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Exchange rate volatility modelling and forecasting:
An application on Turkish economy

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Declaration:

I hereby declare that I am the sole author of the thesis entitled "Exchange rate volatility modelling and forecasting: An application on Turkish economy ". I duly marked out all quotations. The used literature and sources are stated in the attached list of references.

In Prague on 30th of April 2019

Signature

Emrah Yuceer

Acknowledgement

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List of Abbreviations

ADF: Augmented Dickey–Fuller test

AIC: Akaike Information Criterion

AR: Autoregressive Model

ARCH: Autoregressive Conditional Heteroskedastic

ARIMA: Autoregressive Integrated Moving Average

ARMA: Autoregressive Moving Average

ARS: Argentine Peso

CPI: Consumer Price Index

CZK: Czech Crown

E-GARCH: Exponential Generalized Autoregressive Conditional Heteroskedastic

EU: European Union

GARCH: Generalized Autoregressive Conditional Heteroskedastic

GDP: Gross Domestic Product

G20: The Group of Twenty Finance Ministers and Central Bank Governors

IMF: International Monetary Fund

JPY: Japanese Yen

MA: Moving Average

NATO: North Atlantic Treaty Organization

OECD: Organization for Economic Co-operation and Development

SIC: Schwartz Information Criterion

TCMB: Central Bank of the Republic of Turkey

TRY: Turkish Lira

TUIK: Turkish Statistical Institute

T-GARCH: Threshold Generalized Autoregressive Conditional Heteroskedastic

UN: United Nations

USA: United States of America

USD: United States Dollar

WTO: World Trade Organization

Introduction

In today's world, countries, corporations and individuals has become more interconnected with each other in financial transactions. When a crisis occurred in one region, it is possible that another region would be also affected by the crisis even if they do not have any shared borders. In relation to this, financial uncertainty and financial crises have started to appear more often than before due to the exchange rate risk factor. On this point, emerging countries are more likely to be exposed to foreign exchange rate risk due to the dependence on foreign trade. Therefore, analyzing the structure of the volatility of the exchange rate for all market participants in the economy, determining appropriate strategies and methods are very crucial to minimize the exchange rate risk. Regarding this, volatility modeling and forecasting methods have become more common in scientific researches in the last couple of years. Especially, Box-Jenkins and autoregressive conditional heteroskedasticity methods were found to be the most widely used models in many scientific researches to model and forecast exchange rate volatility for a specific time. However, ARCH and generalized ARCH models have been found to provide better results in many scientific researches when they were used in conjunction with Box-Jenkins models. Therefore, GARCH and ARCH models have been used in this thesis in conjunction with ARIMA model which is one of the methods under the Box-Jenkins method in order to model, forecast and find solution of volatility for daily close values of USD/TRY buying exchange rates. On the other hand, after modelling has been made, the most appropriate model has been found for estimation performance. In this context, the impact of political effects on the volatility has been investigated to compare actual and forecasted USD/TRY values.

Research aim and objectives

The main goal of this thesis is to investigate and find the most appropriate ARCH model in conjunction with Box Jenkins method according to estimation performance in order to provide guidance to market participants in terms of foreign exchange rate volatility in Turkey. Other goals have been determined in the following scope:

- To investigate and explain the impact of volatility on the economy
- To clarify what extent global economic and political activities effect volatility
- To determine the most optimum and significant model for forecasting

- Comparing actual and forecasted exchange rate findings to determine efficiency of the model

Structure of the thesis

The first chapter demonstrates concepts and determinants of foreign exchange rate. The chapter starts with introduction of exchange rate concepts. After that, it presents the exchange rate regimes and continues with determinants of exchange rates which influence the volatility in the market. Then, it gives information about foreign exchange rate volatility and risk by the explanations of basic concepts and types of risks which arise from exchange rate fluctuations. In the last topic of the chapter are presented hedging instruments which can be useful to minimize and reduce the foreign exchange risk.

The second chapter serves as an overview on Turkish economy. Initially, it begins with characteristics of Turkish economy by the help of macroeconomic data. Following part of the chapter shows an analysis of Turkish economy and impact of exchange rates on the economy. In relation to this, this chapter depicts how currency fluctuations and political activities influence Turkish economy.

The final chapter presents information about modelling methods, their explanation and relations which can be used to model and to estimate foreign exchange rate volatility. After that the attention focuses on application and forecast of the supplied method. Final part of this chapter provides findings to guide market participants in Turkish economy.

1 Concepts and Determinants of Foreign Exchange Rate

This chapter give information about exchange rates, exchange rate regimes, its determinants and type of exchange rate risks which can be seen when international transactions have been made.

1.1 Introduction to Exchange Rates

Nowadays development of technology provides many opportunities to consumers in terms of purchasing behavior. Purchasing goods and services from abroad became also more accessible thanks to internet usage growth. On this point, consumers must convert the domestic currency to the foreign currency in order to buy goods and services requested from abroad. However, sudden fluctuations in the exchange rate can greatly affect purchasing decision during or before the decision-making. As consumers, companies and also states pay close attention to the sudden fluctuations in the exchange rate when trading with a foreign partner. The main reason for this is that the increase and decrease in the exchange rate can affect many important factors in the domestic market. Given that some of these factors are inflation, interest rates and production costs, it is understood the importance of exchange rate fluctuations for the market. In this context, exchange rates have been recognized as very important factor in international trade and financial transactions. According to Krugman who is one of the best-known economists in the world, the exchange rate has been defined as "*price of one currency in terms of another currency"*. (Krugman, 2010). Based on Krugman's definition, it can be said that weak domestic currency against foreign currencies has a negative impact on the purchasing power of domestic consumers. Therefore, when consumers need to buy products from abroad, it is obvious that they are willing to have stronger local currency in value against foreign currency. On this point, exchange rate makes it also easy from the perspective of international companies to compare prices of products and services in different countries. (Krugman, 2010). For this reason, exchange rates remain as very important factor for the measurement of the competitiveness. To explain it better, an upward trend in the domestic currency value makes price of desired goods in foreign country cheaper for domestic buyers while a downward trend in the domestic currency makes the price of desired foreign goods more expensive for domestic buyers. In relation to this, exchange rate volatility is among one of the major risk factors in international trade for all market actors. Therefore, many different exchange rate regimes have been implemented by the countries from past to present in order to control exchange rate volatility .

1.2 Exchange Rate Regimes in International Financial System

Exchange rate regime can be called as a system which is implemented by countries to arrange international payments and control exchange rate fluctuations.(Szulczyk, 2014). Floating and fixed regimes are the two types of exchange rate regimes which are used in the international financial system. Under floating exchange rate regime which is sometimes called as flexible or fluctuating regime, the exchange rate values are determined by demand and supply in the market. On the other hand, when the currency value is fixed against another currency, the system is called as fixed exchange rate regime. In this respect, some different regimes have been implemented from the past to present that could be called as a fixed exchange rate regime. The Gold standard regime is recognized as fixed exchange rate regime and it had been implemented before World War I. Under this regime, some of the currencies, such as U.S. dollar and British pound, were set as convertible currencies against the gold. However, this system brought many problems to countries and influenced gold production negatively. The system has been modified as a result of problems. After gold standard system has been modified, the Bretton Woods system has been implemented towards the end of World War II. Under this system, U.S. dollar has been recognized as only convertible currency against gold. (Frederic Mishkin, 2016). In addition to that, World Bank and International Monetary Fund have also been established with Bretton Woods agreement. In this context, the Bretton Woods system has a very important place in international trade history. Even though the system led creation of new organizations for the development of international trade, it collapsed in 1971. After the collapse of the system, the dollar lost its ability to be convertible currency against gold, nevertheless, the dollar has been keeping its strong position in international trade.

1.2.1 Floating Exchange Rate Regime

Under floating exchange rate regime, currency value is set by the market without any government activity (Bob Steiner, 2002). However, sudden changes in the exchange rate may push the central bank to intervene in the market. On the one hand, central bank may intervene to fluctuations by selling or buying domestic currency. In such cases, when government intervention occurs, the system is called as dirty floating or managed floating system. The aim of such an intervention is to minimize the negative effects of the volatility so that domestic market would not be negatively affected. On the other hand, exchange rates movements can be

also affected by interest rates which can be increased or decreased by the central bank. In this regard, increases and decreases have an important role in terms of foreign direct investment. By decreasing or increasing interest rates, country may be more convenient or inconvenient for foreign investors. Even if the occurrence of such effects results in positive or negative events, government interventions are used as short-term supportive tool to implement economic reforms for the market stabilization. Therefore, the interventions under the floating exchange rate regime are aimed at eliminating the negative effects of the exchange rate and to analyze the volatility of the exchange rates are very important for any of market participants. In this case, on the one hand, if domestic currency depreciates against foreign currency, the cost of importing products from abroad for any purpose will increase. On the other hand, such a depreciation of domestic currency will make domestic exporter's situation better off against its competitors in domestic market (Bob Steiner, 2002). Therefore, interventions play a very important role under the floating exchange rate system, and their impact may be advantageous or quite disadvantageous on the market actors.

1.2.2 Fixed Exchange Rate Regime

In fixed exchange rate regime, central bank can sell or buy the local currency against foreign currency at a pegged price. Under this regime, the monetary policy of the country is set as single policy which targets to keep the exchange rate level within very narrow band (Mankiw, 2015). In this context, the system restricts to use exchange rates as a policy tool. It is generally indicated that the regime brings credibility and discipline to the system (Toulaboe, D., & Terry, R., 2013). Therefore, when it comes to importers and exporters perspective, the fixed exchange rate system eliminates exchange rate uncertainty.

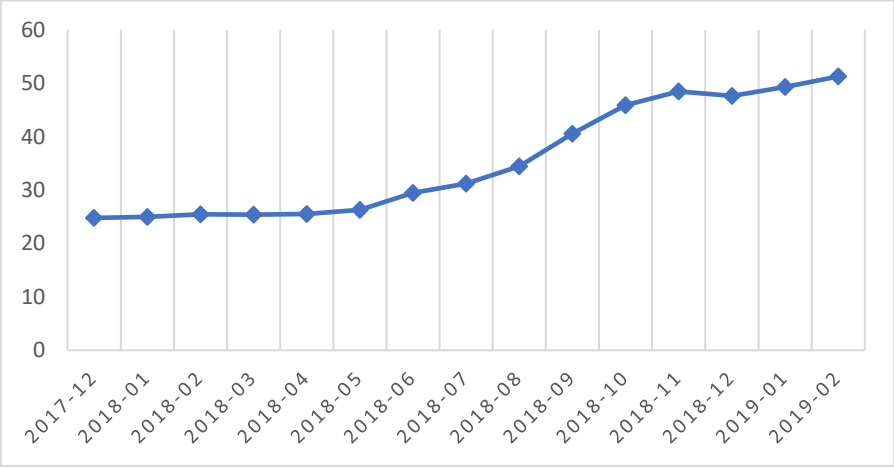
1.3 Determinants of Exchange Rate

As it was previously mentioned, exchange rates can be influenced by some factors negatively or positively. Inflation, interest rates, political uncertainty and economic performance, direction of trade, national debt and government intervention can be given as examples for the factors that can affect exchange rate movements positively or negatively. At the same time, a dramatic increase or decrease in exchange rate can also influence macroeconomic indicators of country. The impact of such changes will be observed in second chapter to see how exchange rates influence Turkish economy.

1.3.1 Inflation

In today's world, states try to maintain price stability by keeping inflation under the control. In this case, considering price stability, the first thing that comes to mind is that the fluctuations in exchange rates should not be intensive in the economy. Therefore, it is important to understand what exactly inflation means. According to the International Monetary Fund (IMF), *"inflation measures how much more expensive a set of goods and services has become over a certain period, usually a year".* Based on the definition, it can be understood how important inflation is in terms of foreign exchange rates. To explain it more specifically, when country faces with high inflation, consumers face high prices in the market and for that reason, high inflation influences consumers purchasing power negatively. In this case, it can be concluded that the impact of high inflation on the local currency would be negative. However, in the case of the opposite situation, low inflation rate does not provide a significant change in domestic currency and exchange rate. From this point of view, the relationship between inflation and exchange rate is quite evident. But another factor that should not be forgotten is interest rate. To be more specific, the relationship of inflation and exchange rate is mainly related to the interest rates. Low interest rates encourage consumer expenditures, production, economic growth and other indicators which will bring positive impact on currency value. Therefore, it is important to evaluate these three factors together. Regarding this situation, the figures 1 and 2 illustrate the relationship between inflation rate and exchange rates in Argentina as an emerging country.

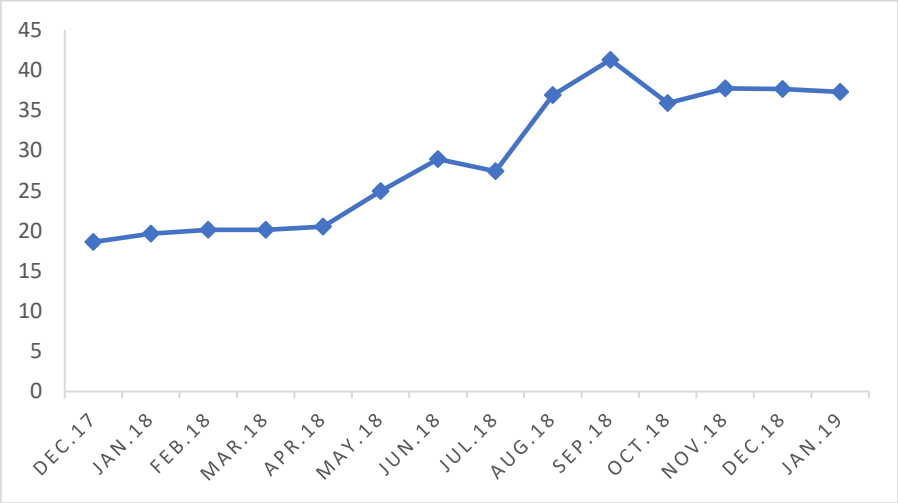
Figure 1: The course of inflation rate (CPI) from December 2017 to February 2019 (%)



Source: Own elaboration with the use of data from OECD

As it can be seen from figure 1 and figure 2, inflation and exchange rates have high correlation between each other. In both cases, it can be clearly observed that increases and decreases show a horizontal appearance to each other. Additionally, the relationship between inflation, exchange rates and interest rates will be shown in second chapter.

Figure 2: USD/APS exchange rates from December 2017 to February 2019



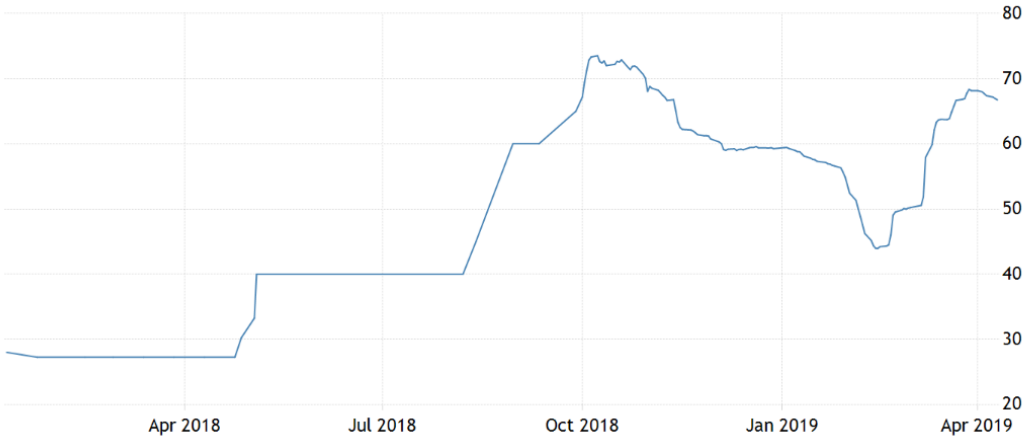
Source: Own elaboration with the use of data from (Investing, 2019)

1.3.2 Interest Rate

Exchange rates, interest rates and inflation are the factors which have connection with each other in highly manner. When the relationship between exchange rates and interest rates considered, interest rate changes made through government interventions directly affect the exchange rate movements. As explained before, government interventions are carried out by the central banks. Central banks intervene interest rates to change the effect of the exchange rate in short-term. On this point, if central bank decides to increase interest rates, loan lenders may get higher rate of return in comparison with foreign countries. With respect to that, foreign direct investment would increase and by that way domestic currency will become stronger against foreign currency due to high demand. However, the impact of such an action might not bring long term efficiency. To eliminate negative effect of the exchange rate, different actions must be taken. The interest rate can only be used as a tool if country's domestic currency depreciates against foreign currency. Therefore, keeping the interest rates high for a long time will also cause inflation expectations to rise. On the other hand, when it is considered from other point of view,

lower interest rates would decrease the interest of foreign investors to invest in country. However, interest rate is not the only factor that should be taken into account when foreign investors would like to invest in the domestic country. Balance of trade, gross domestic product, political and economic stability, government debts are the factors which are considered before the foreign investment decision. Even if these factors are examined in a separate section, the effects of volatility on the exchange rate in the following sections will be better understood as an important indicator of how these factors are related to each other, respectively. Moving from here, it can be clearly seen from the following line chart how the interest rates have been affected due to the exchange rate movements, for example in Argentina. Currently, Argentina has the highest benchmark interest rates in the world (The Irish Times, 2019).

Figure 3: Development of interest rates in Argentina between 2018 and 2019 (%)



Source: (Tradingeconomics, 2019)

1.3.3 Political Uncertainty and Economic Performance

Political environment and economic performance of a country are very important indicators for the foreign investment and exchange rates. If country has good economic performance and positive outlook of political environment, the country would become more attractive for foreign investors. Therefore, a rise in foreign capital would create more demand on domestic currency so that the value of the domestic currency would be appreciated against foreign currencies. On the other hand, any political risk which occurs in country may affect domestic currency value

very negatively. Therefore, it can be said that the sudden changes in the exchange rate have been occurred usually due to political reasons. (Krugman, 2010)

1.3.4 Direction of Trade

Trade direction is another factor that influences exchange rates. From this perspective, if country exports more than it imports with upward tendency of exports, dependence on foreign countries would be less. In relation to this, if exports keep increasing in such a case, in return, demand for domestic currency will increase too. Under these circumstances, an increase in demand will lead to appreciation of domestic currency against foreign currency.

1.3.5 National Debt

Government can face with high public debt due to domestic market financing. Higher national or public debt would stimulate high inflation in country. As it was already explained previously, high inflation can affect domestic currency very negatively. Therefore, national debt is one of the factors that influence domestic currency value.

1.3.6 Government Intervention

When it comes to government interventions, some factors can trigger government to intervene to domestic market in order to decrease negative impacts of the foreign exchange rate. In such a situation, central bank can take an action against negative effect. Under some certain circumstances and exchange rate regime, the reserves can be used to decrease the negative effect of the foreign currency. If domestic currency experiences depreciation, for example TRY depreciates against USD, central bank can decide to sell USD from its reserves to increase the value of TRY. In addition to this, interest rates can be changed to attract foreign investors. All these activities which are stimulated by central bank can influence the foreign exchange rate value.

1.4 Foreign Exchange Rate Volatility and Risk

Under fixed exchange regime, exchange rate remains fixed. On the other hand, under floating exchange rate regime, exchange rate may go up or down due to market conditions with the lapse of time. Accordingly, it is immeasurably difficult to predict the exchange rate by the end of a specific time. As it is known that under floating exchange rate regime, currency value can float up or down, it is expected to experience exchange rate volatility. In relation to this, volatility

can be described as a change degree of the variable over a specific time. (Steve Suranovic, 2010) According to given definition, exchange rate volatility can be defined as an unanticipated movements of exchange rate over the time (Ozturk, 2006). Accordingly, the following figure can be used to better understand the exchange rate volatility. Figure 4 illustrates the exchange rate relationship of U.S. dollar and Japanese Yen between 2017 and 2019.

Figure 4: USD/JPY exchange rate development between 2017 and 2019

Source: (Tradingview, 2019)

When the line chart has been analyzed, it can be observed that it is very difficult to predict exchange rate under such movements. In addition to given information, exchange rate volatility affects large corporations, small-medium enterprises, individuals, countries and other market participants. Also, volatility makes decision making process difficult in terms of investment and international trade (Suranovic, 2010). Therefore, if market experiences very deep and unanticipated exchange rate movements, all the market participants are exposed to risk. Moreover, exchange rate risk can lead to probable loss of money due to sudden appreciation or depreciation of the currencies. Because of that, it will be better to understand to analyze impact of exchange rate risk from the exporter, importer and investor point of view.

