691	0.00232137398373984	-0.00108769918699187
10	0.00276510569105691	-0.00133462601626016	0.00172930081300813
11	0.00509610569105691	-0.00437162601626016	0.00001530081300813
12	-0.00185889430894309	0.000636373983739837	-0.00136069918699187

	AR2015_1	AR2015-2	AR2017
13	0.00557610569105691	-0.00336562601626016	-0.00226069918699187
14	-0.00447289430894309	-0.000327626016260163	-0.00381469918699187
15	0.00140810569105691	0.00136237398373984	0.00414930081300813

	AR2016	AR2018-1	AR2018-2
-15	-0.0147702217741935	0.000323638211382114	0.0052246032388664
-14	-0.00108922177419355	-0.00631236178861789	0.0058236032388664
-13	0.0101907782258065	-0.00522536178861789	-0.0144813967611336
-12	-0.00113522177419355	0.00872263821138211	0.0151976032388664
-11	0.000687778225806452	-0.0122953617886179	-0.0023013967611336
-10	0.00646177822580645	0.00351863821138211	0.0037186032388664
-9	0.00251277822580645	-0.00614836178861789	0.0028106032388664
-8	0.0000927782258064516	-0.00831236178861789	0.0037856032388664
-7	0.0000927782258064516	0.00476263821138211	0.000214603238866397
-6	0.0000927782258064516	- 0.0000223617886178861	-0.0107123967611336
-5	-0.00195222177419355	-0.00695836178861789	0.0050886032388664
-4	0.00680677822580645	0.00643563821138211	-0.0063573967611336
-3	0.0000927782258064516	0.000506638211382114	0.0092826032388664
-2	0.0113817782258065	0.00229063821138211	0.0038706032388664
-1	0.00681277822580645	0.00359463821138211	0.0011586032388664
1	-0.0318192217741936	-0.00845836178861789	-0.0102253967611336

	AR2016	AR2018-1	AR2018-2
2	-0.00433022177419355	0.00182163821138211	0.0036406032388664
3	-0.00723722177419355	0.00522263821138211	-0.0147103967611336
4	-0.0195222217741935	0.00319763821138211	-0.0150623967611336
5	0.000961778225806452	0.00112163821138211	0.0080766032388664
6	0.0145927782258065	0.00111463821138211	0.0072586032388664
7	-0.00275422177419355	-0.000853361788617886	0.000214603238866397
8	-0.00275422177419355	0.00285463821138211	0.000214603238866397
9	0.00106577822580645	0.00823763821138211	0.000214603238866397
10	0.00102377822580645	-0.00161636178861789	0.000214603238866397
11	0.00755177822580645	0.00225463821138211	0.0054706032388664
12	-0.00507722177419355	-0.0132523617886179	0.0123326032388664
13	-0.00713922177419355	-0.0231173617886179	-0.0025053967611336
14	0.00916377822580645	-0.00827336178861789	0.000214603238866397
15	-0.000249221774193548	0.00156063821138211	-0.0023913967611336

## Abnormal Returns for Exchange Rates

	AR2007	AR2009	AR2011
-15		0 0.000145943146869699	0.00415490560499857
-14	-0.00767538518914959	0.00458859632774218	0.00349297372214762
-13	-0.00105494653326221	-0.0119206547755034	-0.00134615265614032
-12	-0.00122561199264655	-0.00230205762295034	0.00215275483103938
-11	0.00269847892027455	-0.0146019048486205	-0.0007201207356055
-10	-0.00295074594107789	0.00266182118646667	0.00071460140722131
-9	-0.00241233158887778	-0.00127730745430957	-0.000882762508692377
-8	0.00116566516547005	0.00182601748558414	-0.00148254446356691
-7	-0.000202499762094268	-0.00470095903022279	-0.000914946831810545
-6	-0.002878936723984	0.00697610022631858	-0.00302522046520574
-5	-0.00279553108404808	-0.00566386971397552	-0.00144637047156585
-4	0.00129772765526054	-0.00772096883892428	0.00261914738946518
-3	0.00102178970019255	-0.00180728802586162	-0.0016897720500779
-2	-0.000204165708642896	0.00154630212003522	0.00047770333917852
-1	-0.004189505786086059	0.0000002556306080529 5	-0.00243938382173391
1	0.00316723505459789	0.00687728007015832	0.00149901945218624
2	-0.00863121827447556	-0.00077283152880138	-0.000402128617396329
3	- 0.0005223234456215871	-0.00409420325108853	0.00201649316119138
4	0.00232819650935845	-0.0110084811014691	0.00689130544961309
5	0.0134610931437373	-0.00864424914511345	0.00038834132532164

	AR2007	AR2009	AR2011
6	0.0044125126817905	-0.00413291562555192	-0.00486900033614957
7	-0.000549118558291802	0.0026871871323138	0.00234904861604886
8	-0.0120713123551016	0.00387784995374344	0.00225560452824095
9	0.008845821415839771	-0.0086542676337094	0.000576901369461494
10		0 0.0000002556306080529 5	0.0056053158496013
11	-0.00734188813236574	-0.000696436880740199	-0.000228670336956921
12		0 0.00427092601428446	0.00171054915983145
13	0.000545596154550029	0.00620439696957894	0.0019678829743733
14	-0.005383530596153131	-0.00243920022272925	-0.00596750505399192
15	0.009959911002179311	0.0000002556306080529 5	0.000465340944586022

	AR2013	AR2015-1-	AR2015-2
-15	0.000587278529984179	-0.00316377247275071	0.000613219028960588
-14	-0.00052029447302065	0.0000546776033519787	0.0013399091993863
-13	-0.00119490407848997	0.00261412216645368	0.00442959716876316
-12	0.000872203191770757	-0.00228919589330279	-0.00455393247229556
-11	0.00187217528960787	0.00183818935908514	-0.00559596612836867
-10	0.00264365600182283	0.00158158035532331	0.0012971564873778
-9	0.000816009575340854	0.00275944540627652	0.00124537533170031
-8	0.00212079964580867	0.00403836268769144	-0.000167847196722892
-7	0.00281105259209008	0.000669620387556257	-0.000659754349860377
-6	0.00121581230835329	0.00215323502013888	-0.00378925249601921

	AR2013	AR2015-1-	AR2015-2
-5	-0.000120672603170967	0.000843905641293088	0.0057672907838959
-4	-0.00011480708776248	0.00329566638534979	-0.00309979033067854
-3	0.001489452792115	-0.00153803469733929	0.00317576800270549
-2	-0.000347361377833853	0.00149980974206256	-0.00249656623351723
-1	0.000386563158336511	-0.00239103734078296	0.00705157476585376
1	0.00284124618297523	-0.00135641904382402	-0.00351273254538581
2	0.00155322563947033	0.0160208624557174	-0.0133421753780741
3	0.00191645816468924	-0.00125371039358375	0.000771153717724059
4	0.000530187184227096	-0.00286600240439662	0.00501211528670739
5	0.0017800499212699	-0.00495613594647379	0.000335540370506628
6	-0.00062114907687181	0.00160698684186476	0.0072228992501756
7	0.00180980887265739	0.00365060030753909	0.000468167184589781
8	0.000684389817395408	-0.000139816502091884	-0.000130321828247775
9	- 0.0000003854287486702 29	-0.000449735278361317	-0.00477697107931422
10	0.00130641941454433	-0.00253264368043034	-0.00304105632635366
11	-0.00154030624977004	-0.0034039939689482	-0.000276017816279183
12	-0.00290007992081478	-0.00452461729116073	0.00220919925253773
13	-0.0034332675890525	0.00213601580429983	-0.00113094231760322
14	-0.000950168343009057	-0.00118543304170806	-0.000671534029772301
15	0.00303998867330468	-0.00322846931670668	-0.0034157132799669

	AR2016	AR2018	AR2018-2
-15	-0.005409340420867679	-0.00102894418551429	-0.00232963064237995
-14	0.010827010162003	0.000397706894927875	-0.00418486336835602
-13	0.00211789341786157	-0.004518953633174641	0.0118932936362418
-12	-0.00722642631261028	-0.005535607836267291	-0.00512312150555004
-11	0.000335149776721855	-0.00214334092632551	0.00292237849078452
-10	-0.00194175714292816	0.00421124164214117	-0.000361315858338391
-9	0.00270855404379	0.00574540033132139	0.00322863875291747
-8	0.000444182439625072	0.00458983210558357	0.0016487166169834
-7	0.00313224031271534	0.00761045446458632	0.0059399434787746
-6	0.0016597105876635	0.00244415408053458	0.0069845425558315
-5	-5.54434059628804e-05	-0.000942535136376734	0.00157900814383458
-4	-0.00669461773326964	0.0010072249317888	0.0166448237701968
-3	0.00158275347184055	0.000452558966588108	-0.00274761566551513
-2	-0.0024552815042236	-0.00108427015911476	0.00412888737926207
-1	0.00228469354928623	-0.00546000539510601	0.0160705811018323
1	-0.00325095177038532	0.00338764964097144	0.0366807056736595
2	0.0205736294534926	-0.00864255091350229	-0.0357847875303325
3	-0.00719394920354542	0.00165535958287124	-0.0279822491707161
4	0.00514995153557351	-0.00350333965595735	-0.0140838861936381
5	-0.00117531585367021	0.000387613549220589	0.0134698072927088
6	-0.00073477395117017	0.00232361398892909	0.00747229814433723
7	-0.00413872512381285	0.005225027090487839	-0.00555537244405437