1.4.1 Exchange Rate Risk: From Exporter and Importer point of view

For instance, it can be assumed that a European seller exports some specific devices to a buyer into the United States. In this specific period, it is assumed that these devices have been sold to 2 U.S. dollars for each piece when each U.S. dollars value determined as 2 euros. However,

after a year, some unexpected changes occurred in the market and 1 U.S. dollar became 1.5 euros in value. In this situation, if European seller exports these devices in the value of 1 million U.S. dollars, the seller would make a loss of half million U.S. dollars due to appreciation of euro against dollar. The reason is that, European exporter may produce goods which are denominated in euro, however if company exports goods to the USA, the money will be sent in USD since importer is located in USA. Therefore, the exporter will lose money from this transaction. In this case, it can be seen clearly that the exporter has suffered losses due to the exchange rate risk. As a result, this example shows the exchange rate risk where exporter faces due to appreciation of euro currency. On this point, it should be noted that the companies engaged in international trade are always likely to be exposed to foreign exchange rate risk. (Suranovic, 2010)

1.4.2 Exchange Rate Risk: From investor point of view

Except from exporters and importers, investors can also be exposed to exchange rate risk because of currency volatility. To give an example, first consider an American resident who invests 20.000$ (for example, save) in November 2017 for one year. The investor deposits his money at 2.40 percent deposit rate for one year in Czech account which has higher deposit rate than U.S. account which is 1.95 percent. When the deposit has been made, the exchange rate sits at 20 CZK/USD. After a year, in November 2018, the investor decides to exchange his deposit from CZK back to U.S. dollars. The exchange rate in that time is recorded as 22 CZK/USD. In relation to this example, rate of return of investment formula can be used in order to calculate how much the investment was profitable. (Suranovic, 2010)

$$RoR_{czk} = i_{czk} + (1+i_{czk}) \times [(1/_{E2018\ czk/\$} - 1/_{E2017\ czk/\$})/_{E2017\ czk/\$}]$$

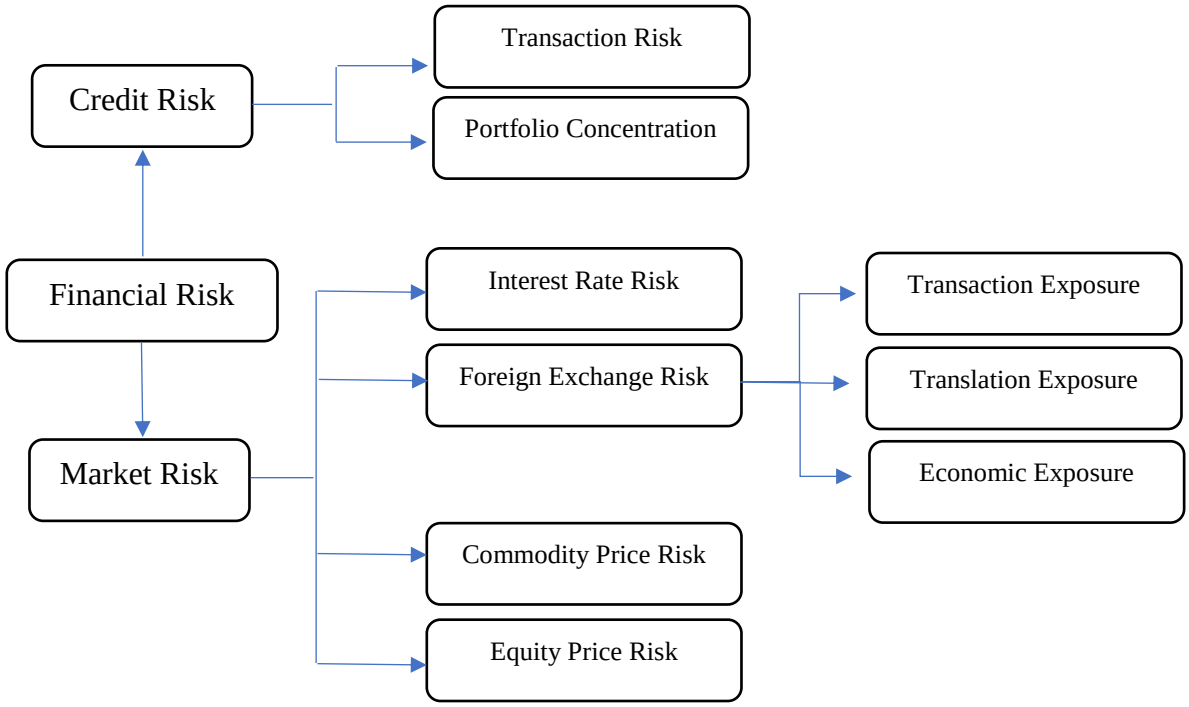
$$= 0.024 + (1+0.024) \times [\ (1/22 - 1/20) / (1/20)]$$

$$= - 0.0690 \times 100 = -6.9\ \%$$

As it can be seen from the figures, the investor makes 6.9% loss of deposited money in the amount of $1380 when he makes deposit on CZK. If he would deposit the money in U.S. account, he would have had return as 1.95% return which is $390. (Suranovic, 2010)

After the given examples, it has been seen once again that the exchange rate plays an important role in international trade. Therefore, based on given examples, 3 types of risk can be faced due to the exchange rate volatility. In relation to this, the following table demonstrates these 3 types of exchange rate risk under the financial risk which are transaction, translation and economic exposure.

Table 1: Schematic presentation of financial risk by categories



Source: Own elaboration with the use of data from (Crouhy, Galai and Mark, 2004)

1.4.3 Transaction Exposure

Transaction exposure is a risk type which arises from exchange rate fluctuations and affects company's future cash flows under current contractual obligations (Eriksen, 2010). If the contract was agreed but not settled, in relation to this, the risk is occurred before the contract is settled. Therefore, if the time between agreement and settlement of contracts is longer, the exposure will be higher due to the exchange rate changes.

1.4.4 Translation Exposure

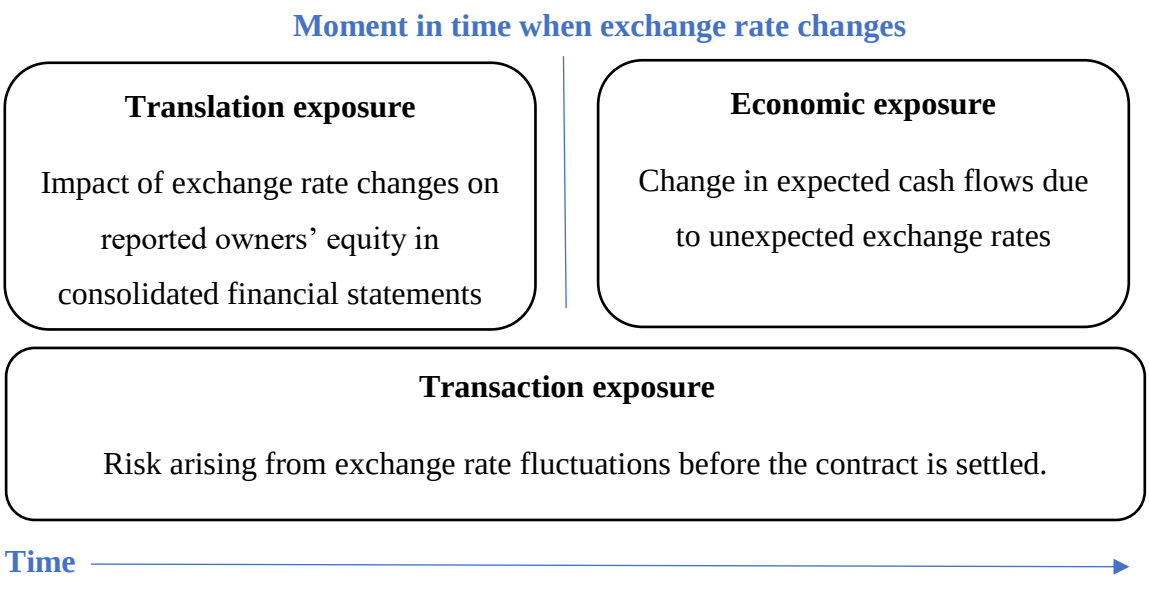
Translation exposure demonstrates the exchange rate changes which affect company owner's equity, assets and liabilities. This exposure type is also identified as accounting exposure in some sources (Eriksen, 2010). Translation exposure occurs when a company has foreign subsidiaries. Because of that, consolidated financial statement needs to be provided in a single report. To be more specific, it mainly derives the need to convert the financial statements of a firm's activities from local currencies to the home country's currency. Additionally, it focuses on how changes in exchange rates affect the company's book value. (Nazarboland, 2003)

1.4.5 Economic Exposure

Economic exposure is also known as operating exposure. Economic exposure is a risk type which arises from unexpected changes in exchange rate. In this type of exposure, exchange rate changes influence future prices, costs and sales of company. From this perspective, it can be defined as an exposure which affects company's future cash flows due to the unanticipated changes in exchange rate. (Eiteman, 2013)

The following table provides comparison of exchange rate exposures for better understanding.

Table 2: Comparison of exchange rate exposures



Source: Own elaboration with the use of data from (Eiteman, 2013)

These 3 types of exposures are very crucial for international companies. When a company extends its work to foreign country, it is high probability that company will be exposed to exchange rate risk. On this point, if company experiences a foreign exchange exposure, some preventions can be taken to reduce the risk. One of the most common methods related to hedging risk are financial derivatives. Hedging is defined as any activity which can be taken to reduce exchange rate risk by taking adverse position. Forwards, futures, options and swaps are tools for hedging which are also known as derivative instruments.

1.5 How to Minimize Foreign Exchange Risk

We defined the types of exposures in previous topic. Therefore, it is very important to define related factors which can help to prevent or reduce the transaction, translation and economic exposure.

1.5.1 Forward Contracts

Forward contracts are settled in order to be prevented from exchange rate risks by providing a customization between counterparties and allow selling or buying an asset in the future at an agreed price. When the contract is made, the price is fixed and according to that, it is not traded on exchange market. Moreover, exchange rate changes between contract date and maturity date do not affect the predetermined rate on the contract. On this point, if the current spot price is lower than future expected price, it is called as forward premium. On the other hand, if future expected price is lower than current spot rate, it is defined as forward discount. (Brealey, 2011). To be more specific, one the one hand, one of the parties to a forward contract takes a long position and accepts to purchase the underlying asset on agreed price and a specified date. On the other hand, other party of the contract takes a short position and agrees to sell the asset at the same price on the same date.

Based on previous information, to give an example, the table 3 sketches out spot rate and forward rates in EUR and U.S. dollar that might be used by an international bank on 18th of June 2018. Regarding table, in the first line, spot bid rate defines that bank is ready to buy U.S. dollar at price 1.2105 for per EUR in the spot market. On the other hand, offer shows that bank is ready to sell each EUR at price 1.2109 in the spot market. The following lines represents that bank can buy USD at price 1.2106, 1.2109 and 1.2115 for each EUR and sell EUR at price

1.2111, 1.2113 and 1.2120 for each dollar, respectively 1-month, 3-month and 6-month forward rates. As an example, it is assumed that German company must pay 2 million EUR in 6 months due to the debts that it has. In addition to that, the German company would like to use 6- month forward agreement due to the risk of exchange rate volatility. Therefore, it is assumed that German company and bank A reached an agreement on 18th of December 2018 for 6-month forward rate. Based on the contract, the German company buys 2 million EUR from the bank in the value of 2.424.000 U.S. dollars on 18th of December 2018 which puts German company into long forward contract on euro. On the other hand, bank will sell 2 million euro for 2.424.000 U.S. dollars in the short forward contract position. In this way, the forward contract has been performed when one of the parties takes a short position and the other side takes a long position.

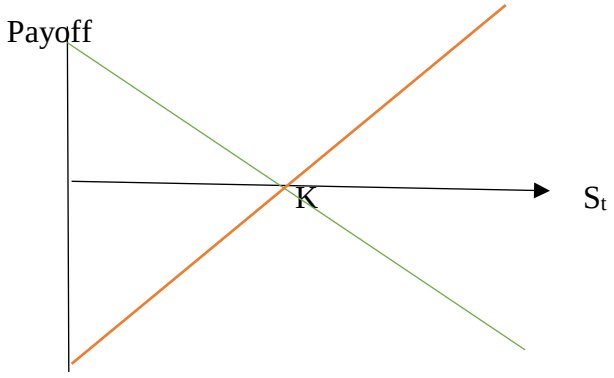
Table 3: Spot and forward rates for EUR/USD on June 18, 2018

	Bid	Offer
Spot rate	1.2105	1.2109
1-month forward	1.2106	1.2111
3-month forward	1.2109	1.2113
6-month forward	1.2115	1.2120

Source: Own elaboration with the use of data from (Hull, 2012)

According to the example above, the long and short position has been shown on the table below.

Table 4: Forward contracts payoff in a long and short position



Source: Own elaboration

In the table above, red line represents long position while green line demonstrates short position. Point "K" identifies delivery price and point "S_t" is the asset price at maturity date of contract.

At the maturity day, if price of the exchange rate increases to 1.30 U.S. dollars for each euro, the forward contract would worth $2.600.000 - $2.424.000= $176.000 to German company. On the contrary, if the exchange rate declines to $1.15 for per EUR, it would be 2.300.000 – 2.424.000 = -$124.000 costed to Germany company. Therefore, payoffs depend on the exchange rate in the specified date and in relation to that, it can cause positive or negative effects to company. (Hull, 2012)

1.5.2 Future Contracts

Future contracts are standardized agreements which put obligation to buyer to buy certain amount of exchange rate which is determined at the date of contract at a specified date in the future. The most significant function of the futures is to protect buyer and seller against increase or decrease in prices. Future contracts are quite similar with forward contracts except from some significant differences.

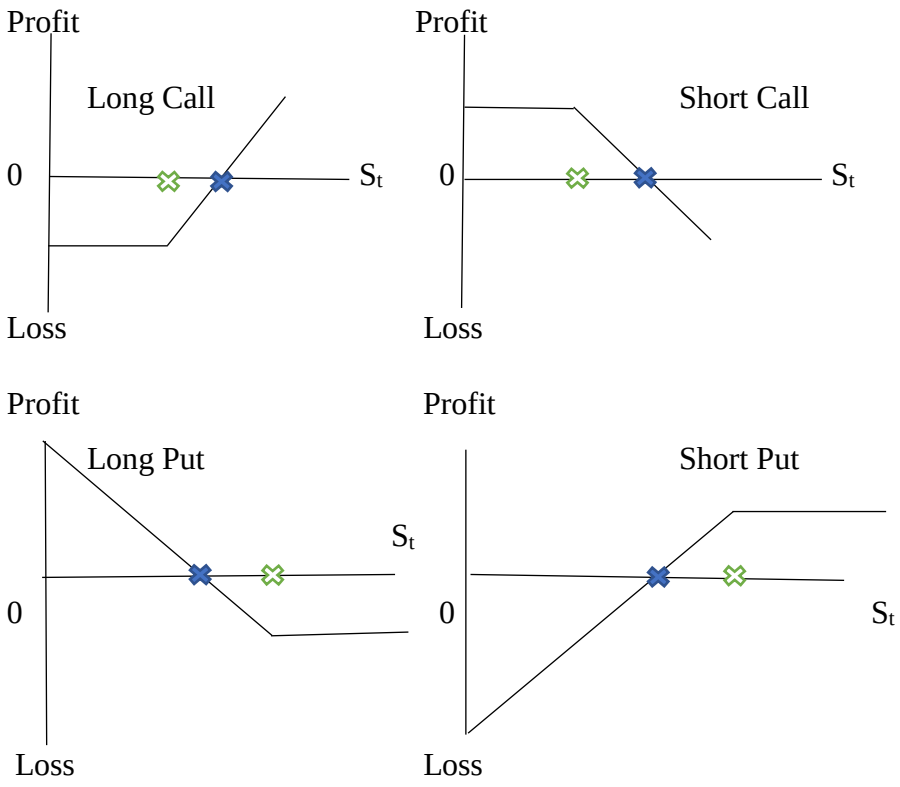
- Forward contracts are a result of negotiation between counterparties. Future contracts are standardized agreements.
- Future contracts are secured by the exchange market while forward contracts include counterparty risk.
- Future contracts are more liquid in comparison with forward contract due to the possibility to be sold to third parties before maturity date.
- Banks play very important role in terms of forward contracts. On the other hand, futures cannot be prepared by any banks.
- Even though both contracts have some differences, there are also some similarities arise from arbitrage opportunities. (Connolly, 2007)

1.5.3 Currency Option

Currency option hedging strategy is one of the most famous strategies to reduce exchange rate risk. The currency option allows buyer to buy or sell certain amount of currency at a specified date. In relation to this, seller receives premium which is cost of buying option. Moreover, currency options do not include any obligation for the parties about buying or selling. In this hedging method, put and call options are two main type of this method. Put option has been determined as an option type which provides right to holder to sell an asset at a specified date.

On the other hand, call option provides right to buy an asset at a specified date with provided strike price. On this point, strike price can be defined as predetermined buy or sell price or an exercise price to be paid for asset when the option was processed. For better understanding, the following graphics show short and long positions of these two types of currency options.

Table 5: Put-Call Options in long and short position



Source: Own elaboration

The graphics represent short, long call and put options at expiration. Firstly, the term (S_t) indicates spot rates. Then, blue cross demonstrates the break-even point where is no profit or loss while green cross shows the strike price. Long and short positions can be defined in a same way as it was mentioned in the forward contracts. In long call, if future or spot exchange rate is bigger than the strike price, it is said that this position is profitable. On the contrary, if the exchange rate or spot rate is less than strike price, it is known as unprofitable long call. In the long put, the option will be profitable when the strike price is greater than future or spot exchange rate price. In relation to this, if spot or future rate is higher than strike price, the option is considered as loss-making. Turning to short put which is also known as uncovered put, it is

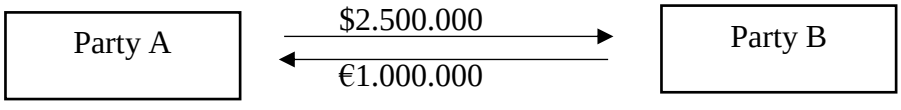
profitable when spot rate is less than strike price and unprofitable vice versa. On the contrary, short call brings profit when spot rate is greater than the strike price and unprofitable vice versa. (Telegraph.co.uk, 2002)

To be clearer, if an importer buys a call option in order to minimize foreign exchange risk and if exchange rate raises noticeably, importer can use the option. On the contrary, if exchange rate reduces, the importer just let the option to have expired. On the other hand, when the exporter situation is considered, if exporter has expectations that domestic currency value would decrease, then exporter would like to buy put option by selling currency to hedge exposure against depreciation in the local currency. In such a case, if exchange rate declines the exporter will use the option. In relation to this, if exchange rate raises, the exporter would not exercise the option. Therefore, as noted by examples, the use of currency options to eliminate exchange rate exposure in economies where uncertainty and risk arise provides significant advantages.

1.5.4 Currency Swaps

Currency swap agreement is a financial instrument which allows to exchange one security with another. Swap agreements can be used against foreign exchange exposure and interest rate risk. In this agreement, two different parties may mutually change different currencies or different interest payments with each other to be protected against exposure. On this point, for example, let's say that party A has U.S. dollars on its account and is willing to exchange those U.S. dollars for euros. On the other hand, there is also party B which has euros on its account and is willing to exchange those euros for U.S. dollars. If we look from this perspective, both parties may mutually agree to change U.S. dollars and euros according to their needs to have currency swap agreement. In that case, it can be said that the reason for currency swap is the real need for funds denominated in other currency. (Kolb and Overdahl, 2003). The following illustrations are examples of how currency swap agreement works and therefore, it will help to better understand the currency swap agreement.

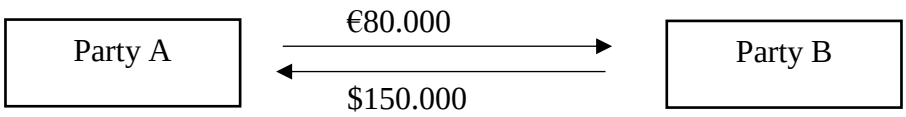
Table 6: Initial cash flow of swap agreement



Source: Own elaboration with the use of data from (Kolb and Overdahl, 2003)

It is assumed that the current exchange rate between euro and U.S. dollars is $2.5 for each euro. At the same time, it is determined that EU interest rate is 8 percent and U.S. interest rate is 6 percent. Moreover, it is assumed that party A has $2.500.000 while party B has €1.000.000. In relation to this, party A is willing to exchange its $2.500.000 dollars for euros. In return to that, party B will pay $1.000.000 against to party A for the swap. Moreover, it is also assumed that swap has 5 years term and interest payments will be made annually. In this case, the interest payments shall be in the following schedule.

Table 7: Swap annual interest rate payment

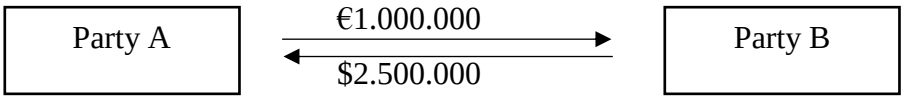


Source: Own elaboration with the use of data from (Kolb and Overdahl, 2003)

Regarding to interest rates, party A will pay 8 percent interest rate for the received euros. Therefore, party A will pay 80.000 euros for each year. On the other hand, party B will pay 6 percent interest rate for received dollars which will be 150.000 dollars for each year. (Kolb and Overdahl, 2003)

After 5 years interest rate payment, the exchanged amounts will be paid back in order to finalize swap agreement.

Table 8: Repayment of currency in the end of 5 years



Source: Own elaboration with the use of data from (Kolb and Overdahl, 2003)

As it can be seen from the tables, initially, two parties mutually agree to do currency swap. Secondly, the parties agree to make interest rate payment for each year until due date of the swap agreement. And finally, both parties pay back the initial amount that they exchanged. (Kolb and Overdahl, 2003)

In this respect, it is evident that to what extent swap agreement is advantageous for both parties where it provides benefits and eliminates risks.

2 Overview of the Turkish economy

The Turkish economy seemed to be optimistic up to a few years ago. However, the political and economic turmoil has rapidly pulled the country's economy to the bottom in recent years. Especially, deep and severe depreciation of the Turkish lira pushes country's economic situation to be on cliff edge. Because of this emerging scenario, all the participants in the economy are very negatively affected. Therefore, this section will start with a general introduction to the Turkish economy. Then, economic analysis will be made to see how much that the foreign exchange rate affects economic indicators. After the observation of how economic indicators have been affected, the last part will provide information about how political developments and shocks cause uncertainty and influence foreign exchange rate volatility in the economy.

2.1 General Overview of Turkish economy

Turkey, officially the Republic of Turkey since 1923, is a country with secular, unitary and previously had parliamentary system which declared presidential system in 2017 referendum. Economically, Turkey is categorized as an emerging market economy according to International Monetary Fund (IMF, 2018). The country has very important strategic location which contributes to development of the country by linking Europe, Middle East and Central Asia in energy sector and logistics (Export.gov, 2019). The country has 82.003.882 residents according to Turkish Statistical Institute in 2018 (TUIK, 2019). Furthermore, Turkey has been a charter member of the UN, member of NATO since 1952 (NATO, 2012), member of IMF since 1947 (Imf.org, 2017), member of World Bank and WTO since 1995 and founding member of the OECD and G20. In addition to that, it is the 13th member state of the Council of Europe since 1950 (Council of Europe, 2019). In addition to that, Turkey is a member state of the EU Customs Union since 1995 and began for accession negotiations with the EU in 2005.

When it comes to exchange rate regimes, fixed exchange rate regime was used in Turkey until 1980. As of 1980 various exchange rate regimes were implemented due to the economic instability and high inflation. In 1999, economic problems became unbearable due to the negative effects of international crises and the earthquake disasters in Turkey. Therefore, Turkey and IMF made a stand-by agreement for three years in order to recover from these negative problems and provide relief in foreign resources. The primary objective of this agreement was determined as to reduce inflation which was recorded over 60 percent and to provide economic

stability by implementing reforms along with the new monetary and exchange rate policy system. (Spk.gov.tr, 2004) Therefore, the crawling peg exchange rate regime has been implemented in conjunction with this agreement. With this system, the exchange rate fluctuates over a certain band, however, if the exchange rate exceeds band limits, the central bank can intervene to the exchange rate. On the other hand, in the beginning of 2000, even though, the regime had economically optimistic expectations, it was realized that this exchange rate system could not produce the desired effect towards end of the year. In addition to that, financial crises took place in early 2001 and the floating exchange rate system has been decided to be implemented by the new reform program. (Spk.gov.tr, 2004)

On this point, it is important to recall that exchange rates are determined by the supply and demand conditions in the market under the floating exchange rate regime. The main factors that determine the supply and demand of foreign currency are (TCMB, 2019):

- Monetary and fiscal policies
- Economic infrastructure
- International developments
- Expectations

Based on the above explained factors, Turkey showed very important economic developments since the beginning of 21st century. However, dramatic changes in foreign exchange rates and political developments caused a recession and instability on the economy in recent years. Therefore, it would be useful to see the position of the country in international trade before the examination of macroeconomic indicators and the impact of sudden exchange rate movements and political developments on the country's economy.

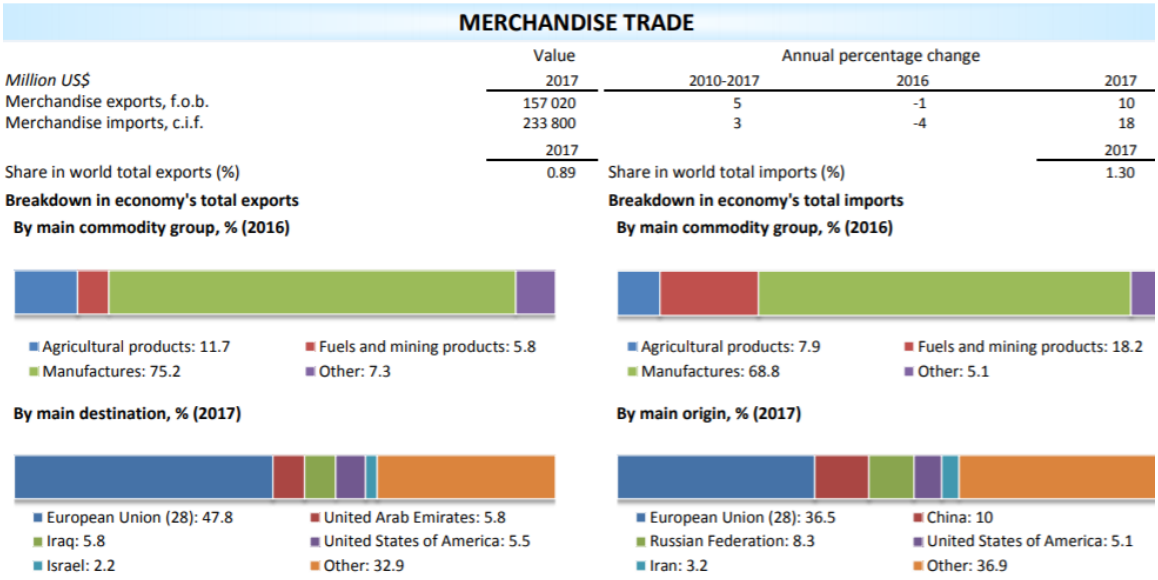
Turkey has a very important position in the world trade. In addition to its strategic location, exports and imports of the country also show how country plays an active role in the world trade. On this point, according to WTO database, Turkey has been ranked as 21st country in merchandise imports, 29th in commercial services exports, 31st in merchandise exports and 40th in commercial services in 2017. Furthermore, the country shared 0.89 percent of total exports and 1.30 percent total imports of the world in the same year. Manufactures have been recorded as the main commodity group with 75.2 percent in total exports and 68.8 percent in total imports

by the year of 2016. In addition to that, European Union has been recorded as the major export partner with almost 50 percent which is followed by United Arab Emirates, Iraq and United States of America respectively 5.8, 5.8 and 5.5 percent. On the other hand, European Union remains as biggest partner on imports when the data is observed for the year 2017. (Wto.org, 2018)

The reason that EU is the number one export and import partner of Turkey is linked to Customs Union Agreement which came into force in 1995. However, the agreement only covers industrial goods, but does not include services, public procurement, agriculture (apart from processed agricultural products). (Ec.europa.eu, 2019)

In line with the given information, figure 5 and 6 provide information about export and import of merchandise trade, agricultural and non-agricultural products in detail.

Figure 5: Merchandise Trade export and import figures of Turkey

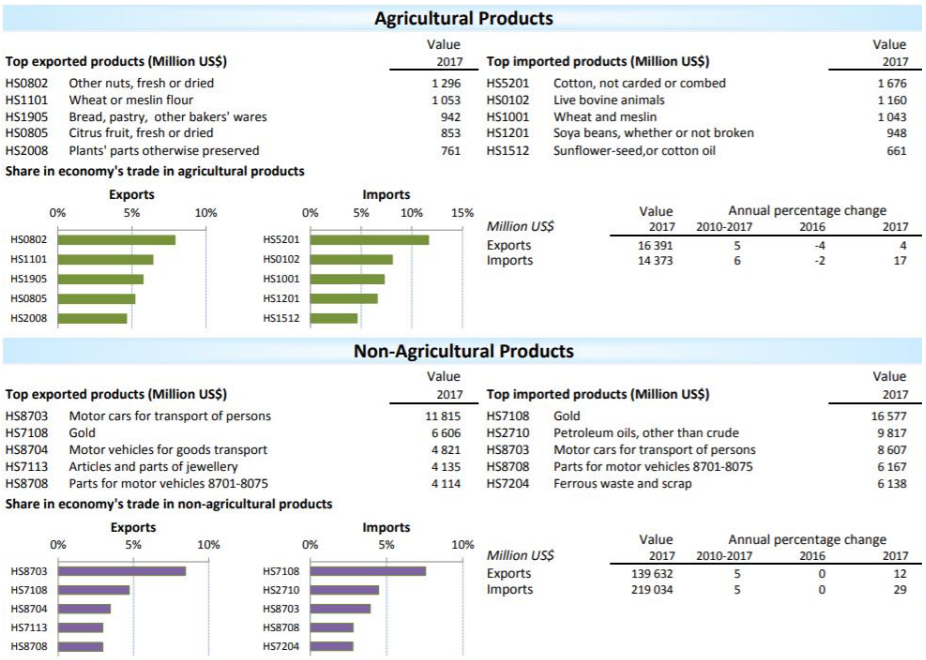


Source: (Wto.org, 2018)

When both illustrations have been compared, it is clearly seen that the share of the merchandise trade in exports and imports have the majority in country trade. However, it is also important to realize that non-agricultural products play an important role in exports and imports of the country. Especially, motor cars for transport of persons in exports with 11.815 million US$ and

gold in imports with 16.577 million US$ in 2017 have significant effect on country total exports and imports.

Figure 6: Agricultural and Non-Agricultural products data in 2017



Agricultural Products

Top exported products (Million US$)		Value 2017
HS0802	Other nuts, fresh or dried	1 296
HS1101	Wheat or meslin flour	1 053
HS1905	Bread, pastry, other bakers' wares	942
HS0805	Citrus fruit, fresh or dried	853
HS2008	Plants' parts otherwise preserved	761

Top imported products (Million US$)		Value 2017
HS5201	Cotton, not carded or combed	1 676
HS0102	Live bovine animals	1 160
HS1001	Wheat and meslin	1 043
HS1201	Soya beans, whether or not broken	948
HS1512	Sunflower-seed,or cotton oil	661

Share in economy's trade in agricultural products

Million US$	Value 2017	Annual percentage change 2010-2017	2016	2017
Exports	16 391	5	-4	4
Imports	14 373	6	-2	17

Non-Agricultural Products

Top exported products (Million US$)		Value 2017
HS8703	Motor cars for transport of persons	11 815
HS7108	Gold	6 606
HS8704	Motor vehicles for goods transport	4 821
HS7113	Articles and parts of jewellery	4 135
HS8708	Parts for motor vehicles 8701-8075	4 114

Top imported products (Million US$)		Value 2017
HS7108	Gold	16 577
HS2710	Petroleum oils, other than crude	9 817
HS8703	Motor cars for transport of persons	8 607
HS8708	Parts for motor vehicles 8701-8075	6 167
HS7204	Ferrous waste and scrap	6 138

Share in economy's trade in non-agricultural products

Million US$	Value 2017	Annual percentage change 2010-2017	2016	2017
Exports	139 632	5	0	12
Imports	219 034	5	0	29

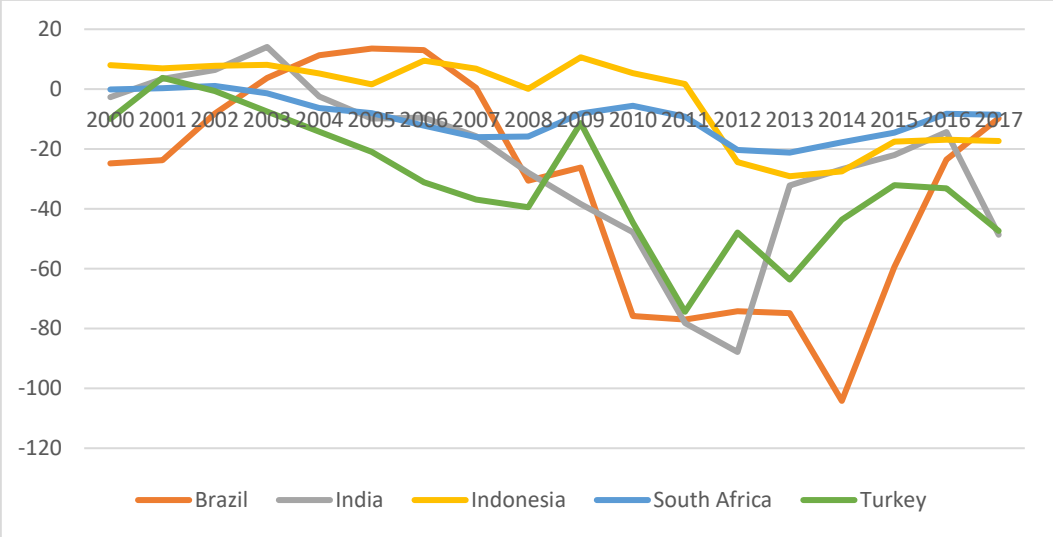
Source: (Wto.org, 2018)

2.2 Analysis of Macroeconomic Development and Current Economic Status

Turkish economy has performed remarkably good economic growth in recent years. Even though Turkey has been recognized as having good economic conditions, according to some reports published by various organizations, the country is shown as fragile economy among emerging markets. On this point, when the macroeconomic indicators have been analyzed, initially, Morgan Stanley's report gives information why Turkey is categorized as fragile economy. According to report, Turkey is recognized as a country in the ''Fragile Five'' category. The Fragile Five countries are defined as Brazil, India, Indonesia, South Africa and Turkey in the report. This report puts forward that emerging markets are dependent on foreign investment to finance their growth targets. It is also stated in the report that these countries have high and increasing current account deficits in common. Besides the increasing current account deficit, high inflation rate and decreasing growth rates are also other factors which pull these countries into the Fragile Five group. (Morgan Stanley, 2013). On the other hand, S&P credit

rating agency also came up with a new Fragile Five group which includes Turkey, Pakistan, Argentina, Egypt and Qatar in 2017. In keeping with this report, the main reason to categorize these countries in this group was the increasing interest rates. (S&P Global Ratings, 2017) Even though, new Fragile Five group has been categorized with new countries in the S&P report, the Morgan Stanley's report still remains as the most recognized one.

Figure 7: Fragile Five countries current account balance in U.S. dollars (in Billions)

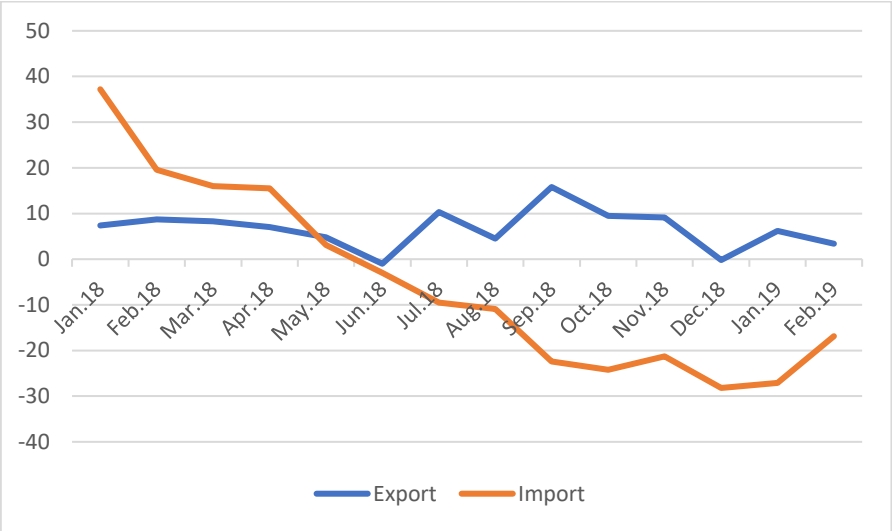


Source: Own elaboration with the use of data from (Data.worldbank.org, 2019)

In relation to Morgan Stanley report, as far as current account balance is considered, it can be clearly observed from figure 7 that Fragile Five economies experienced large current account deficit between 2000 and 2017. In addition to that, current account deficit increased year by year as it was also reported by Morgan Stanley. According to given line chart, India and Turkey have highest deficit of 2017 in the group. From the perspective of Turkey, while current account deficit recorded 47.347 million in 2017, the deficit decreased to 27.813 million dollars in 2018 (Tcmb.gov.tr, 2018). The main reason of this decline results from the dramatic appreciation of foreign currencies against Turkish lira. On this point, these movements caused substantial decrease in imports of the Turkey. In relation to that, depreciation of Turkish lira led to increase in exports, then at the same time, the current account deficit started to decline due to the increased exports and falling imports. Therefore, it also becomes important to analyze change in the export and import figures from the perspective of Turkey in order to figure out how much

exports and imports changed and influenced current account balance. Accordingly, following figure demonstrates changes of the imports and exports rates between 2018 and 2019 in Turkey.

Figure 8: External trade change on the same months of the preceding year in Turkey between 2018 and 2019 (%)



Source: Own elaboration with the use of data from (Ticaret.gov.tr, 2019)

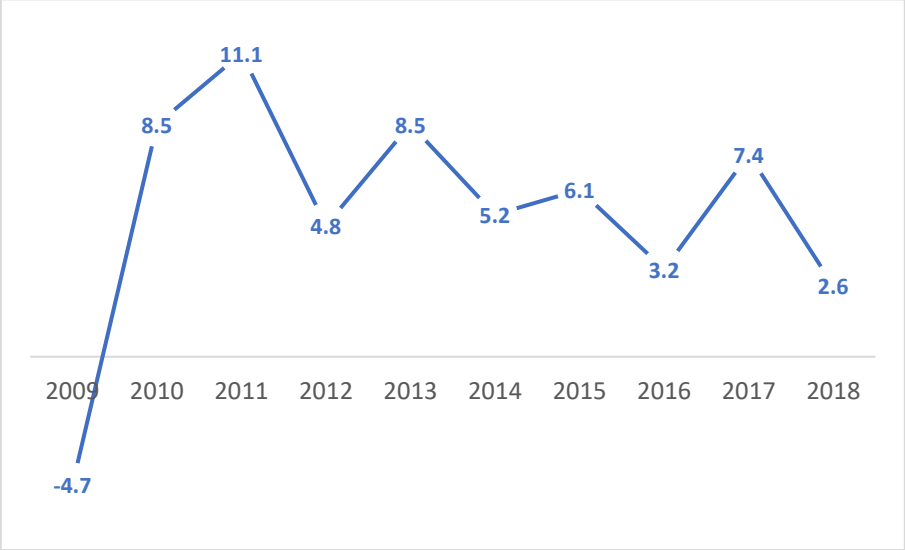
In accordance with the figure, TUIK press release indicates that country exports went up by 6.2% in January 2019 and 3.4% in February 2019 when it is compared with 2018. On the other hand, it is clear from the data that imports of the country declined significantly during the year 2018 when it is compared to previous year 2017. Based on Republic of Turkey Ministry of Trade data, in this context, exports have been recorded as 13 billion 593 million dollars with a 3.4% rise while imports were 15 billion 727 million dollars with a 16.9% reduction in February 2019 in contrast to February 2018 (Ticaret.gov.tr, 2019). In relation to that, TUIK press release also gives information on top imported and exported countries. It is stated by the press release that the main export partner was Germany with 1 billion 225 million dollars. It was chased by the United Kingdom with 857 million dollars which is followed by Italy and Spain respectively 815 million dollars and 741 million dollars. On the other hand, top import partners have been recorded as Russia with 1 billion 577 million dollars, China with 1 billion 371 million dollars, Germany and USA with 1 billion 347 million dollars and 842 million dollars, respectively. (TUIK, 2019). In line with given information, it is also expected that exports will keep growing

in the next periods and create optimistic expectations for the future in Turkish economy. (BloombergHT, 2019)

As stated previously that Turkish economy has optimistic expectations for the current account deficit in the future, however, it is not seen as much optimistic as for the GDP growth rate. For years on end, Turkish economy recorded very good growth rates. Nevertheless, the economy sounds alarm bells and faces major challenges in recent years. Particularly, sudden fluctuations in exchange rates causes negative effects on the growth rate and other important indicators.