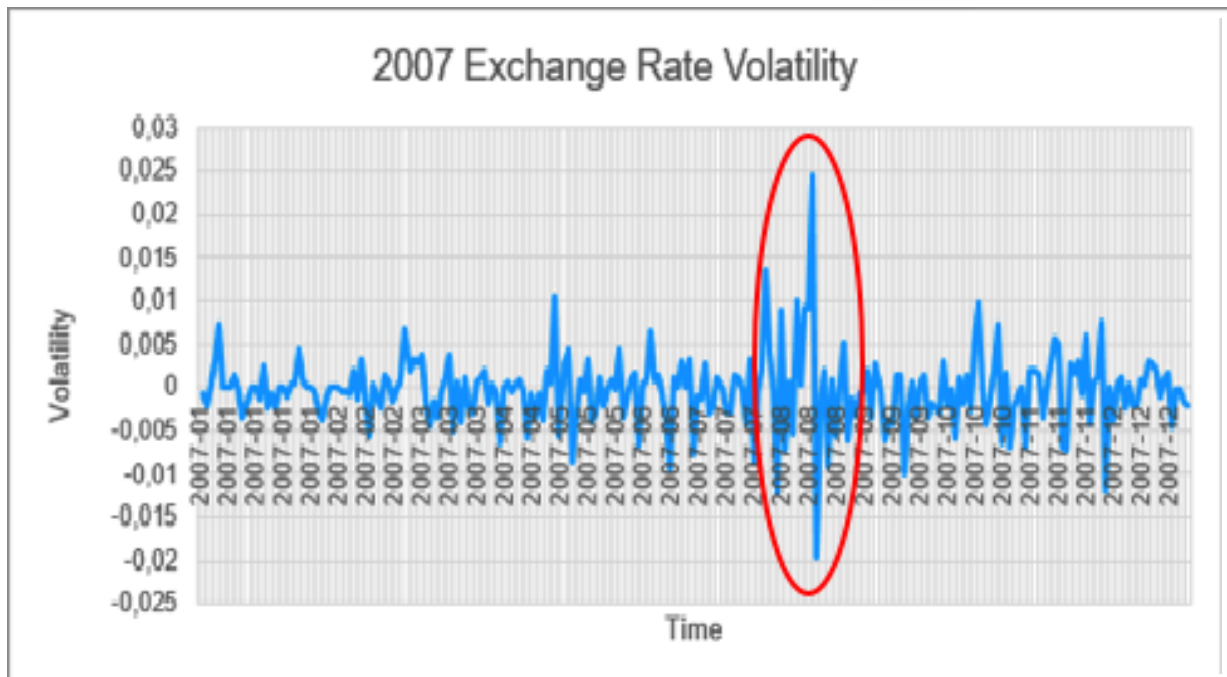
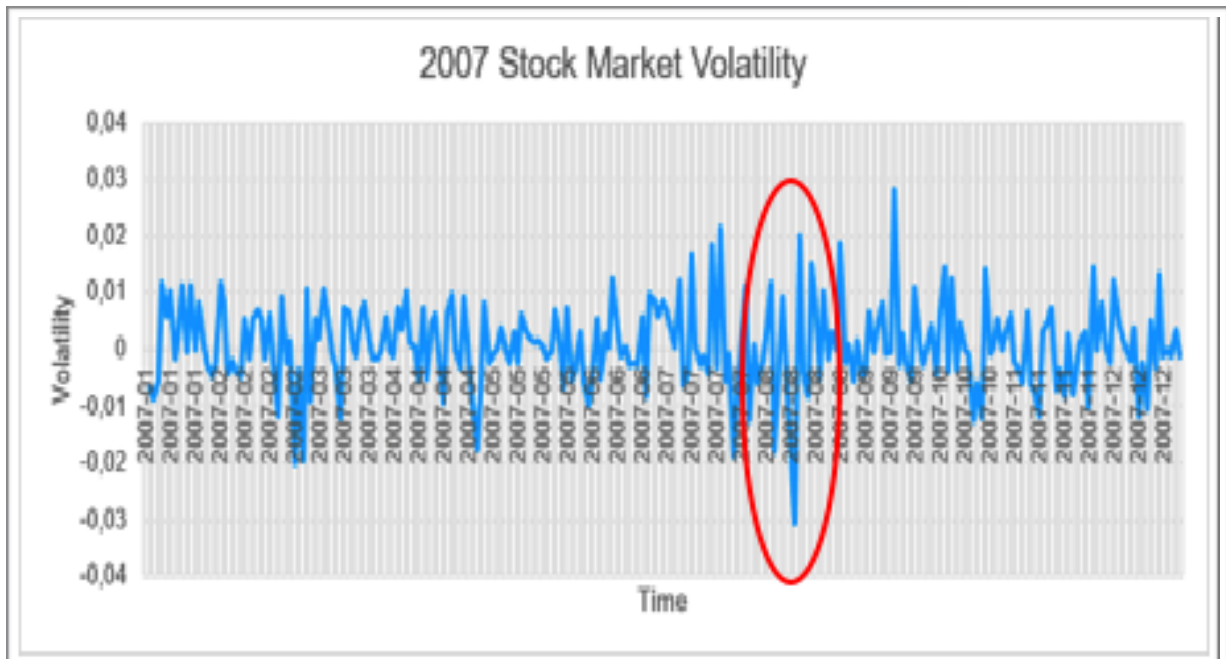
	AR2016	AR2018	AR2018-2
8	0.00118285451752662	-0.00100508038324788	-0.000606863914967161
9	-0.000806077178310109	-0.00752650345302619	0.00395208696055173
10	-0.00319255714437706	-0.00124535020244921	-0.00596311549333407
11	-0.00408084640409543	-0.000304054608453074	0.00893170271703464
12	0.000610730743940206	0.0140128719291681	0.00868016718215173
13	0.000256816725757158	0.00957276670424421	0.009265913202749901
14	0.00279338833732146	0.000764547733604739	0.0200569661637973
15	-9.8013560637857e-05	0.00124736751316938	-0.008282609704533249

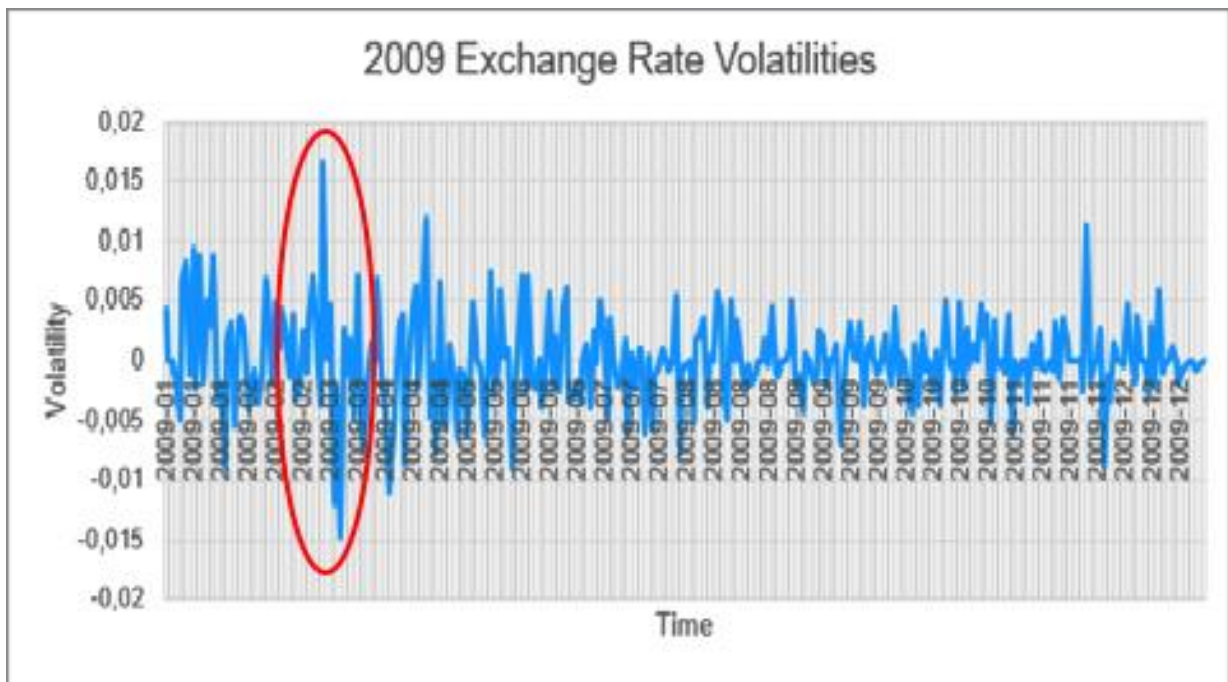
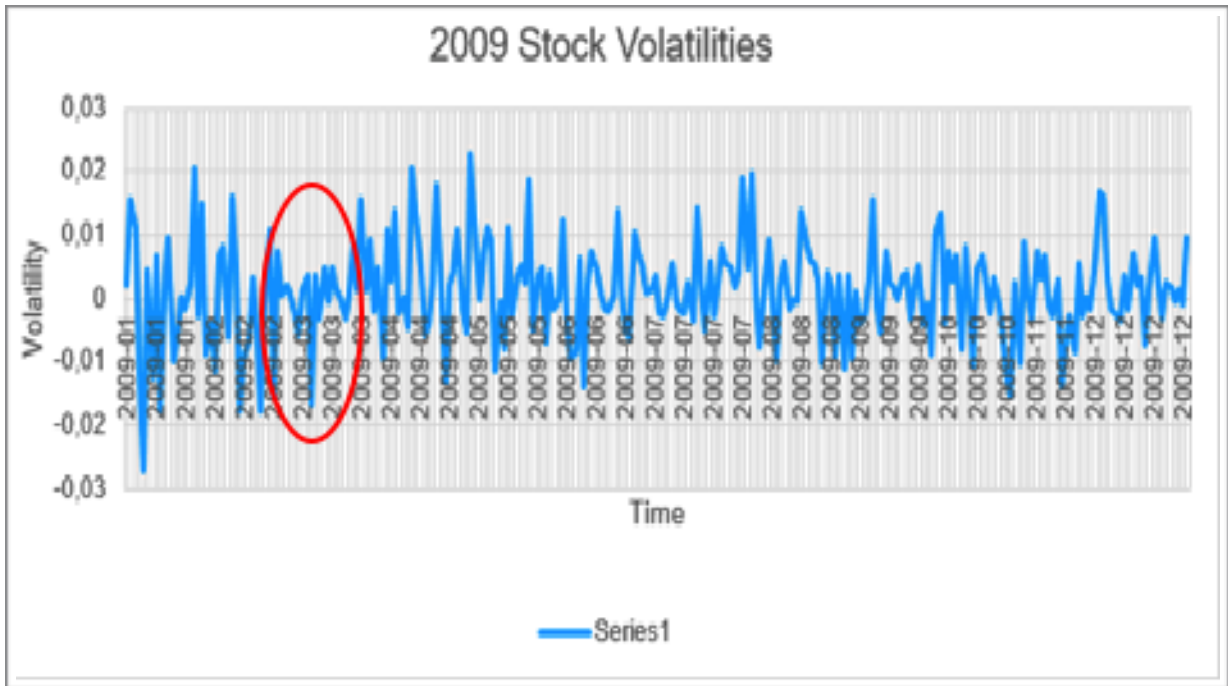
	AR2017
-15	0.000648767097766411
-14	0.00424389843651446
-13	0.000950232978797122
-12	-0.00298110350459474
-11	-0.000253773143885263
-10	0.00140323748894713
-9	0.00358793198680164
-8	0.00359355118695483
-7	0.000142070205687769
-6	0.00384163870177355
-5	-0.0010161909603098
-4	-0.00332699555285262
-3	-0.00442902426865691
-2	-0.000414310975911415
-1	0.0030144245062415