Based on previous information, it is apparently seen from figure 9 that Turkish economy experienced rapid ups and downs in economic growth during last 10 years. On this point, the second lowest growth rate has been recorded in 2018. The negative effects of exchange rate volatility are also seen in press releases of governmental institutions.

Figure 9: GDP Growth Rate 2009-2018 in Turkey (Annual %)

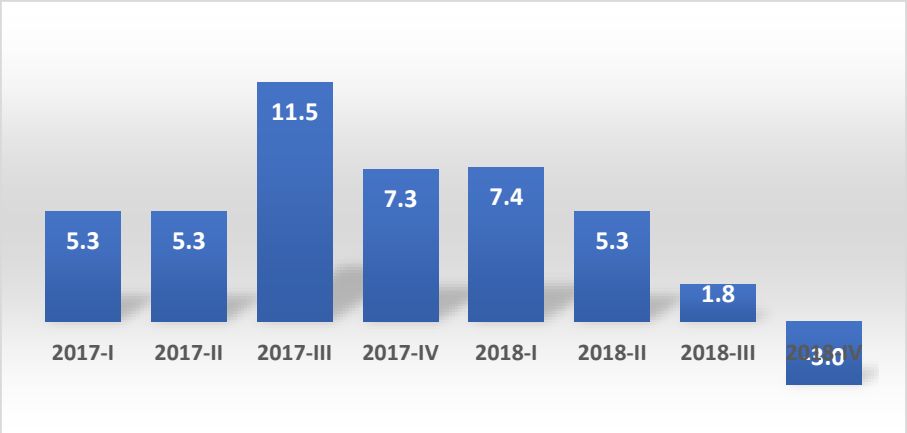


Source: Own elaboration with the use of data from World bank and Tuik

According to Turkish Statistical Institute press release, Gross Domestic Product increased 2,6 percent in 2018 and reached 700 billion 989 million TRY, on the contrary, GDP declined by 3 percent in the last quarter of 2018 compared with 2017 which can be seen from figure 10. Particularly, it has been recorded drop by 0.5% in agricultural, 8.7% in construction, 6.4% in industry and 0.3% in services sector.

Furthermore, the press release also represents that final consumption expenditures of households rose by 1.15% in 2018 compared to 2017. However, final consumption expenditures of households dropped by 8,9% in the last quarter of 2018. In addition to that, exports of goods and services have been recorded with an increase by 7.5% and imports declined by 7.9% in 2018 compared to previous year data. (TUIK, 2019)

Figure 10: GDP Growth rate quarterly between 2017 and 2018 (%)



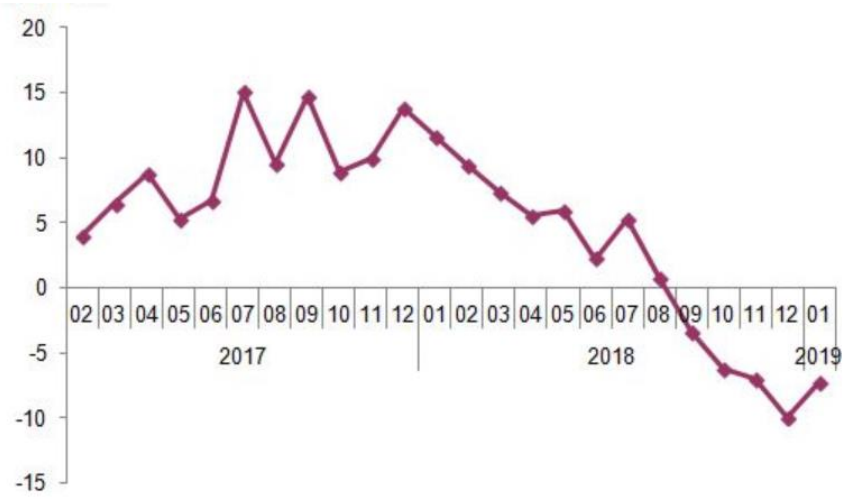
Source: Own elaboration with the use of data from Turkish Statistical Institute

When Turkish lira dropped by 30 percent against US dollar in August 2018, imports became nearly a third unaffordable. On this point, the Central Bank of Turkey increased interest rates which made borrowing costly. Therefore, many sectors such as housing sales have been affected very negatively and consequently industrial production considerably fell and caused a sharp decrease in economic growth which can be seen in last quarter of 2018.

On the other hand, depreciation of domestic currency also caused very serious decline in domestic demand. Particularly, industrial production and capacity utilization rate of manufacturing industry experienced sharp decrease in last years.

The dramatic changes in industrial production and capacity utilization rate of manufacturing industry can be observed from the next two line charts.

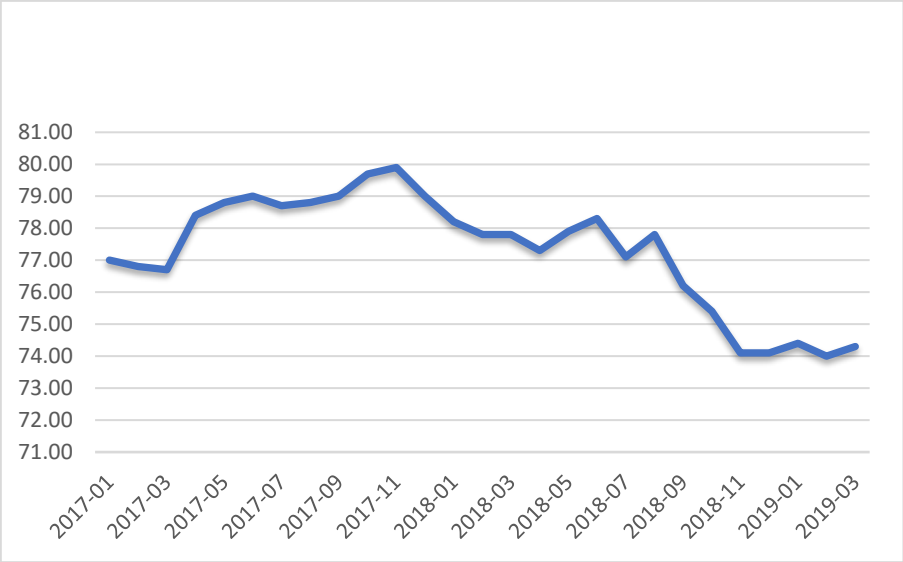
Figure 11: Industrial Production Index between 2017 and January 2019 (Annual %)



Source: Own elaboration with the use of data from Turkish Statistical Institute

The dramatic decrease of industrial production in 2018 is evident from the chart above. In relation to this, the industrial sector reduced its capacity utilization in line with the decline in demand, and therefore resulted in a decline in production.

Figure 12: Capacity utilization rate of manufacturing industry between 2017 and March 2019

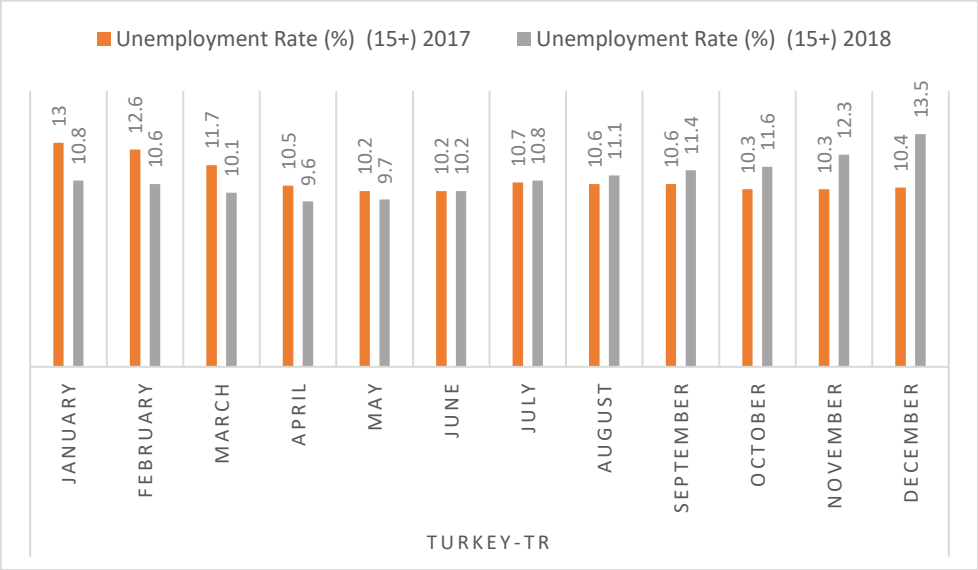


Source: Own elaboration with the use of data from Central Bank of the Republic of Turkey

Afterwards, the development of exchange rates in recent years will be examined in detail. Even so, the domino effect of increasing rate of exchange rates is shown in the provided figures.

Regarding to this, it is seen that GDP growth rate has similar tendency as industrial production and capacity utilization rate of manufacturing in the same quarters which can be observed when previous three figures have been analyzed. Additionally, we also see the impact of lower industrial production and capacity utilization rate of manufacturing on the unemployment rate.

Figure 13: Unemployment Rate between 2017 and 2018 based on monthly data



Source: Own elaboration with the use of data from Turkish Statistical Institute

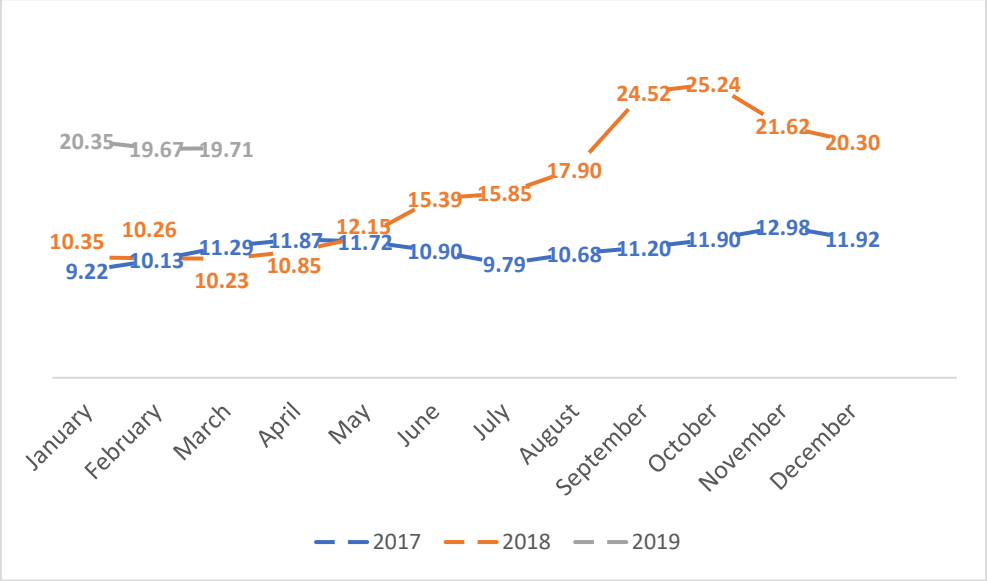
From the perspective of unemployment, the column chart clearly shows that unemployment rate began rising after June and reached a peak of 13.5 percent in December 2018. In accordance with this, TUIK reveals in the report that unemployment continued to rise by increasing 1 million 11 thousand people in 2018 and reached in total of 4 million 302 thousand unemployed people. In addition to that, it can be recognized that unemployment rate expectation will not be optimistic for future when supplied industrial production and gross domestic product diagrams have been analyzed. (TUIK, 2019)

Besides previously mentioned factors, the effects of increasing exchange rates are not only seen in the economic growth and external trade, but also seen in inflation. Therefore, inflation becomes very important factor to take into consideration in the Turkish economy.

When it comes to comparison of data for unemployment and inflation, the relationship between inflation and unemployment in the economy is explained by so-called 'Philips curve'. According

to the Philips curve, the decline in inflation creates an increase in unemployment. Nevertheless, theory and facts in the economy do not always overlap. In economic theory, it is generally assumed that the variables remain constant. This may in fact mean disregarding the dynamics in the economy from time to time. According to figure 14, it is evident that consumer prices increased more than double in September and October 2018 when it is compared with 2017. In relation with the provided data, the inflation rate in October 2018 has been recorded as the highest in last 15 years.

Figure 14: Consumer Price Index 2017-2019 monthly rate of change (%)

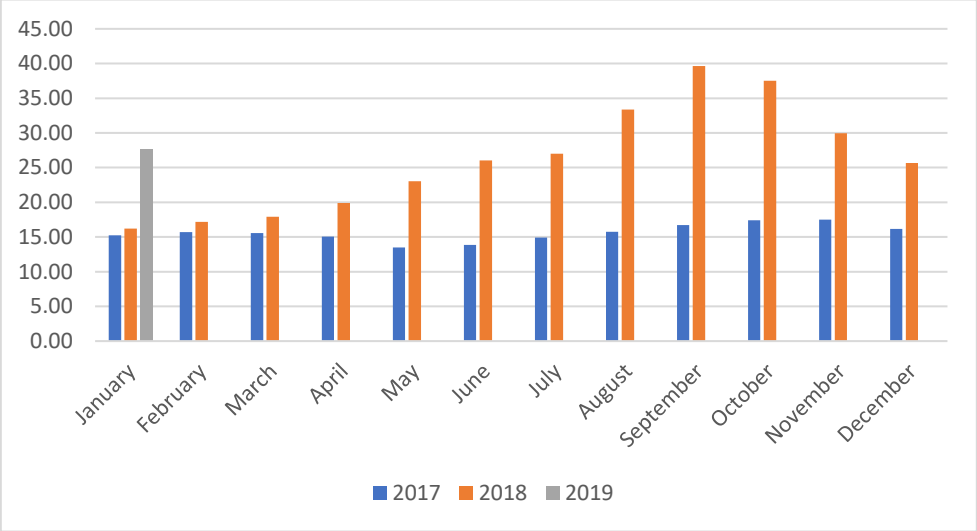


Source: Own elaboration with the use of data from Turkish Statistical Institute

However, in our case, we can see that unemployment and consumer price inflation did not overlap. In relation to this, the direct proportion between unemployment and consumer price index can be recognized from given figures. After the analysis of the increase in costs of production, it will be better understood why direct proportion has been recorded between unemployment and inflation.

In relation to inflation, when it comes to construction sector which touched the lowest growth rate in the last quarter of 2018, construction costs increased considerably in 2018 compared to 2017 which can be observed from following figure.

Figure 15: Construction cost index and rate of change from 2017 to January 2019



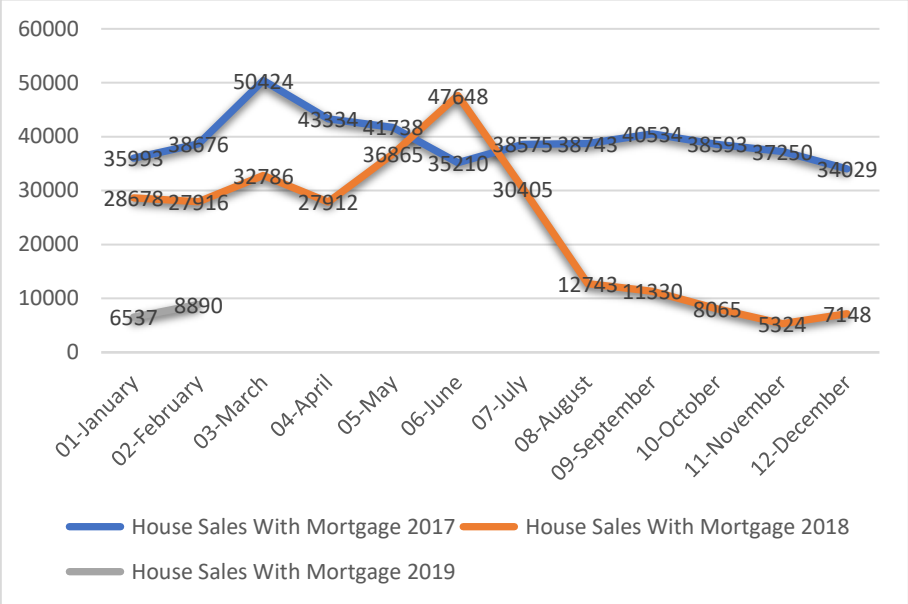
Source: Own elaboration with the use of data from Turkish Statistical Institute

In the same way, house sales with mortgage went down in 2018 when it is compared with 2017. In terms of house sales statistics, it is evident from the figure 16 that sales declined in last two years and experienced lowest numbers in the end of 2018. Moreover, construction cost and rate of change index also indicates that September experienced the highest construction costs in 2018, and therefore, house sales statistics hit the bottom by recording 5324 sales in November 2018. Similarly, it is also seen from the figure 14 that consumer price index has a tendency nearly the same as construction cost index.

From this point of view, it has been noticed that the increase in costs adversely affected production and consequently negatively affected sales. In this context, increase in prices caused inflation which led contraction in domestic demand. Therefore, it can be understood that it is not surprising finding direct proportion between unemployment and inflation in such a case.

Even though inflation has a large share in the decline of house sales, there are also other factors which influence house sales. In common, bank loans in other words mortgage loans for houses play very crucial role for sales of houses in Turkey. The given line chart shows that house sales with mortgage decreased in January 2018 from 35 993 to 28 678 when it is compared with previous year. Moreover, it is also noticed that the sales have been recorded as 6537 in January 2019 which is almost five times less than previous year. Therefore, it is also important to take consideration of loan interest rates.