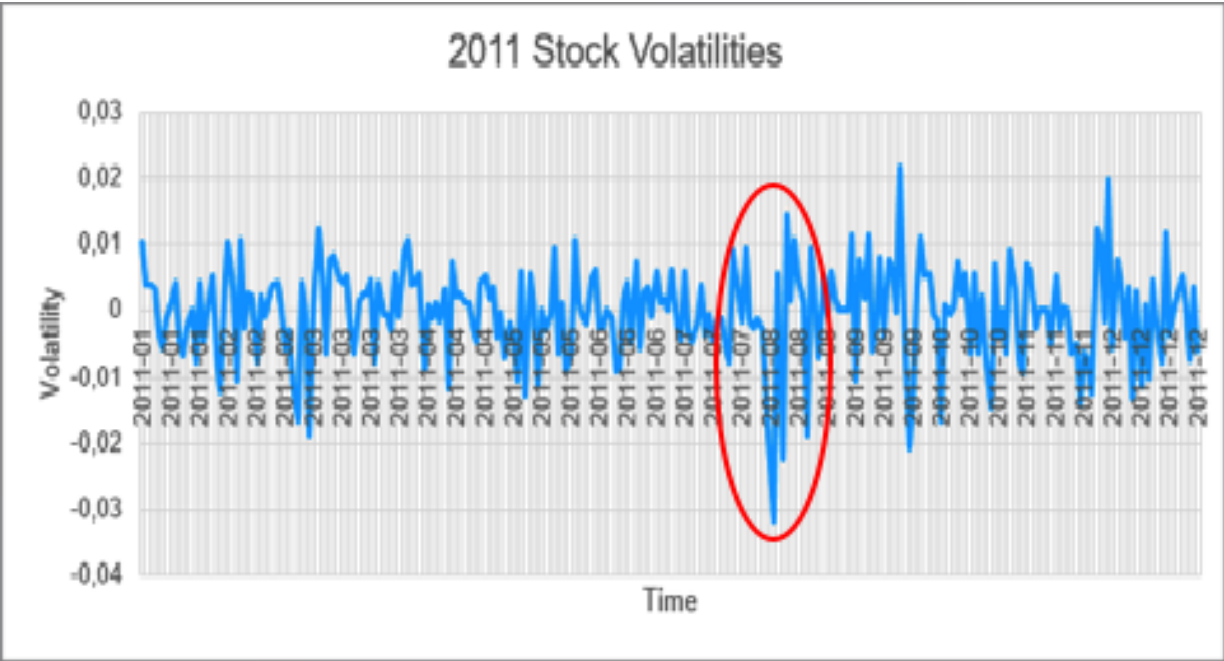
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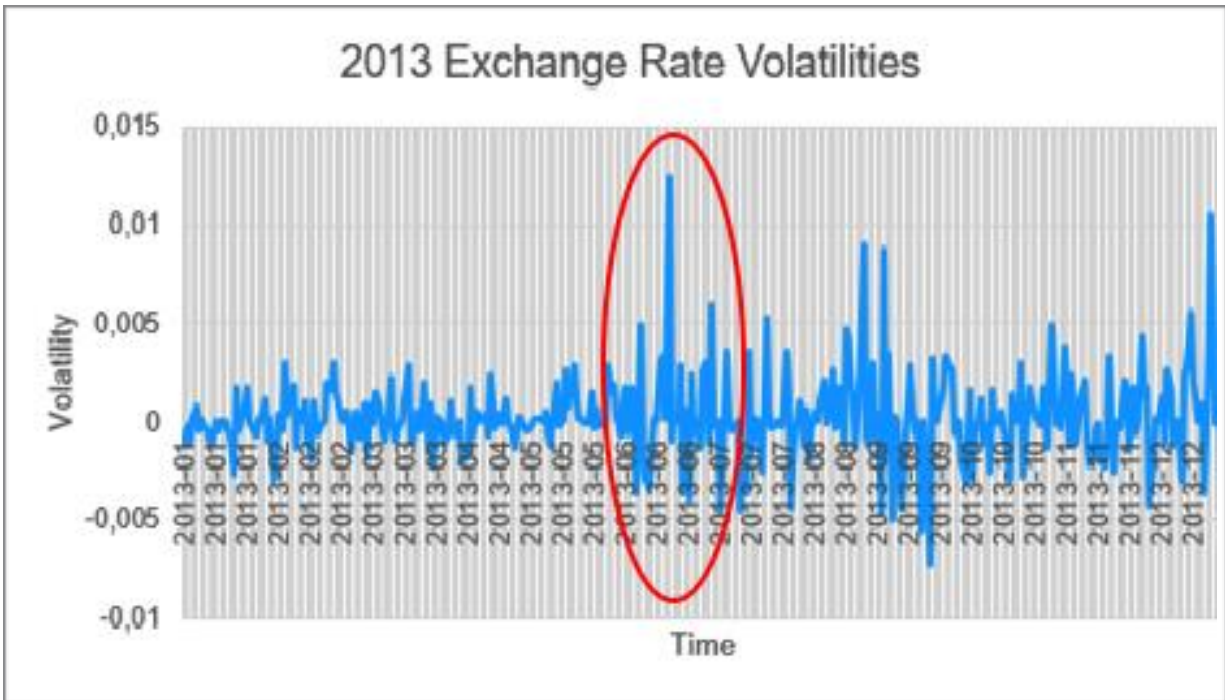
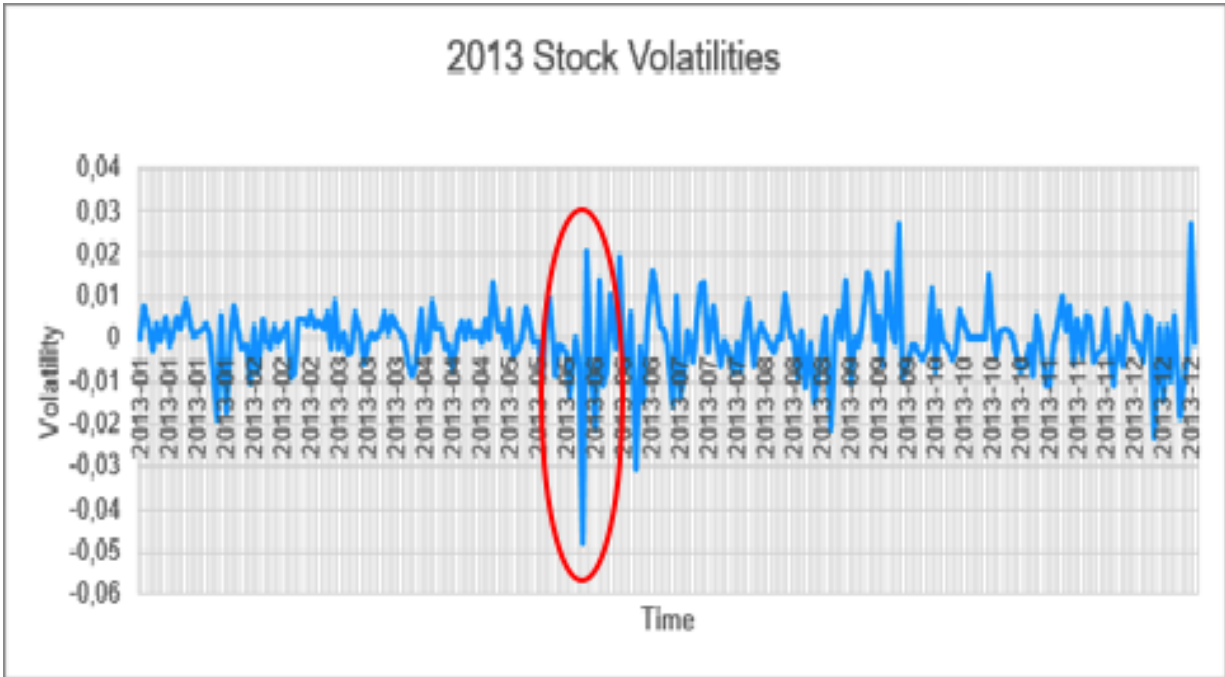
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2	0.0000487881657171404
3	0.000970598499427431
4	-0.00321084771119318
5	-0.000544700620602973
6	-0.00879110631311797
7	0.00147434153955202
8	0.00025534127023224
9	-0.00294104704836506
10	-0.00114495938993523
11	-0.0000287016190823586
12	-0.0037869178308821
13	-0.0000103776017003448
14	0.00390906946364757
15	-0.00122964887734942

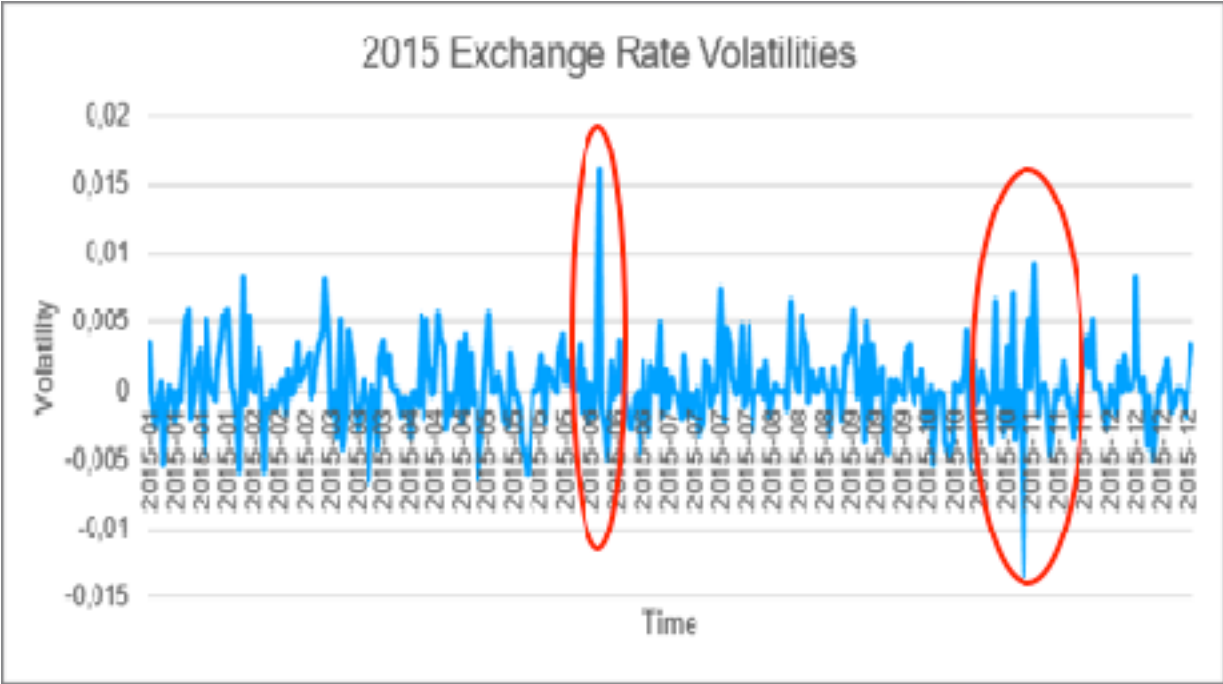
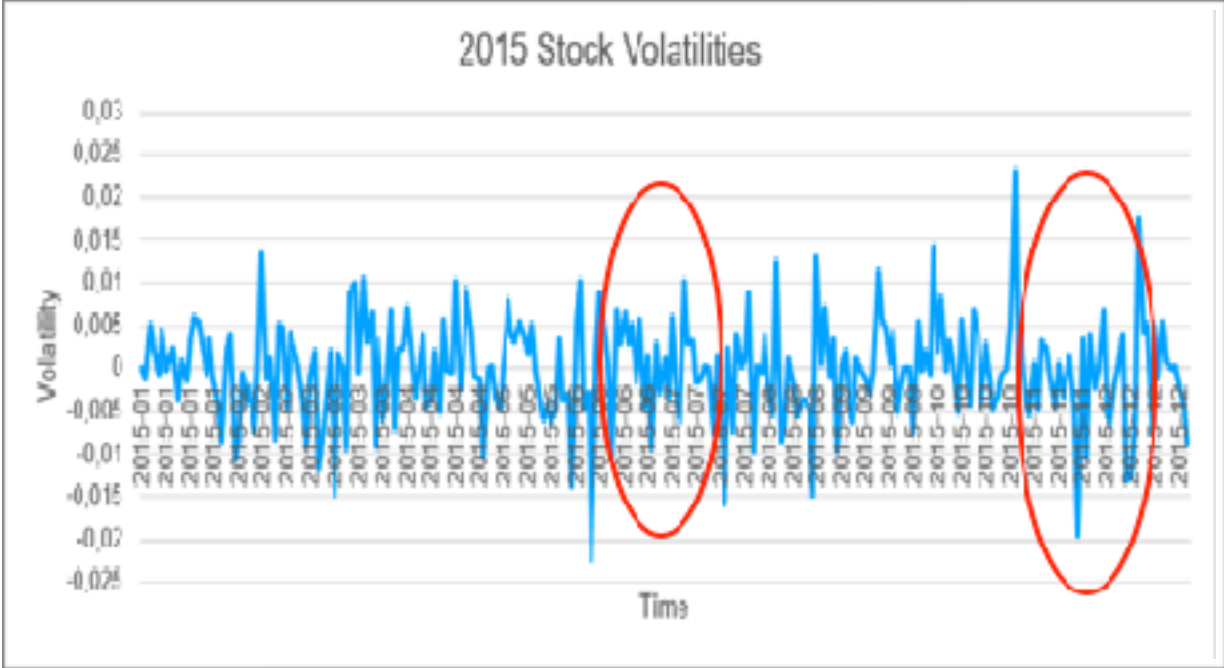
# GRAPHS