Figure 16: House Sales Statistics between 2017 and 2019



Source: Own elaboration with the use of data from Turkish Statistical Institute

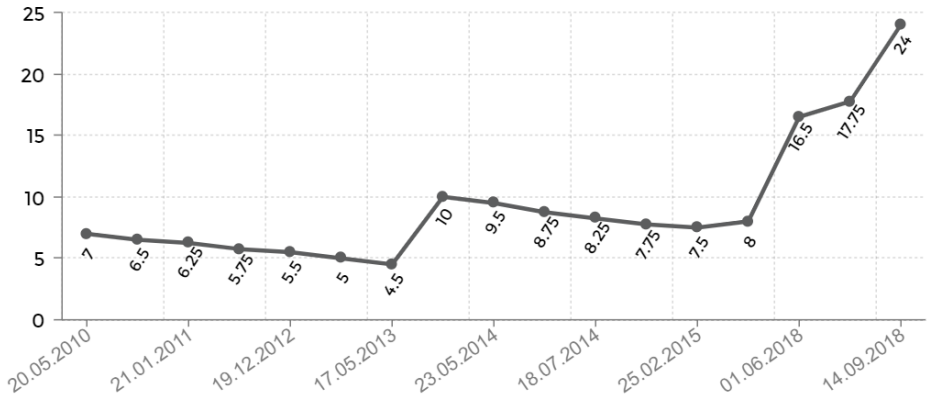
In relation to previously given information, Association of Turkish Construction Material Producers published in February 2019 report which states that mortgage loans interest rates are close to 2 percent on monthly average which leads to reduction in the demand of house sales in 2019. Therefore, according to the report, it is indicated that downward trend in house sales with mortgage is expected to continue throughout 2019. On this point, the report asserts also that there are some other factors which influence this negative situation in housing sector. In accordance with this, it is stated that high exchange rates and high interest rates made more difficult to reimburse current bank loans. Therefore, reduction in demand and sales caused also reduction in cash flows of the companies. In relation to this, the need of working capital rose due to increasing construction costs. Consequently, contractors point out these financial problems which were created by these financial constraints as the most significant barrier to restricting activities in the construction sector. (Association of Turkish Construction Material Producers, 2019)

As far as interest rates are concerned in relation to the previous paragraph, Central Bank of the Republic of Turkey has decided to raise the one-week repo benchmark interest rate from 17.75 to 24 percent in September 2018. Since September 2018, Turkey has the second highest central bank interest rate after Argentina among G20 countries. (Tradingeconomics.com, 2019)

When the report of the Turkish Central Bank has been analyzed to find the reason behind that decision, sharp increases in exchange rates have been reported as one of the main reasons of interest rate decision. According to the Central Bank, the decision was taken due to "*the recent developments regarding the inflation outlook point to significant risks to price stability".* The press release also indicates some other important points regarding to increase in the interest rate (TCMB, 2018);

- Domestic demand shows downward trend even external demand keeps its strong position
- Price increases have a generalized trend based on sub-items due to exchange rate movements
- The deterioration in pricing behavior continues to show an upward risk on the inflation outlook. (Tcmb.gov.tr, 2018)

Figure 17: Central Bank benchmark interest rates between 2010 and 2018 in Turkey (%)



Source: Own elaboration with the use of data from Central Bank of the Republic of Turkey

On this point, based on Central Bank press release, it becomes crucial to look at the changes on the interest rates in previous years to see the impact of exchange rate volatility. Therefore, the line chart 17 can be analyzed to see the development of interest rate between 2010 and 2018. As is observed, the interest rate dramatically increased and hit the peak in 2018. However, when the previous years have been analyzed, it is interesting to note that interest rates have been recorded less than 10 points in previous years. In relation to that, such increase in interest rates

also raises many questions marks regarding how the economy will be affected. When Central Bank raises the interest rates in order to take inflation under control, the policy is so called ‘‘Contractionary monetary policy’’. Therefore, we see that Turkish Central Bank has taken the same action in order to control inflation and exchange rates. In relation to that, possible consequences of such an action are described in the table 9 as it is below.

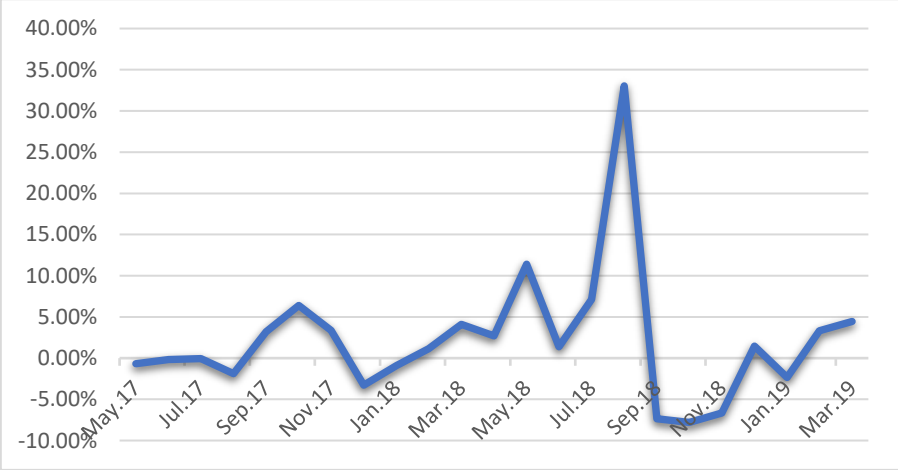
Table 9: Possible consequences of higher interest rates in the economy

Increase in savings	→	Decrease in investments
Appreciation in domestic currency	→	Depreciation in foreign currency
Slowdown in economic growth	→	Decrease in production
Higher interest rates on bank loans	→	Higher cost of borrowing money

Source: Own elaboration

From the perspective of exchange rates, the impact of the interest rate decision can be analyzed on the following figure.

Figure 18: Development of USD/TRY from 2017 to March 2019 in Turkey



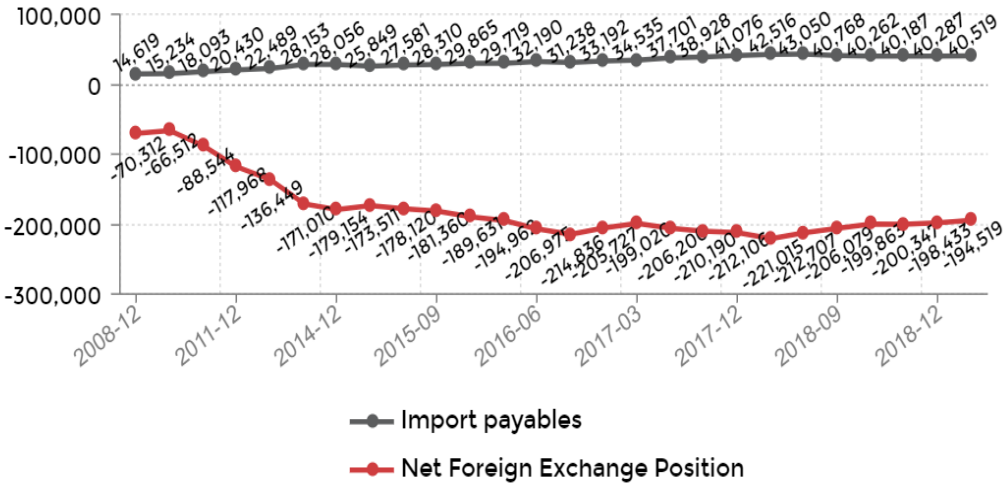
Source: : Own elaboration with the use of data from (Investing.com, 2019)

The given line chart illustrates information about change in USD/TRY commencing from May 2017 to March 2019. At a first glance, it is evident that USD depreciated against TRY enormously in September 2018. On the other hand, another dramatic depreciation of USD can be seen in May 2018. The main reason of these substantial changes was the consequence of the decisions to raise policy interest rate which was taken by the Central Bank of Turkey in May 2018 and September 2018. In relation to this, the interest rate decision has been taken by the

Central Bank to stabilize Turkish lira against foreign currencies. On this point, it can be said that it is positive that Turkish lira appreciated against foreign currencies, however, high interest rate may lead negative economic problems in the long term especially in a country, which faces with many political and economic difficulties.

When we look at the developments in the Turkish economy that were analyzed, we can clearly see the impact of dramatic increases of exchange rates on the high inflation, declines in the growth rate, increase in costs and interest rate. Starting from this point of view, it is explicitly observed that how the jumps in exchange rate will create domino effect in the economy and produce many negative results. Accordingly, it is also important to see to what extent these negative effects can influence private sector.

Figure 19: The development of import payables and net foreign exchange position in the private sector over the years in Turkey (Million USD)



Source: : Own elaboration with the use of data from Central Bank of the Republic of Turkey

As is presented in the line chart, the external debt of the private sector increased over the years. Even if there is a slight rebound in the last period, the increase in the exchange rate continues to affect companies quite negatively. In addition to that, high interest rates make it even more difficult for companies to pay their debts by borrowing. On the other hand, when import payables were analyzed, it is also seen from the data that import payables almost trebled in last

ten years. In this context, it becomes very difficult to overcome to finance import payables for the private sector companies in foreign currencies due to the obtained income denominated in Turkish lira. Therefore, if companies do not have any insurance, such as hedging strategies that were mentioned before, against debt denominated in foreign currencies, they will not be able to pay their debts when exchange rate raised dramatically. Considering these developments caused by volatility in foreign exchange rates, it is clear how important it is for companies and states to forecast foreign exchange rates. However, it is also important to investigate the impact of political policies on this uncertainty. Therefore, the impact of political decisions on exchange rates is examined in the next section.

2.3 Impact of political decisions on Exchange Rates

In the previous chapters, we examined how the economy derailed due to exchange rate volatility. The reason for this is not only that economic factors trigger each other, but also the impact of sudden changes in political directions. Based on the analyzed data before, let's take a closer look at the changes in the exchange rates experienced by the Turkish economy in recent years.

Figure 20: Development of USD/TRY exchange rate between 2010-2019 in Turkey

Source: : Own elaboration with the use of data from Central Bank of the Republic of Turkey

The given chart above shows the development of Turkish lira in the last ten years. When the chart has been analyzed, we see the biggest splash in 2018 at first glance. Moreover, it is also seen that sudden rises have occurred in various years. In relation to this, we have emphasized previously how these sudden increases have affected many factors in the economy negatively.

However, it is important to emphasize the negative consequences of these sharp increases in the exchange rate, as well as the reasons behind these sharp increases. In relation to this, when the daily exchange rate movements taken from the Central Bank's website were examined between the dates 2017 and 2019, there can be seen that some dates experienced dramatic changes. The table below presents the reasons for some of these changes.

Table 10: Examination of the developments in the exchange rate of USD/TRY between 2017 and 2019

Dates	**Open**	**Close**	**Reason of Movement**
01.01.2017-31.01.2017	3.52	3.83	Extension of the state of emergency
01.02.2017-28.02.2017	3.79	3.59	Central Bank interventions
01.03.2017-31.03.2017	3.61	3.64	No significant change
01.04.2017-30.04.2017	3.64	3.56	No significant change
01.05.2017-31.05.2017	3.55	3.56	No significant change
01.06.2017-30.06.2017	3.53	3.51	No significant change
01.07.2017-31.07.2017	3.52	3.53	No significant change
01.08.2017-31.08.2017	3.52	3.44	No significant change
01.09.2017-30.09.2017	3.44	3.57	No significant change
01.10.2017-31.10.2017	3.55	3.77	U.S. suspends visa services in Turkey
01.11.2017-30.11.2017	3.78	3.95	Increasing political concerns
01.12.2017-31.12.2017	3.94	3.81	US-Turkey lifting visa restrictions
01.01.2018-31.01.2018	3.77	3.78	The effect of US-Turkey lifting visa restrictions
01.02.2018-28.02.2018	3.75	3.78	The effect of US-Turkey lifting visa restrictions
01.03.2018-31.03.2018	3.80	3.99	The impact of developments in global markets
01.04.2018-30.04.2018	3.95	4.05	The impact of developments in global markets
01.05.2018-31.05.2018	4.04	4.48	Political and economic concerns
01.06.2018-30.06.2018	4.48	4.61	Political and economic concerns (elections)
01.07.2018-31.07.2018	4.56	4.89	U.S. sanctions threat against Turkey
01.08.2018-12.08.2018	4.90	5.40	Action on sanctions
13.08.2018-14.08.2018	5.94	6.88	U.S. doubles tariffs on steel and aluminium
15.08.2018-31.08.2018	6.55	6.41	No significant change
01.09.2018-30.09.2018	6.55	6.08	Decision of Central Bank to increase interest rates
01.10.2018-31.10.2018	5.99	5.52	Positive political developments
01.11.2018-30.11.2018	5.50	5.16	Impact of positive news
01.12.2018-31.12.2018	5.16	5.26	No significant change
01.01.2019-31.01.2019	5.28	5.28	No significant change
01.02.2019-28.02.2019	5.21	5.29	No significant change

Source: Own elaboration with the use of data from Central Bank of the Republic of Turkey

As can be seen from the table above, the first significant increase in the foreign exchange rate took place in the first month of 2017. As a result of the research, it was found that the reason for

this was due to the announcement that the state of emergency would be extended (Official Gazette of the Republic of Turkey, 2017). The state of emergency decision had been taken due to failed coup attempt on July 15, 2016. From that time, Turkey maintained state of emergency and Turkey's parliament approved extension the state of emergency for three more months in January 2017 (DW.COM, 2019). Therefore, the taken decision led to depreciation of Turkish lira against U.S. dollar. In the following month, the Central Bank of Republic of Turkey took some actions against appreciation of U.S. dollar against Turkish Lira which led a decline in foreign exchange rate.

On the other hand, it is seen that there is no significant change from March 2017 to the end of September 2017. However, significant changes are seen in exchange rate starting from October 2017. In October, U.S. decided to suspend visa services in Turkey after U.S. consulate employee has been arrested in Istanbul. After U.S. statement, Turkey declared also that application in visas, e-Visas and visas acquired at the border have been suspended for U.S. citizens due to the reciprocity principle (CNN, 2017). Therefore, the relationship between Turkey and U.S. hit Turkish lira and caused dramatic decrease in currency value. The effects of the decisions continued in September and the Turkish lira remained in negative tendency against other currencies.

When we turn to the developments which were occurred in December 2017, we see that the exchange rates tend to fall and remain almost stable in January and February 2018. In relation to this, U.S. and Turkey decided to lift visa restrictions after consultations in December 28, 2017 (U.S. Department of State, 2017). Because of that, U.S. dollar started depreciating against Turkish lira in following months. Despite this, we see that in March and in April of 2018, Turkish lira started depreciating again. The reason for this is that the Turkish lira in general is very fragile and appears to be influenced by the additional customs duties on the steel and aluminium imports statement which was introduced by the American President Trump in early March 2018 (Cbp.gov, 2018).

In May and June 2018, it is obviously clear that dramatic decline in Turkish lira has been recorded. In relation to this, general and presidential election took place in June. Due to the

importance and uncertainty of this election, the domestic currency depreciated in these two months before elections. (the Guardian, 2018)

On the other hand, when we look at the developments since July 2018 it is clearly seen how political relations are critical to the country's economy. In July, the President of the U.S. stated that large sanctions will be imposed on Turkey if U.S. citizen Pastor Andrew Brunson will not be released (Bloomberg.com, 2018). In this context, U.S. Department of the Treasury announced some sanctions against Turkey's Minister of Justice and Minister of Interior on 1st of August 2018 (Home.treasury.gov, 2018). In addition to that, on 10 August 2018, the President of the United States announced the imports duties will be doubled on aluminium and steel imported from Turkey (Reuters.com, 2018). After these sanctions announced, Turkish lira experienced the worst depreciation and broke the record of all time with 30 percent of the value loss in August 2018.

After sharp increases, it can be observed from the table significant declines recorded in September 2018. In relation to that, the Central Bank of Republic of Turkey increased policy interest rate from 17.75 percent to 24 percent because of substantial increase of foreign exchange rates. The consequences of this decision are seen in the value of Turkish lira in September. In addition to that, Turkish lira kept rising in value against U.S. dollar after Turkish court ordered the release of Pastor Brunson on 12 October 2018. Therefore, Turkish lira kept recovering the rest of the year after positive news and Central Bank's interventions. (United States Commission on International Religious Freedom, n.d.)

With respect to provided table data, it is explicitly observed that political decisions can affect the country's economy quite positively or negatively. As it can be seen from the examined facts, Turkey has tendency to be affected in a deep way by the developments both inside and outside the country, and this causes pressure on the Turkish lira. These facts also shed light on why the Turkish economy has been shown among fragile economies. For this reason, it is important to note that why the Turkish economy should be examined together in the way of economically and politically. As all data highlighted previously how economy is affected by exchange rates, it can be observed that changes in the value of currency may affect all the factors in the economy. Sudden and high-frequency changes in the exchange rates can influence inflation, interest rates,

employment, country's exports and imports and financial position of the companies in the private sector.

As a result, Turkish economy as a fragile economy, can be easily affected by internal and external factors. Therefore, it is very important to get secured against foreign exchange rate risk. In relation to this, even though derivatives provide an insurance against exchange rate volatility, the next part of the thesis will investigate the methods of modeling and forecasting exchange rate volatility by the help of ARCH and ARIMA model to minimize the exchange rate risk.

3 Case study on Turkish Economy: Modelling and forecasting foreign exchange rate volatility

Emerging countries have an economically fragile structure and are more likely to be affected by internal or external political and economic developments than developed countries. Particularly, the Turkish economy reveals its fragile structure among the emerging market economies with the negative impact of the exchange rate shocks that has been experienced in recent years. In the light of this, modelling and estimating methods have become much more important against volatile structure of the exchange rates. In this point, time series play an important role for modelling and forecasting of any variable.

3.1 Time Series Models

Time series is an observation set where each one variable recorded at a specific time. (Brockwell and Davis, 2002). In relation to this, time series can be employed for any variable which experience changes at a specific period. The usage of time series is seen frequently in statistics, mathematics, engineering and econometrics. In accordance with this, time series can be modelled, analyzed and forecasted. The modelling of time series is usually made to see the effect of employed method for the applied variable while the analysis is made to see how the variable changes over time. On the other hand, forecasting is made to estimate future tendency of the employed variable.

3.1.1 Box-Jenkins Method

Box-Jenkins method is very well-known time series method. The method has been developed by George Box and Gwilym Jenkins to forecast future values of variables by using historical data and error terms. In addition to that, Box-Jenkins approach is known as a combination of autoregressive models and moving average models to model univariate time series. Under Box-Jenkins method, AR, MA, ARMA or ARIMA models can be used depend on stationarity.

Box-Jenkins methodology includes four steps. In the first step, model identification is made to see whether the time series is stationary or not. According to stationarity, the model selection is made. Then, in the second step, parameters for the model is determined. In the next step, determination is made to see whether the selected model with parameters is adequate or not.

After that, in the final step, the selected model is used for forecast. Before starting Box-Jenkins methods it is better to define the meanings of some terms.

Regression: Regression is a statistical analysis which measures the strength of the relationship between a dependent variable and one or more independent variables. Basically, it indicates how much the dependent variable changes when one of the independent variable changes, while the others remain constant**.** There are two types of regressions which are linear and multiple linear regression. In linear regression, outcome of the dependent variable is estimated according to one independent variable. On the other hand, more than one independent variable is used used to estimate dependent variable outcome.

Variance: Variance refers distribution of a series around the mean. Basically, it measures how far is each variable from the mean.

Covariance: The covariance term explains the movement of mean values of two variables. If covariance is positive, then it means two variables move together. If two variables move in the opposite direction, then covariance would be negative.

Conditional variance: It is a random variable variance denoted the value of one or more other variables.

Correlation: It is a statistical term which refers how two or more variables fluctuate in relation to each other.

Error term: It is a variable in a statistical model that is generated when the model does not show current relationship between dependent variable and independent.

3.1.2 Autoregressive Model (AR)

In relation to Box-Jenkins, an autoregressive model is a linear regression of the current value of the series (Y_t), which does not only depend on previous period (Y_{t-1}), but also two or more periods. Therefore, the model is defined as autoregressive process of order (p) which is represented below. (Box, Jenkins and Reinsel, 2008)

$$AR(p) \Rightarrow Y_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \ldots + \phi_p Y_{t-p} + a_t$$

In the model, Y_t represents time series, ϕ model parameters and coefficient, a_t is white nose which is random component of the data where variables are independent with a mean of zero and μ determined as the level of the process. (Box, Jenkins and Reinsel, 2008)

According the given explanation, the given time series Y_t follows first order of AR process which is represented as AR(1). AR(1) means that the present value is based on the previous value where μ and $-1 < \phi < 1$ are constants. The AR(1) equation is shown below. (Box, Jenkins and Reinsel, 2008)

$$AR(1) \Rightarrow Y_{t=} \mu + \phi_1 Y_{t-1} + a_t$$

Therefore, AR(2) would represent the process of the present value based on preceding two values.

3.1.3 Moving Average (MA)

Moving average is another model which is linear regression of current value of the series which does not only depend on previous period but also two or more periods against random shocks. Therefore, the model is called moving average (MA) process of order q which is represented below. (Box, Jenkins and Reinsel, 2008)

$$MA(q) \Rightarrow Y_t = \mu + \theta_1 a_{t-1} + \theta_2 a_{t-2} + \ldots + \theta_q a_{t-q} + a_t$$

In this model, Y_t represents time series, θ represents model parameters, a_t is white nose which is random component of the data where variables are independent with a mean of zero and μ determined as the level of the process. (Box, Jenkins and Reinsel, 2008)

3.1.4 Autoregressive moving average (ARMA)

To obtain more flexible results in time series, it is beneficial to use the combination of autoregressive and moving average. When both models have been used in a mixed model, it is so called autoregressive-moving average model. In ARMA process, AR process needs to be stationary and MA process needs to be invertible. To be more specific, when parameter ϕ_p, ϕ_1 or ϕ_2 is less than 1, the AR process is stationary and when θ_q, θ_1 or θ_2 less than 1, the MA process is invertible. (Box, Jenkins and Reinsel, 2008)

3.1.5 Autoregressive Integrated Moving Average (ARIMA)

When time series have been analyzed, many series exhibit non-stationary behavior (such as, stock prices). However, this kind of series can still exhibit a homogenous behavior over time. Although the general level at which fluctuations occur differently at different times, the behavior of the series may be similar over time when differences at the level are allowed. Therefore, homogeneous nonstationary behavior of time series can sometimes be showed by a model which requires the dth difference of the process to make series stationary. To be clearer, when the time series is non-stationary and if it becomes stationary when "d" times difference has been taken, the series later on can be simulated with ARMA (p,q) process. When it follows such a way, the model can be called as autoregressive integrated moving average process of order (p,d,q). (Box, Jenkins and Reinsel, 2008). Under the ARIMA model:

- "p" represents number of autoregressive terms
- "q" represents number of errors in the moving average equation
- "d" represents nonseasonal differences for the stationarity

3.1.6 Unit Root Test

Time series have generally non-stationary tendency. However, if the time series is stationary, mean, variance and covariance do not change over time. Because of that, it is crucial to differentiate whether shocks have permanent or transitory effects. In stationary time series, shocks have temporary figures, on the contrary, non-stationary series have permanent figures which means that the mean and variance are time-dependent. Therefore, unit root tests are used, to see if the time series is stationary or non-stationary. Many tests have been used to detect stationarity of the time series. Dickey-fuller test and Augmented Dickey-fuller test are the ones which are very well-known tests. Dickey-fuller test cannot be used if error terms include autocorrelation. In this context, the autocorrelation in the error terms can be eliminated by using lagged values of the time series. In relation to this, Augmented Dickey-fuller test has been developed to deal with more complicated set of time series. In our study, Augmented Dickey-fuller test will be used to determine stationarity. In line with it, Akaike Information Criteria (AIC) and Schwarz Information Criterion (SIC) criteria will be used to determine the appropriate lag lengths. (Enders, 1995)

3.2 Autoregressive conditional heteroskedasticity models

In relation with the study, ARCH, GARCH, E-GARCH, T-GARCH and component ARCH will be investigated under autoregressive conditional heteroskedasticity models to find most appropriate model for volatility.

3.2.1 Autoregressive Conditional Heteroskedasticity (ARCH)

The autoregressive conditional heteroskedasticity process developed by Engle (1982) which expresses that the conditional variance of the actual error terms as a function of the squares of the past time periods error terms. In this model, heteroskedasticity indicates changing volatility over a time meaning that conditional variance changes over time, however, the unconditional variance remains constant. (Bollerslev, 1986)

When first-order of autoregression AR(1) has been considered; (Engle, 1982)

$$y_t = \gamma y_t{-}1 + e_t$$

where e_t is the white nose with conditional variance σ^2 , $\gamma y_t{-}1$ is the conditional mean of y_t and unconditional mean remains as zero. In relation to that, σ^2 is the conditional variance of y_t and unconditional variance of y_t is $\sigma^2/1- y^2$. (Engle, 1982)

On the other hand, the model that allows the conditional variance to depend on the past realization of the series can be explained as : (Engle, 1982)

$$y_t = e_t y_{t-1}$$

Then, the conditional variance will become $\sigma^2 y^2_{t-1}$ and unconditional variance will remain zero or infinite which may show the formulation as unappealing. Therefore, the formula can be defined as below: (Engle, 1982)

$$y_t = e_t h_t^{1/2},$$

$$ht = \alpha_0 + \alpha_1 y^2_{t-1},$$

with $\sigma(e) = 1$, the autoregressive conditional heteroscedasticity model will be given. When the p order of ARCH considered, the function can be described as: (Engle, 1982)

$$h_t = h(y_{t-1}, y_{t-2}, \dots , y_{t-p}, \alpha)$$

where α is vector of unknown parameters. (Engle, 1982)

In accordance with ARCH model, it has been found out that ARMA models with ARCH errors are effective for modelling time series based on Weiss research in 1984 (Weiss, 1984). In relation to that the combination of autoregressive conditional heteroscedasticity and autoregressive integrated moving average models can be used to forecast volatility of time series. (Bollerslev, 1986)

3.2.2 Generalized Autoregressive Conditional Heteroskedasticity

Generalized autoregressive conditional heteroskedasticity is the model introduced by Bollerslev which is generalized model of ARCH which assumes that it allows more flexible lag structure. According to Bollerslev, the extension of the ARCH process to the GARCH process is very similar to the extension of the time series AR process to the ARMA process (Bollerslev, 1986). Therefore, when error variance keeps autoregressive model, the ARCH model will be more appropriate in time series. On the other hand, if the error variance in time series follows ARMA process, then GARCH will be the appropriate model. The GARCH (p,q) process is described by: (Bollerslev, 1986)

$$\alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-i} + \sum_{i=1}^{p} \beta_i h_{t-i}$$

where

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

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

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

In the light of given information, Arch (q) process exists when p=0, on the other hand, if p=q=0 then error term will have white nose. In the ARCH (q) process, conditional variance is expressed as a linear function of only previous sample variance, while the GARCH(p, q) permits also lagged conditional variance.

3.2.3 Exponential GARCH

The exponential GARCH was developed by Daniel B. Nelson in 1991. According to Nelson, standard GARCH models do not record inverse correlation between volatility and returns.

Nevertheless, Nelson assumes that exponential GARCH captures asymmetrical effects of shocks on volatility. In other words, the impact of good news has different effect than bad news. In relation to that, the exponential GARCH is given by: (Nelson, 1991)

$$\log(\sigma_t^2) = \omega_{\ t} + \sum_{k=1}^{\infty} \beta_k g\,(Z_{t-k}) \qquad \beta \equiv 1$$

$$g(Z_t) = \theta Z_t + \gamma(|Z_t| - E|Z_t|)$$

where $\omega_{\ t}$ and β_k are coefficients, θZ_t and $\gamma(|Z_t| - E|Z_t|)$ are mean zero which are components of $g(Z_t)$. Volatility of exponential GARCH is given by σ_t^2 conditional variance. If Z_t has symmetric distribution, then θZ_t and $\gamma(|Z_t| - E|Z_t|)$ are orthogonal which make them dependent. If the range is $0 < Z_t < \infty$, then $g(Z_t)$ is linear with Z_t by slope $\theta + \gamma$. And if the range is $-\infty < Z_t \leq 0$, then $g(Z_t)$ is linear with slope $\theta - \gamma$. Therefore, $g(Z_t)$ makes σ_t^2 to react asymmetrically to increases and decreases to volatility. (Nelson, 1991)

3.2.4 Threshold GARCH

Threshold GARCH was introduced by Zakoian to handle leverage effects which assumes that positive or negative shocks do not have same effect on the volatility. The process (p,q) of TGARCH (p,q) is given by: (Mapa, 2004)

$$\sigma_t^2 = \omega + \sum_{j=1}^{p} \beta_j\ \sigma_{t-j}^2 + \sum_{i=1}^{q} \alpha_i\ u_{t-i}^2 + \sum_{k=1}^{r} \gamma_k\, u_{t-k}^2 I_{t-k}^-$$

where I_{t-k}^- = 1 if u_t is less than 0 and in other cases I_{t-k}^- = 0.

If bad news occurs, then u_{t-i} will be bigger than 0 and in case of positive news the function is u_{t-i}<0. If $\gamma_k \neq 0$, then it could be said that impact of news is asymmetrical and leverage effect exits. On the other hand, if $\gamma_k = 0$, the TARCH model will be same as GARCH model. (Mapa, 2004)

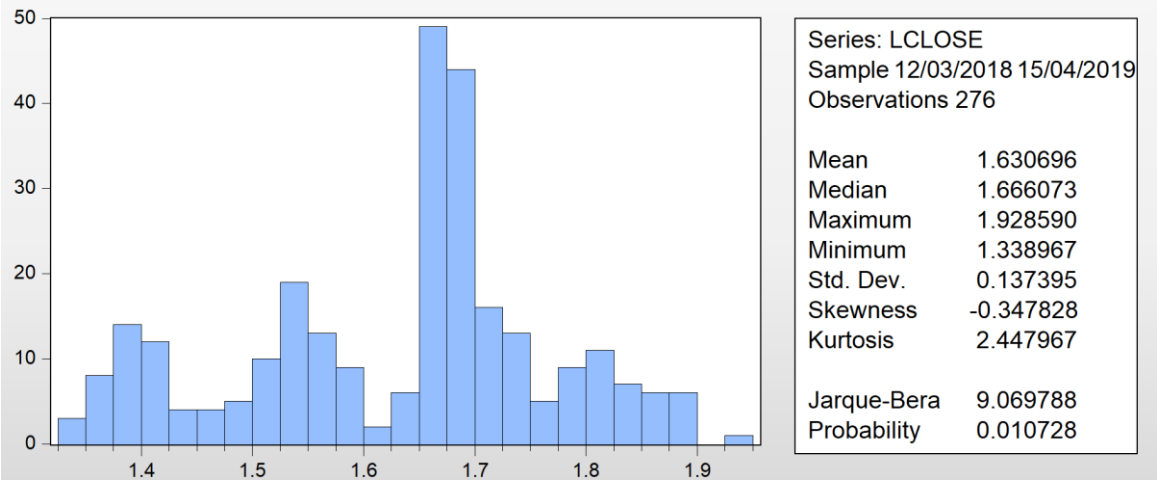
3.2.5 Component GARCH

The model was developed by Engle and Lee (1999) in contrast to standard GARCH models which assumes that long-term variance stays stable while the component GARCH assumes that long-term variance may also change.

3.3 Modelling and Forecasting Exchange Rate Fluctuations by using ARCH models on Turkish Economy

In this section, the logarithmic values of daily USD/TRY buying exchange rates is analyzed, modelled and estimated between 12/03/2018 and 15/04/2019. After the best model fit has been found, forecast will be made for following 15 days exchange rates. In relation to that, exchange rate values have been taken from database of Central Bank of the Republic of Turkey and EViews 10 program has been used to achieve results for the research.

Figure 21: Statistical data and histogram



Source: EViews 10 SV

When 276 daily observations were analyzed in logarithmic values, the mean and median values were recorded as 1.63 and 1.66, the maximum and minimum values were recorded as 1.92 and 1.33, respectively. On the other hand, skewness value has been observed in negative value which indicates that median is greater than mean. In addition to that, the observation also represents that kurtosis value is less than 3 which indicates that data has lighter tails than a normal distribution.

Figure 22: Development of USD/TRY exchange rate values in 276 days

Source: EViews 10 SV

The above line chart shows the change in the exchange rate within 276 days. Accordingly, when the graph is analyzed, it is seen that the values have an increasing and decreasing trend during the period. In this context, it has been observed that the time series is not stationary. Therefore, it is necessary to make the series stationary in order to perform the modeling process. In this respect, Augmented Dickey-fuller test will be implemented to investigate the presence of unit root and stationarity.

Table 11: Augmented Dickey-fuller test with intercept

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.933585	0.3166
Test critical values:	1% level	-3.454263	
	5% level	-2.871961	
	10% level	-2.572396	

Source: EViews 10 SV

H_0: Series contains unit root. Series is non-stationary.

H_1: Series does not contain unit root. Series is stationary.

When the ADF test with intercept has been implemented, it was observed from the figure above that probability value is 0.31 which is greater than %5 level of significance. In relation to that, the obtained p value indicates that our series is not stationary and contains unit root. Therefore, the H_1 hypothesis was rejected and the H_0 hypothesis was accepted. In the light of this, the test results also prove that the series is not stationary as it was mentioned in the previously.

Table 12: Augmented Dickey fuller test with intercept and trend

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.537265	0.8145
Test critical values:	1% level	-3.992156	
	5% level	-3.426433	
	10% level	-3.136443	

Source: EViews 10 SV

H_0: Series contains unit root. Series is non-stationary.

H_1: Series does not contain unit root. Series is stationary.

Since the previous test observed that our series is not stationary, the ADF test has been implemented by adding both intercept and trend at the same time. However, according to results, it is still evident that our series is not stationary because of the probability value which is greater than 0,05 level of significance. Therefore, we cannot accept H_1 hypothesis.

Table 13: 1st difference of Augmented Dickey fuller test without intercept and trend

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.65303	0.0000
Test critical values:	1% level	-3.454263	
	5% level	-2.871961	
	10% level	-2.572396	

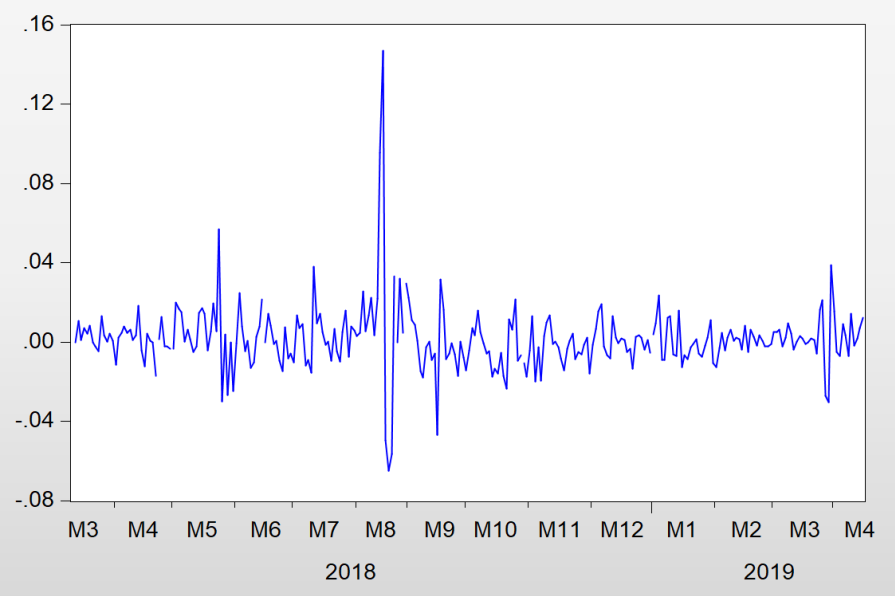
Source: EViews 10 SV

H_0: Series contains unit root. Series is non-stationary.

H_1: Series does not contain unit root. Series is stationary.

In the light of information obtained from previous data, 1st difference has been added to the ADF test. Based on the results, it was observed that the p value of the series is 0 which is less than 0,05 significance level. Therefore, we can say that the series became stationary and does not contain unit root. After the series became stationary, the graph was re-examined to observe the volatility.

Figure 23: The chart of stationary USD/TRY values in logarithmic values



Source: EViews 10 SV

When the chart of the series is examined after it became stationary, the volatility structure at the exchange rate is observed more clearly. In accordance with this, the appropriate autoregressive moving average model can be identified. In this regard, when the test has been employed to identify most appropriate autoregressive moving average model, ARIMA (1,1,4) model has been determined as the most appropriate estimation model for our series. The achieved data can be analyzed from the following table.

Table 14: ARIMA (1,1,4) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001414	0.001389	1.017902	0.3096
AR(1)	0.893935	0.099498	8.984461	0.0000
MA(1)	-0.624500	0.105966	-5.893403	0.0000
MA(2)	-0.318528	0.070889	-4.493333	0.0000
MA(3)	-0.276001	0.066249	-4.166119	0.0000
MA(4)	0.370375	0.057838	6.403660	0.0000

R-squared	0.150838	Mean dependent var	0.001516
Adjusted R-squared	0.134995	S.D. dependent var	0.017047
S.E. of regression	0.015855	Akaike info criterion	-5.429005
Sum squared resid	0.067370	Schwarz criterion	-5.349885
Log likelihood	749.7737	Hannan-Quinn criter.	-5.397248
F-statistic	9.521036	Durbin-Watson stat	2.015180
Prob(F-statistic)	0.000000		

Source: EViews 10 SV

After determining the most appropriate model, it is necessary to test whether there is an ARCH effect in the series to examine the volatility with the help of ARCH models. Therefore, ARCH-LM test has been carried out in the series to testify the heteroskedasticity effect. The results can be viewed from following table.

Table 15: ARCH-LM test for heteroskedasticity

Heteroskedasticity Test: ARCH

F-statistic	160.8938	Prob. F(1,271)	0.0000
Obs*R-squared	101.7010	Prob. Chi-Square(1)	0.0000

Source: EViews 10 SV

H_0: ARCH effect does not exist.

H_1: ARCH effect exists.

As is observed from the table data, P=0 value is less than 0,05 level of significance. Therefore, H_1 hypothesis will be accepted and H_0 hypothesis will be rejected. After it has been founded that ARCH effect is evident, ARCH models can be investigated to find solution for volatility problem. To find the most appropriate ARCH model, Akaike info criterion and Schwarz criterion values will be analyzed. In relation to that, lower Akaike and Schwarz criterion values indicate better fit for the model selection. Therefore, the lowest AIC and SC values will be

investigated among the models. In this context, when ARCH effect and autocorrelation have been eliminated from error terms, the obtained model will be statistically significant to solve volatility problem.

Table 16: ARCH (1,0) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001281	0.000936	1.369615	0.1708
AR(1)	-0.355931	0.259491	-1.371653	0.1702
MA(1)	0.557364	0.254004	2.194307	0.0282
MA(2)	0.170549	0.073131	2.332116	0.0197
MA(3)	-0.071002	0.063771	-1.113383	0.2655
MA(4)	0.094924	0.088487	1.072753	0.2834
Variance Equation				
C	0.000104	8.15E-06	12.72985	0.0000
RESID(-1)^2	0.499409	0.098410	5.074801	0.0000
R-squared	0.090595	Mean dependent var		0.001516
Adjusted R-squared	0.073628	S.D. dependent var		0.017047
S.E. of regression	0.016408	Akaike info criterion		-5.870952
Sum squared resid	0.072150	Schwarz criterion		-5.765459
Log likelihood	812.3204	Hannan-Quinn criter.		-5.828610
Durbin-Watson stat	1.840841			

Source: EViews 10 SV

When autoregressive conditional heteroskedasticity models have been analyzed starting from the ARCH model, which is the origin of the models, it is seen that ARCH (1,0) is statistically significant according to p=0 value which is less than 0,05. Since the model is statistically significant, the Akaike info criterion and Schwarz criterion can be examined and obtained values can be compared with other models. In this context, Schwarz criterion has been recorded as -5,765459 while Akaike was -5,870952.

Table 17: GARCH (1,1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001261	0.000559	2.255452	0.0241
AR(1)	-0.872187	0.138095	-6.315859	0.0000
MA(1)	1.019210	0.178589	5.707010	0.0000
MA(2)	0.078263	0.120959	0.647016	0.5176
MA(3)	-0.216338	0.100931	-2.143428	0.0321
MA(4)	-0.127936	0.077664	-1.647307	0.0995
Variance Equation				
C	2.01E-05	8.30E-06	2.424691	0.0153
RESID(-1)^2	0.542735	0.128327	4.229323	0.0000
GARCH(-1)	0.489714	0.108713	4.504669	0.0000
R-squared	0.108400	Mean dependent var		0.001516
Adjusted R-squared	0.091766	S.D. dependent var		0.017047
S.E. of regression	0.016246	Akaike info criterion		-5.957255
Sum squared resid	0.070737	Schwarz criterion		-5.838575
Log likelihood	825.1439	Hannan-Quinn criter.		-5.909620
Durbin-Watson stat	1.780879			

Source: EViews 10 SV

When the next model GARCH (1,1) was examined, it is also seen that GARCH (1,1) model is also statistically significant. Based on this information, AIC and SC values have been explored lower than the ARCH(1,0) model values. The value for AIC is -5,957265 and -5,838575 for SC. After the two main models examined, other models obtained by ARCH and GARCH models were also investigated.