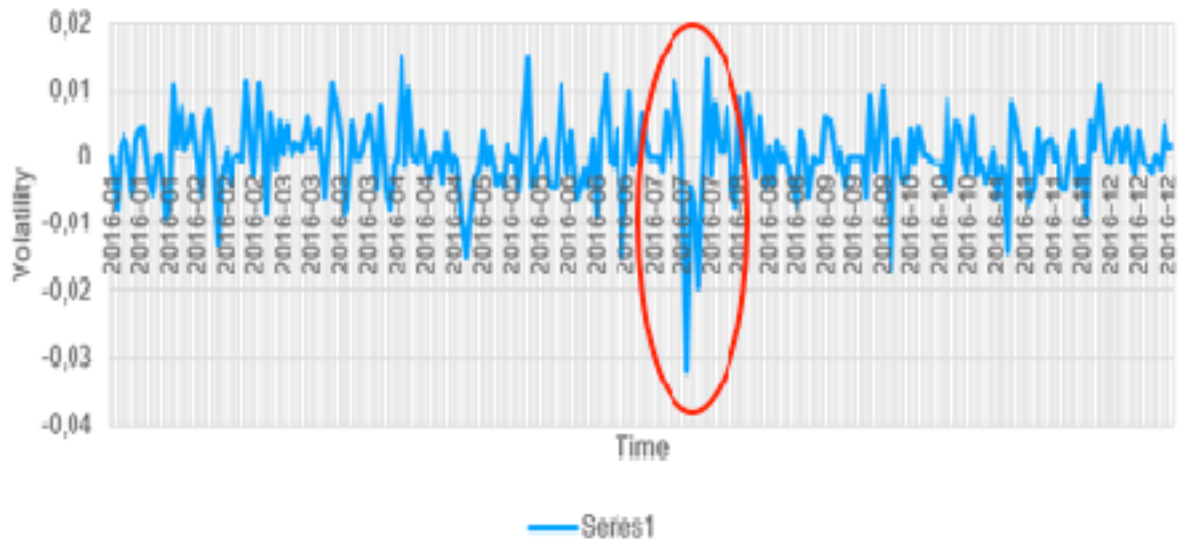




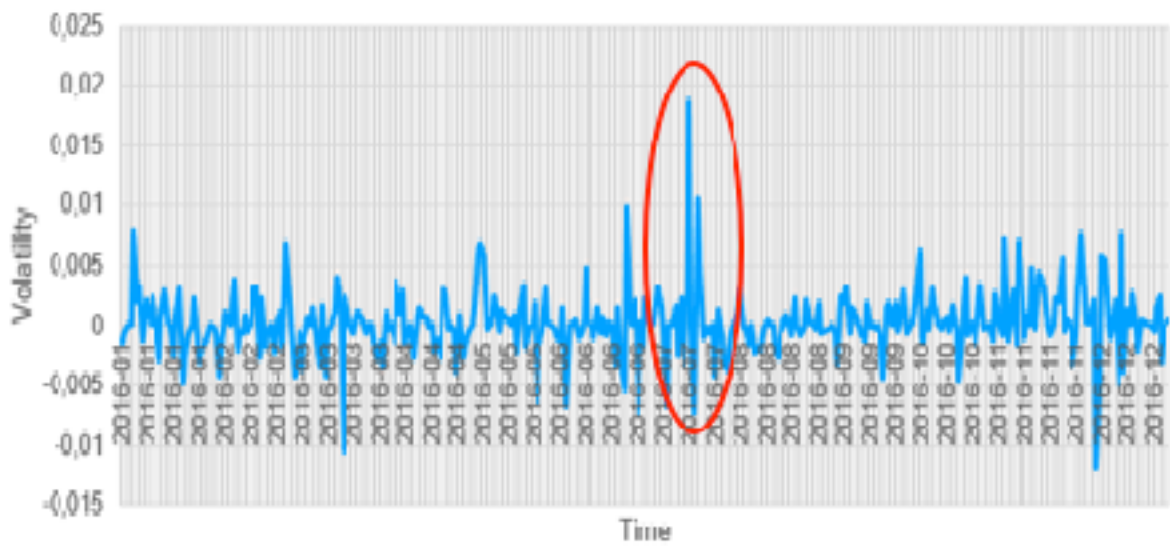




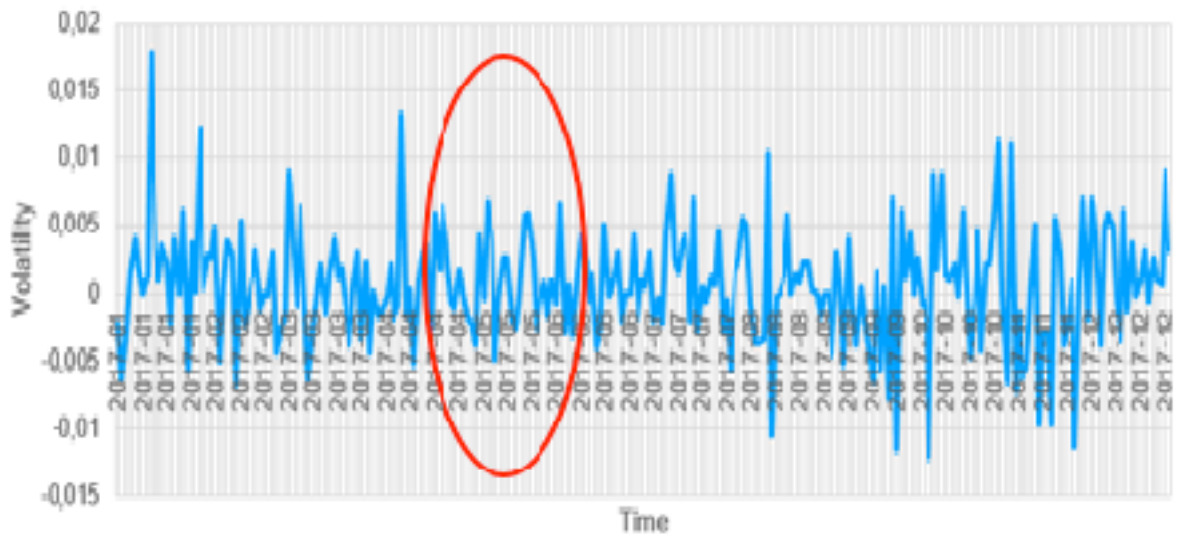
### 2016 Stock Volatilities



### 2016 Exchange Rate Volatilities



### 2017 Stock Volatilities



### 2017 Exchange Rate Volatilities