Table 18:T-GARCH (1,1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001453	0.000744	1.951665	0.0510
AR(1)	-0.989491	0.019300	-51.26857	0.0000
MA(1)	1.163898	0.088344	13.17468	0.0000
MA(2)	0.121438	0.130213	0.932607	0.3510
MA(3)	-0.214430	0.116363	-1.842774	0.0654
MA(4)	-0.158664	0.075728	-2.095171	0.0362
Variance Equation				
C	2.28E-05	8.96E-06	2.550916	0.0107
RESID(-1)^2	0.601637	0.148083	4.062832	0.0000
RESID(-1)^2*(RESID(-1)<0)	-0.213218	0.127529	-1.671922	0.0945
GARCH(-1)	0.495291	0.114535	4.324367	0.0000
R-squared	0.111757	Mean dependent var		0.001516
Adjusted R-squared	0.095186	S.D. dependent var		0.017047
S.E. of regression	0.016216	Akaike info criterion		-5.952801
Sum squared resid	0.070471	Schwarz criterion		-5.820935
Log likelihood	825.5338	Hannan-Quinn criter.		-5.899874
Durbin-Watson stat	1.833896			

Source: EViews 10 SV

When the model T-GARCH (1,1) has been examined, it is also obvious that the model is statistically significant based on probability value. When the AIC and SC values have been considered, it is seen that the values are higher than the GARCH (1,1) model.

Table 19: E-GARCH (1,1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.002162	0.000685	3.154366	0.0016
AR(1)	-0.852765	0.155371	-5.488556	0.0000
MA(1)	1.048093	0.184998	5.665424	0.0000
MA(2)	0.143706	0.115124	1.248270	0.2119
MA(3)	-0.164956	0.105266	-1.567045	0.1171
MA(4)	-0.098854	0.085139	-1.161096	0.2456
Variance Equation				
C(7)	-1.519495	0.430921	-3.526153	0.0004
C(8)	0.574214	0.113520	5.058245	0.0000
C(9)	0.098084	0.046116	2.126919	0.0334
C(10)	0.874410	0.044297	19.73983	0.0000
R-squared	0.109376	Mean dependent var		0.001516
Adjusted R-squared	0.092760	S.D. dependent var		0.017047
S.E. of regression	0.016237	Akaike info criterion		-5.981466
Sum squared resid	0.070660	Schwarz criterion		-5.849600
Log likelihood	829.4608	Hannan-Quinn criter.		-5.928538
Durbin-Watson stat	1.870863			

Source: EViews 10 SV

On the other hand, when the next model E-GARCH has been analyzed, it is seen that p=0 is less than 5% level of significance. Therefore, the model statistically significant and considerable. In addition to that, AIC and SC values have been recorded as -5,981466 and -5,849600.

Table 20: Component ARCH (1,1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.001191	0.000690	1.725479	0.0844
AR(1)	-0.418342	0.441531	-0.947481	0.3434
MA(1)	0.637088	0.444834	1.432194	0.1521
MA(2)	0.092068	0.131598	0.699615	0.4842
MA(3)	-0.128305	0.065628	-1.955026	0.0506
MA(4)	0.001118	0.095238	0.011739	0.9906
Variance Equation				
C(7)	0.000194	3.75E-05	5.155347	0.0000
C(8)	0.791164	0.082425	9.598618	0.0000
C(9)	0.480172	0.023308	20.60123	0.0000
C(10)	-0.092014	0.029514	-3.117639	0.0018
C(11)	-0.662135	0.079786	-8.298860	0.0000
R-squared	0.112598	Mean dependent var		0.001516
Adjusted R-squared	0.096042	S.D. dependent var		0.017047
S.E. of regression	0.016208	Akaike info criterion		-5.958990
Sum squared resid	0.070404	Schwarz criterion		-5.813937
Log likelihood	827.3816	Hannan-Quinn criter.		-5.900770
Durbin-Watson stat	1.903234			

Source: EViews 10 SV

In accordance with obtained values, component ARCH model is also statistically significant due to probability values which are less than 0,05. In relation to that, AIC and SC values have been recorded as -5,958990 and -5,813937, respectively.

When all the models have been compared, it is obviously seen that E-GARCH has the lowest values in AIC and SC. Therefore, E-GARCH model has been found as the most appropriate model when the USD/TRY volatility between 2018 and 2019 has been investigated.

In order to testify whether the selected model is statistically significant or not, the ARCH LM test must be employed. If obtained p-value is greater than 5% level of significance, it means that ARCH effect and autocorrelation have been eliminated and the model provides all the requirements that is needed for volatility problem.

Table 21: ARCH LM test

Heteroskedasticity Test: ARCH

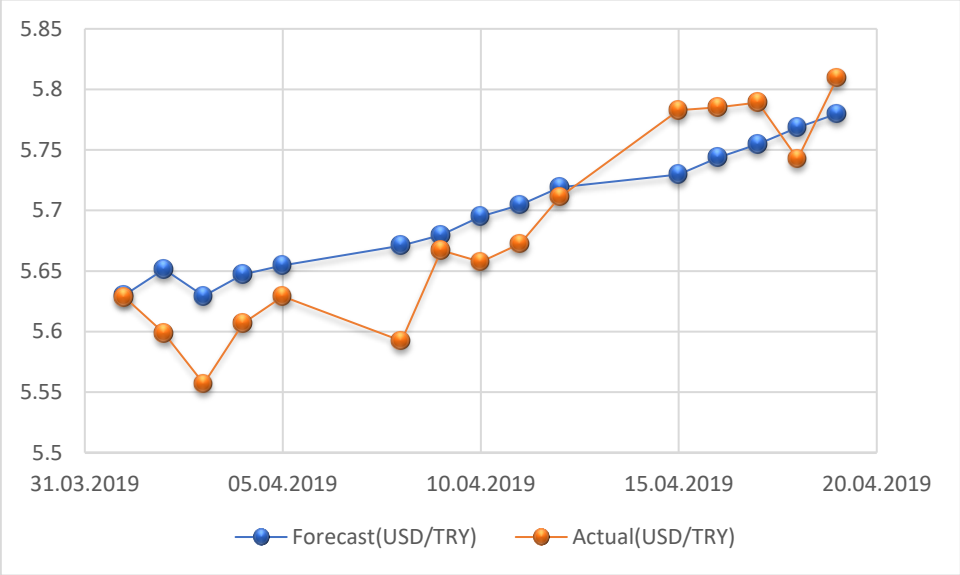
F-statistic	0.402979	Prob. F(1,271)	0.5261
Obs*R-squared	0.405351	Prob. Chi-Square(1)	0.5243

Source: EViews 10 SV

As it can be seen from the probability value 0,5261 which is bigger than level of significance 0,05, it can be said that ARCH effect and autocorrelation have been eliminated. As a result, after the investigation, it can be seen that EGARCH (1,1) model needs to be used for modelling and estimating the USD/TRY (buying) exchange rates between 12/03/2018 and 15/04/2019.

After modelling and estimation of the ARCH models, the USD/TRY forecast has been made for the following 15 days excluded from weekends and holidays. In relation to that, the below chart demonstrates a comparison of the results of the forecasted and the actual exchange rate values.

Figure 24: Forecasting results of USD/TRY for following 15 days



Source: Created by author

On the one hand, based on ARIMA(1,1,4) and E-GARCH (1,1) models, it has been found out that both actual and forecasted values for USD/TRY have an upward trend. On the other hand, it has been observed that there are no sudden increases and decreases in the estimated exchange rate values, however, the dramatic increases and decreases in the actual values are quite evident. When the reason of these dramatic changes has been investigated, it was found out that results of the Turkish local elections which was held on March 31, 2019, had great impact on the exchange rate fluctuations. Based on the research carried out in the second part of the thesis, the impact of political events on the volatility has also shown itself clearly in this part of the thesis.

Conclusion

The U.S. dollar is the most popular currency in the international transactions which is used by emerging countries such as Turkey. Turkish domestic market must cover the value produced on the basis of TL in dollars to afford the current account deficit in foreign trade. Therefore, the appreciation of the U.S. dollar against TL causes many factors to be negatively affected in the domestic market. In this respect, inflation rates, interest rates, investments, economic growth, imported goods and products that have a dollar-based cost in production are adversely affected and bring many challenges for the market participants. These negative factors have been experienced drastically by Turkish economy in recent years due to the volatility of the exchange rate. In this context, it has been observed that the U.S. dollar gradually increased in value against Turkish lira in recent years, however, dramatic increases and decreases have been recorded since 2017. According to research which was carried out in second chapter, it was determined that these sudden increases and decreases in the dollar were caused by factors arising from the political environment. In addition to that in the last chapter, the ARIMA model and autoregressive conditional heteroskedasticity models, which are involved in many scientific studies, have been used to model and estimate volatility in terms of USD/TRY exchange rate between 12/03/2018 and 15/04/2019 to provide most appropriate heteroskedasticity model for volatility. According to the results, the E-GARCH(1,1) model was determined as the most appropriate autoregressive condition heteroscedasticity model with the mean equation of ARIMA(1,1,4). In line with that information, USD/TRY exchange rate has been forecasted from 01/04/2019 to 19/04/2019. In accordance with obtained results, it has been observed that both actual and forecasted values have an upward trend. However, the actual values have been experienced dramatic increases during the time. When reasons for these changes have been investigated, it was determined that the developments were again caused by political factors.

As a result, it has been proven that E-GARCH(1,1) model with the mean equation of ARIMA(1,1,4) provide a significant advantage to see the future trend of volatility of USD/TRY exchange rate in the given time series, however, it is also important to take unexpected political events into the consideration in order to make healthy decisions and minimize the exchange rate volatility risk. Therefore, it can be suggested that using financial derivatives would be good in such a position for the Turkish market participants who have foreign debt denominated in USD.

Bibliography

1. Krugman, P., Obstfeld, M. and Melitz, M. (2010). *International economics*. 9th ed. Boston: Pearson Addison-Wesley, pp.293,321.
2. Szulczyk, K. (2014). *Money, banking, and international finance*. 2nd ed. [North Charleston]: Createspace Independent Publishing Platform, p.183.
3. Imf.org. (n.d.). *About the IMF: History: The end of the Bretton Woods System (1972–81)*. [online] Available at: https://www.imf.org/external/about/histend.htm [Accessed 2 Jan. 2019].
4. Mankiw, N. (2015). *Macroeconomics*. 9th ed. New York, NY: Worth Publishers, Incorporated, p.321.
5. Toulaboe, D., & Terry, R. (2013). Exchange rate regime: Does it matter for inflation? *The Journal of Applied Business and Economics*, *14*(1), 56-71. Retrieved from https://search-proquest-com.zdroje.vse.cz/docview/1450693502?accountid=17203
6. IMF. (2018). *Inflation: Prices on the Rise*. [online] Available at: https://www.imf.org/external/pubs/ft/fandd/basics/inflat.htm [Accessed 4 Jan. 2019].
7. OECD. (2019). *Prices - Inflation (CPI) - OECD Data*. [online] Available at: https://data.oecd.org/price/inflation-cpi.htm [Accessed 5 Jan. 2019].
8. The Irish Times. (2019). *Argentina raises interest rates to 60%*. [online] Available at: https://www.irishtimes.com/business/economy/argentina-raises-interest-rates-to-60-1.3612339 [Accessed 15 Mar. 2019].
9. Suranovic, S. (2010). *International trade: Theory and Policy*. 1st ed. Flat World Knowledge, Inc., pp.1131-1133.
10. Crouhy, M., Galai, D. and Mark, R. (2004). *Risk management*. New York: McGraw-Hill, pp.38,39.
11. Ozturk, I. (2006). *Exchange Rate Volatility And Trade: A Literature Survey*, 3, 86.
12. Eriksen, K., & Wedøe, O. (2010). *Foreign exchange risk management. How Are The Largest Non-Financial Companies In Norway Managing Their Foreign Exchange Rate Exposure*, 22.
13. Nazarboland, G. (2003). The attitude of top UK multinationals towards translation exposure. *Journal of Management Research, 3*(3), p.120. Retrieved from https://search-proquest-com.zdroje.vse.cz/docview/237233002?accountid=17203

14. Eiteman, D., Stonehill, A., & Moffett, M. (2013). *Multinational business finance* (13th ed., p. 153,276). Boston: Pearson.
15. Brealey, R., Myers, S., & Allen, F. (2011). *Study guide for Principles of corporate finance*, 10th ed. (10th ed., p. 652). New York: McGraw-Hill/Irwin.
16. Hull, J. (2012). *Options, futures, and other derivatives*. 8th ed. Boston (Mass.): Pearson, p.5.
17. Connolly, M. (2007). *International business finance* (1st ed., pp. 45-48). New York: Routledge.
18. Telegraph.co.uk. (2002). *Part 3: Currency derivatives: options*. [online] Available at: https://www.telegraph.co.uk/finance/2955703/Part-3-Currency-derivatives-options.html [Accessed 30 Mar. 2019].
19. Kolb, R. and Overdahl, J. (2003). *Financial derivatives*. 3rd ed. Hoboken, NJ: John Wiley & Sons, pp.170-172.
20. Mishkin, F. (2016). *The economics of money, banking, and financial markets* (11th ed., p. 504). Harlow: Pearson Education.
21. Export.gov. (2019). *Turkey - Market Overview | export.gov*. [online] Available at: https://www.export.gov/article?id=Turkey-Market-Overview [Accessed 27 Mar. 2019].
22. IMF. (2018). *World Economic Outlook, October 2018: Challenges to Steady Growth*. [online] Available at: https://www.imf.org/en/Publications/WEO/Issues/2018/09/24/world-economic-outlook-october-2018 [Accessed 27 Mar. 2019].
23. Wto.org. (2018). [online] Available at: https://www.wto.org/english/res_e/statis_e/daily_update_e/trade_profiles/TR_e.pdf [Accessed 1 Apr. 2019].
24. S&P Global Ratings (2017). *Sovereign Postcard: The New Fragile Five*. Frankfurt: S&P Global Ratings, p.2.
25. Morgan Stanley (2013). *Tales from the Emerging World. Elections 2014: How Fragile are the "Fragile Five"?*. p.2.
26. Data.worldbank.org. (2019). *Current account balance (BoP, current US$) | Data*. Available at:

https://data.worldbank.org/indicator/BN.CAB.XOKA.CD?end=2017&locations=TR-IN&start=1974&view=chart [Accessed 30 Mar. 2019].

27. Ticaret.gov.tr. (2019). *T.C. Ticaret Bakanlığı*. [online] Available at: https://www.ticaret.gov.tr/istatistikler/dis-ticaret-istatistikleri/dis-ticaret-istatistikleri-ocak-subat-2019 [Accessed 1 Apr. 2019].
28. BloombergHT. (2019). *Ekonomistler cari açığın düşmesini bekliyor*. [online] Available at: https://www.bloomberght.com/haberler/haber/2193463-ekonomistler-cari-acigin-dusmesini-bekliyor [Accessed 1 Apr. 2019].
29. TUIK. (2019). *Dönemsel Gayrisafi Yurt İçi Hasıla, IV. Çeyrek: Ekim - Aralık, 2018*. [online] Available at: http://www.tuik.gov.tr/HbGetirHTML.do?id=30886 [Accessed 27 Mar. 2019].
30. TCMB. (2019). *EVDS*. [online] Available at: https://evds2.tcmb.gov.tr/index.php?/evds/portlet/FNYLFW4ykjc%3D/tr [Accessed 27 Mar. 2019].
31. Phillips, A. (1958). *The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861-1957*. [London], pp.283-299.
32. Association of Turkish Construction Material Producers (2019). *İnşaat Malzemesi Sanayicileri Derneği, Şubat 2019 Sektör Raporu'nu Açıkladı.* [online] Available at: http://www.turkonfed.org/tr/detay/1972/insaat-malzemesi-sanayicileri-dernegi-subat-2019-sektor-raporunu-acikladi/ [Accessed 27 Mar. 2019].
33. Tradingeconomics.com. (2019). *Interest Rate - Countries - List | G20*. [online] Available at: https://tradingeconomics.com/country-list/interest-rate?continent=g20 [Accessed 27 Mar. 2019].
34. Tcmb.gov.tr. (2018). *TCMB - Press Release on Interest Rates (2018-38)*. [online] Available at: https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Announcements/Press+Releases/2018/ANO2018-38 [Accessed 28 Mar. 2019].
35. Investing.com. (2019). *USD TRY Historical Data - Investing.com*. [online] Available at: https://www.investing.com/currencies/usd-try-historical-data [Accessed 28 Mar. 2019].
36. Bloomberg.com. (2018). *Turkey Raises Repo Rate to 16.5 Percent in Simplification*. [online] Available at:

https://www.bloomberg.com/news/articles/2018-05-28/turkey-raises-repo-rate-to-16-5-percent-in-simplification-move [Accessed 28 Mar. 2019].

37. BBC (2019). *Dolar/TL kurundaki yükseliş ekonomiyi nasıl etkiler?* [online] Available at: https://www.bbc.com/turkce/haberler-turkiye-44223130 [Accessed 2 Apr. 2019].
38. Nato.int. (2012). *NATO Review - Greece and Turkey: 60 years in NATO*. [online] Available at: https://www.nato.int/docu/review/2012/Turkey-Greece/EN/index.htm [Accessed 3 Apr. 2019].
39. Imf.org. (2017). *List of Members' Date of Entry*. [online] Available at: https://www.imf.org/external/np/sec/memdir/memdate.htm [Accessed 3 Apr. 2019].
40. Council of Europe. (2019). *Turkey - Member state*. [online] Available at: https://www.coe.int/en/web/portal/turkey [Accessed 3 Apr. 2019].
41. Spk.gov.tr. (2019). *DÖVİZ KURU POLİTİKALARI VE TÜRKİYE'DE DÖVİZ KURU. OYNAKLIĞININ ETKİLEŞİMLERİ*. [online] Available at: http://www.spk.gov.tr/SiteApps/Yayin/YayinGoster/943 [Accessed 1 Apr. 2019].
42. Ec.europa.eu. (2019). *Turkey - Trade - European Commission*. [online] Available at: http://ec.europa.eu/trade/policy/countries-and-regions/countries/turkey/ [Accessed 3 Apr. 2019].
43. DW.COM. (2019). *Turkey extends state of emergency by three months | DW | 04.01.2017*. [online] Available at: https://www.dw.com/en/turkey-extends-state-of-emergency-by-three-months/a-36994046 [Accessed 7 Apr. 2019].
44. Official Gazette of the Republic of Turkey (2017). *Olağanüstü Halin Uzatılmasına Dair Karar* [online] Available at: http://www.resmigazete.gov.tr/eskiler/2017/01/20170105.htm [Accessed 7 Apr. 2019].
45. CNN. (2017). *United States and Turkey mutually suspend visa services*. [online] Available at: https://edition.cnn.com/2017/10/08/world/us-turkey-halt-visa-service/index.html [Accessed 7 Apr. 2019].
46. U.S. Department of State. (2017). *Full Resumption of U.S. Visa Services in Turkey*. [online] Available at:

https://www.state.gov/r/pa/prs/ps/2017/12/276772.htm [Accessed 7 Apr. 2019].

47. Cbp.gov. (2018). *Section 232 Tariffs on Aluminum and Steel | U.S. Customs and Border Protection*. [online] Available at: https://www.cbp.gov/trade/remedies/232-tariffs-aluminum-and-steel [Accessed 7 Apr. 2019].
48. the Guardian. (2018). *Turkey elections 2018: everything you need to know*. [online] Available at: https://www.theguardian.com/world/2018/jun/18/turkey-elections-2018-everything-you-need-to-know [Accessed 7 Apr. 2019].
49. Bloomberg.com. (2018). *Turkey's Fragile Economy Faces New Risk in U.S. Sanctions Threat*. [online] Available at: https://www.bloomberg.com/news/articles/2018-07-26/pence-warns-turkey-u-s-to-impose-sanctions-if-pastor-not-freed [Accessed 7 Apr. 2019].
50. Home.treasury.gov. (2018). *Treasury Sanctions Turkish Officials with Leading Roles in Unjust Detention of U.S. Pastor Andrew Brunson | U.S. Department of the Treasury*. [online] Available at: https://home.treasury.gov/news/press-releases/sm453 [Accessed 7 Apr. 2019].
51. Reuters.com. (2018). *Trump escalates feud with Turkey, imposing higher metals tariffs*. [online] Available at: https://www.reuters.com/article/uk-turkey-currency-usa/trump-doubles-tariffs-on-turkish-steel-and-aluminium-idUSKBN1KV1H4 [Accessed 7 Apr. 2019].
52. United States Commission on International Religious Freedom. (n.d.). *Pastor Andrew Brunson*. [online] Available at: https://www.uscirf.gov/pastor-andrew-brunson [Accessed 7 Apr. 2019]
53. Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), pp.307-327.
54. Engle, R. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4), pp.987-990.
55. Brockwell, P. and Davis, R. (2002). *Introduction to time series and forecasting*. 2nd ed. New York: Springer, p.1.

56. Box, G., Jenkins, G. and Reinsel, G. (2008). *Time series analysis*. 4th ed. Hoboken, N.J.: J. Wiley & Sons, pp.1-12.
57. Enders, W. (1995). *Applied econometric time series*. 2nd ed. Hoboken, NJ: Wiley, pp.206-232.
58. Weiss, A. (1984). ARMA MODELS WITH ARCH ERRORS. *Journal of Time Series Analysis*, 5(2), pp.129-143.
59. Nelson, D. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach. *Econometrica*, *59*(2), 347-370. doi:10.2307/2938260
60. Mapa, D. (2004). *A Forecast Comparison of Financial Volatility Models: GARCH (1,1) is not Enough - Munich Personal RePEc Archive*. [online] Mpra.ub.uni-muenchen.de. Available at: https://mpra.ub.uni-muenchen.de/21028/ [Accessed 23 Apr. 2019].

Appendix

Appendix A: USD/TRY buying rates for first half of 2017

02-01-2017	3.52	01-02-2017	3.79	01-03-2017	3.61	01-04-2017		01-05-2017		01-06-2017	3.53
03-01-2017	3.53	02-02-2017	3.77	02-03-2017	3.63	02-04-2017		02-05-2017	3.55	02-06-2017	3.53
04-01-2017	3.57	03-02-2017	3.73	03-03-2017	3.68	03-04-2017	3.64	03-05-2017	3.53	03-06-2017	
05-01-2017	3.58	04-02-2017		04-03-2017		04-04-2017	3.64	04-05-2017	3.53	04-06-2017	
06-01-2017	3.59	05-02-2017		05-03-2017		05-04-2017	3.64	05-05-2017	3.54	05-06-2017	3.53
07-01-2017		06-02-2017	3.74	06-03-2017	3.72	06-04-2017	3.68	06-05-2017		06-06-2017	3.51
08-01-2017		07-02-2017	3.68	07-03-2017	3.71	07-04-2017	3.71	07-05-2017		07-06-2017	3.53
09-01-2017	3.61	08-02-2017	3.71	08-03-2017	3.68	08-04-2017		08-05-2017	3.56	08-06-2017	3.52
10-01-2017	3.70	09-02-2017	3.74	09-03-2017	3.70	09-04-2017		09-05-2017	3.55	09-06-2017	3.54
11-01-2017	3.76	10-02-2017	3.70	10-03-2017	3.75	10-04-2017	3.72	10-05-2017	3.59	10-06-2017	
12-01-2017	3.85	11-02-2017		11-03-2017		11-04-2017	3.73	11-05-2017	3.60	11-06-2017	
13-01-2017	3.84	12-02-2017		12-03-2017		12-04-2017	3.72	12-05-2017	3.57	12-06-2017	3.52
14-01-2017		13-02-2017	3.67	13-03-2017	3.75	13-04-2017	3.68	13-05-2017		13-06-2017	3.52
15-01-2017		14-02-2017	3.69	14-03-2017	3.74	14-04-2017	3.66	14-05-2017		14-06-2017	3.52
16-01-2017	3.80	15-02-2017	3.65	15-03-2017	3.75	15-04-2017		15-05-2017	3.59	15-06-2017	3.51
17-01-2017	3.76	16-02-2017	3.65	16-03-2017	3.73	16-04-2017		16-05-2017	3.56	16-06-2017	3.50
18-01-2017	3.78	17-02-2017	3.67	17-03-2017	3.67	17-04-2017	3.68	17-05-2017	3.55	17-06-2017	
19-01-2017	3.78	18-02-2017		18-03-2017		18-04-2017	3.66	18-05-2017	3.55	18-06-2017	
20-01-2017	3.79	19-02-2017		19-03-2017		19-04-2017	3.68	19-05-2017		19-06-2017	3.51
21-01-2017		20-02-2017	3.67	20-03-2017	3.61	20-04-2017	3.66	20-05-2017		20-06-2017	3.50
22-01-2017		21-02-2017	3.62	21-03-2017	3.63	21-04-2017	3.64	21-05-2017		21-06-2017	3.52
23-01-2017	3.82	22-02-2017	3.62	22-03-2017	3.61	22-04-2017		22-05-2017	3.61	22-06-2017	3.53
24-01-2017	3.77	23-02-2017	3.61	23-03-2017	3.63	23-04-2017		23-05-2017	3.56	23-06-2017	3.52
25-01-2017	3.75	24-02-2017	3.57	24-03-2017	3.61	24-04-2017	3.64	24-05-2017	3.57	24-06-2017	
26-01-2017	3.80	25-02-2017		25-03-2017		25-04-2017	3.59	25-05-2017	3.56	25-06-2017	
27-01-2017	3.83	26-02-2017		26-03-2017		26-04-2017	3.58	26-05-2017	3.56	26-06-2017	
28-01-2017		27-02-2017	3.57	27-03-2017	3.62	27-04-2017	3.59	27-05-2017		27-06-2017	
29-01-2017		28-02-2017	3.59	28-03-2017	3.59	28-04-2017	3.56	28-05-2017		28-06-2017	3.50
30-01-2017	3.88			29-03-2017	3.62	29-04-2017		29-05-2017	3.57	29-06-2017	3.52
31-01-2017	3.83			30-03-2017	3.64	30-04-2017		30-05-2017	3.58	30-06-2017	3.51
				31.03.2017	3.64			31.05.2017	3.56		

Appendix B: USD/TRY buying rates for second half of 2017

01-07-2017		01-08-2017	3.52	01-09-2017		01-10-2017		01-11-2017	3.78	01-12-2017	3.94
02-07-2017		02-08-2017	3.52	02-09-2017		02-10-2017	3.55	02-11-2017	3.81	02-12-2017	
03-07-2017	3.52	03-08-2017	3.53	03-09-2017		03-10-2017	3.58	03-11-2017	3.81	03-12-2017	
04-07-2017	3.53	04-08-2017	3.54	04-09-2017		04-10-2017	3.58	04-11-2017		04-12-2017	3.93
05-07-2017	3.55	05-08-2017		05-09-2017	3.44	05-10-2017	3.56	05-11-2017		05-12-2017	3.92
06-07-2017	3.58	06-08-2017		06-09-2017	3.44	06-10-2017	3.57	06-11-2017	3.82	06-12-2017	3.86
07-07-2017	3.62	07-08-2017	3.53	07-09-2017	3.44	07-10-2017		07-11-2017	3.86	07-12-2017	3.85
08-07-2017		08-08-2017	3.53	08-09-2017	3.42	08-10-2017		08-11-2017	3.85	08-12-2017	3.86
09-07-2017		09-08-2017	3.53	09-09-2017		09-10-2017	3.60	09-11-2017	3.88	09-12-2017	
10-07-2017	3.63	10-08-2017	3.54	10-09-2017		10-10-2017	3.70	10-11-2017	3.85	10-12-2017	
11-07-2017	3.60	11-08-2017	3.53	11-09-2017	3.41	11-10-2017	3.68	11-11-2017		11-12-2017	3.85
12-07-2017	3.63	12-08-2017		12-09-2017	3.40	12-10-2017	3.68	12-11-2017		12-12-2017	3.83
13-07-2017	3.60	13-08-2017		13-09-2017	3.43	13-10-2017	3.64	13-11-2017	3.86	13-12-2017	3.83
14-07-2017	3.57	14-08-2017	3.54	14-09-2017	3.43	14-10-2017		14-11-2017	3.87	14-12-2017	3.84
15-07-2017		15-08-2017	3.53	15-09-2017	3.45	15-10-2017		15-11-2017	3.87	15-12-2017	3.83
16-07-2017		16-08-2017	3.53	16-09-2017		16-10-2017	3.65	16-11-2017	3.88	16-12-2017	
17-07-2017	3.56	17-08-2017	3.53	17-09-2017		17-10-2017	3.64	17-11-2017	3.87	17-12-2017	
18-07-2017	3.54	18-08-2017	3.52	18-09-2017	3.43	18-10-2017	3.65	18-11-2017		18-12-2017	3.86
19-07-2017	3.53	19-08-2017		19-09-2017	3.45	19-10-2017	3.67	19-11-2017		19-12-2017	3.85
20-07-2017	3.53	20-08-2017		20-09-2017	3.49	20-10-2017	3.66	20-11-2017	3.88	20-12-2017	3.83
21-07-2017	3.53	21-08-2017	3.52	21-09-2017	3.48	21-10-2017		21-11-2017	3.89	21-12-2017	3.83
22-07-2017		22-08-2017	3.51	22-09-2017	3.51	22-10-2017		22-11-2017	3.95	22-12-2017	3.82
23-07-2017		23-08-2017	3.50	23-09-2017		23-10-2017	3.66	23-11-2017	3.96	23-12-2017	
24-07-2017	3.53	24-08-2017	3.50	24-09-2017		24-10-2017	3.70	24-11-2017	3.92	24-12-2017	
25-07-2017	3.54	25-08-2017	3.48	25-09-2017	3.49	25-10-2017	3.71	25-11-2017		25-12-2017	3.81
26-07-2017	3.56	26-08-2017		26-09-2017	3.52	26-10-2017	3.73	26-11-2017		26-12-2017	3.81
27-07-2017	3.56	27-08-2017		27-09-2017	3.53	27-10-2017	3.77	27-11-2017	3.94	27-12-2017	3.80
28-07-2017	3.53	28-08-2017	3.48	28-09-2017	3.57	28-10-2017		28-11-2017	3.93	28-12-2017	3.82
29-07-2017		29-08-2017	3.44	29-09-2017	3.57	29-10-2017		29-11-2017	3.92	29-12-2017	3.81
30-07-2017		30-08-2017		30-09-2017		30-10-2017	3.82	30-11-2017	3.95	30-12-2017	
31-07-2017	3.53	31-08-2017	3.44			31-10-2017	3.77			31-12-2017	

Appendix C: USD/TRY buying rates for first half of 2018

01-01-2018		01-02-2018	3.75	01-03-2018	3.80	01-04-2018		01-05-2018		01.06.2018	4.48
02-01-2018	3.77	02-02-2018	3.76	02-03-2018	3.81	02-04-2018	3.95	02-05-2018	4.04	02-06-2018	
03-01-2018	3.77	03-02-2018		03-03-2018		03-04-2018	3.96	03-05-2018	4.12	03-06-2018	
04-01-2018	3.76	04-02-2018		04-03-2018		04-04-2018	3.98	04-05-2018	4.19	04-06-2018	4.59
05-01-2018	3.76	05-02-2018	3.75	05-03-2018	3.80	05-04-2018	4.01	05-05-2018		05-06-2018	4.63
06-01-2018		06-02-2018	3.76	06-03-2018	3.82	06-04-2018	4.03	06-05-2018		06-06-2018	4.61
07-01-2018		07-02-2018	3.78	07-03-2018	3.80	07-04-2018		07-05-2018	4.26	07-06-2018	4.61
08-01-2018	3.75	08-02-2018	3.77	08-03-2018	3.80	08-04-2018		08-05-2018	4.26	08-06-2018	4.55
09-01-2018	3.75	09-02-2018	3.81	09-03-2018	3.81	09-04-2018	4.05	09-05-2018	4.28	09-06-2018	
10-01-2018	3.76	10-02-2018		10-03-2018		10-04-2018	4.06	10-05-2018	4.29	10-06-2018	
11-01-2018	3.78	11-02-2018		11-03-2018		11-04-2018	4.07	11-05-2018	4.27	11-06-2018	4.50
12-01-2018	3.79	12-02-2018	3.81	12-03-2018	3.82	12-04-2018	4.15	12-05-2018		12-06-2018	4.51
13-01-2018		13-02-2018	3.81	13-03-2018	3.82	13-04-2018	4.13	13-05-2018		13-06-2018	4.55
14-01-2018		14-02-2018	3.80	14-03-2018	3.86	14-04-2018		14-05-2018	4.26	14-06-2018	4.65
15-01-2018	3.76	15-02-2018	3.80	15-03-2018	3.86	15-04-2018		15-05-2018	4.32	15-06-2018	
16-01-2018	3.76	16-02-2018	3.77	16-03-2018	3.89	16-04-2018	4.08	16-05-2018	4.39	16-06-2018	
17-01-2018	3.82	17-02-2018		17-03-2018		17-04-2018	4.10	17-05-2018	4.46	17-06-2018	
18-01-2018	3.81	18-02-2018		18-03-2018		18-04-2018	4.10	18-05-2018	4.44	18-06-2018	4.65
19-01-2018	3.80	19-02-2018	3.75	19-03-2018	3.90	19-04-2018	4.10	19-05-2018		19-06-2018	4.72
20-01-2018		20-02-2018	3.75	20-03-2018	3.94	20-04-2018	4.03	20-05-2018		20-06-2018	4.75
21-01-2018		21-02-2018	3.77	21-03-2018	3.94	21-04-2018		21-05-2018	4.47	21-06-2018	4.75
22-01-2018	3.78	22-02-2018	3.78	22-03-2018	3.93	22-04-2018		22-05-2018	4.55	22-06-2018	4.75
23-01-2018	3.81	23-02-2018	3.80	23-03-2018	3.91	23-04-2018		23-05-2018	4.58	23-06-2018	
24-01-2018	3.79	24-02-2018		24-03-2018		24-04-2018	4.03	24-05-2018	4.85	24-06-2018	
25-01-2018	3.76	25-02-2018		25-03-2018		25-04-2018	4.08	25-05-2018	4.70	25-06-2018	4.71
26-01-2018	3.74	26-02-2018	3.78	26-03-2018	3.96	26-04-2018	4.08	26-05-2018		26-06-2018	4.64
27-01-2018		27-02-2018	3.78	27-03-2018	3.97	27-04-2018	4.07	27-05-2018		27-06-2018	4.67
28-01-2018		28-02-2018	3.78	28-03-2018	3.98	28-04-2018		28-05-2018	4.72	28-06-2018	4.63
29-01-2018	3.74			29-03-2018	3.99	29-04-2018		29-05-2018	4.60	29-06-2018	4.61
30-01-2018	3.77			30-03-2018	3.99	30-04-2018	4.05	30-05-2018	4.60	30-06-2018	
31-01-2018	3.78			31-03-2018				31-05-2018	4.48		

Appendix D: USD/TRY buying rates for second half of 2018

01-07-2018		01-08-2018	4.90	01-09-2018		01-10-2018	5.99	01-11-2018	5.50	01-12-2018	
02-07-2018	4.56	02-08-2018	4.92	02-09-2018		02-10-2018	5.97	02-11-2018	5.57	02-12-2018	
03-07-2018	4.62	03-08-2018	5.05	03-09-2018	6.55	03-10-2018	6.01	03-11-2018		03-12-2018	5.16
04-07-2018	4.66	04-08-2018		04-09-2018	6.62	04-10-2018	6.03	04-11-2018		04-12-2018	5.19
05-07-2018	4.70	05-08-2018		05-09-2018	6.68	05-10-2018	6.12	05-11-2018	5.46	05-12-2018	5.27
06-07-2018	4.64	06-08-2018	5.08	06-09-2018	6.68	06-10-2018		06-11-2018	5.45	06-12-2018	5.37
07-07-2018		07-08-2018	5.15	07-09-2018	6.59	07-10-2018		07-11-2018	5.34	07-12-2018	5.36
08-07-2018		08-08-2018	5.26	08-09-2018		08-10-2018	6.15	08-11-2018	5.36	08-12-2018	
09-07-2018	4.60	09-08-2018	5.28	09-09-2018		09-10-2018	6.15	09-11-2018	5.41	09-12-2018	
10-07-2018	4.53	10-08-2018	5.40	10-09-2018	6.47	10-10-2018	6.12	10-11-2018		10-12-2018	5.33
11-07-2018	4.71	11-08-2018		11-09-2018	6.45	11-10-2018	6.09	11-11-2018		11-12-2018	5.28
12-07-2018	4.75	12-08-2018		12-09-2018	6.45	12-10-2018	5.98	12-11-2018	5.48	12-12-2018	5.35
13-07-2018	4.82	13-08-2018	5.94	13-09-2018	6.39	13-10-2018		13-11-2018	5.48	13-12-2018	5.36
14-07-2018		14-08-2018	6.88	14-09-2018	6.36	14-10-2018		14-11-2018	5.48	14-12-2018	5.36
15-07-2018		15-08-2018	6.55	15-09-2018		15-10-2018	5.90	15-11-2018	5.46	15-12-2018	
16-07-2018	4.84	16-08-2018	6.14	16-09-2018		16-10-2018	5.81	16-11-2018	5.42	16-12-2018	
17-07-2018	4.84	17-08-2018	5.80	17-09-2018	6.07	17-10-2018	5.78	17-11-2018		17-12-2018	5.37
18-07-2018	4.84	18-08-2018		18-09-2018	6.26	18-10-2018	5.68	18-11-2018		18-12-2018	5.38
19-07-2018	4.79	19-08-2018		19-09-2018	6.36	19-10-2018	5.55	19-11-2018	5.34	19-12-2018	5.35
20-07-2018	4.82	20-08-2018	5.99	20-09-2018	6.31	20-10-2018		20-11-2018	5.32	20-12-2018	5.33
21-07-2018		21-08-2018		21-09-2018	6.27	21-10-2018		21-11-2018	5.33	21-12-2018	5.26
22-07-2018		22-08-2018		22-09-2018		22-10-2018	5.61	22-11-2018	5.35	22-12-2018	
23-07-2018	4.80	23-08-2018		23-09-2018		23-10-2018	5.65	23-11-2018	5.30	23-12-2018	
24-07-2018	4.75	24-08-2018		24-09-2018	6.27	24-10-2018	5.77	24-11-2018		24-12-2018	5.27
25-07-2018	4.78	25-08-2018		25-09-2018	6.23	25-10-2018	5.72	25-11-2018		25-12-2018	5.29
26-07-2018	4.85	26-08-2018		26-09-2018	6.12	26-10-2018	5.68	26-11-2018	5.28	26-12-2018	5.30
27-07-2018	4.82	27-08-2018	5.99	27-09-2018	6.12	27-10-2018		27-11-2018	5.24	27-12-2018	5.28
28-07-2018		28-08-2018	6.19	28-09-2018	6.08	28-10-2018		28-11-2018	5.24	28-12-2018	5.29
29-07-2018		29-08-2018	6.22	29-09-2018		29-10-2018		29-11-2018	5.25	29-12-2018	
30-07-2018	4.86	30-08-2018		30-09-2018		30-10-2018	5.62	30-11-2018	5.16	30-12-2018	
31-07-2018	4.89	31-08-2018	6.41			31-10-2018	5.52			31-12-2018	5.26

Appendix E: USD/TRY buying rates for first three months of 2019

01-01-2019		01-02-2019	5.21	01-03-2019	5.32
02-01-2019	5.28	02-02-2019		02-03-2019	
03-01-2019	5.33	03-02-2019		03-03-2019	
04-01-2019	5.46	04-02-2019	5.19	04-03-2019	5.34
05-01-2019		05-02-2019	5.22	05-03-2019	5.38
06-01-2019		06-02-2019	5.20	06-03-2019	5.37
07-01-2019	5.41	07-02-2019	5.21	07-03-2019	5.38
08-01-2019	5.36	08-02-2019	5.24	08-03-2019	5.43
09-01-2019	5.43	09-02-2019		09-03-2019	
10-01-2019	5.50	10-02-2019		10-03-2019	
11-01-2019	5.46	11-02-2019	5.24	11-03-2019	5.45
12-01-2019		12-02-2019	5.26	12-03-2019	5.43
13-01-2019		13-02-2019	5.26	13-03-2019	5.44
14-01-2019	5.42	14-02-2019	5.24	14-03-2019	5.45
15-01-2019	5.51	15-02-2019	5.29	15-03-2019	5.46
16-01-2019	5.44	16-02-2019		16-03-2019	
17-01-2019	5.40	17-02-2019		17-03-2019	
18-01-2019	5.36	18-02-2019	5.26	18-03-2019	5.46
19-01-2019		19-02-2019	5.29	19-03-2019	5.45
20-01-2019		20-02-2019	5.31	20-03-2019	5.46
21-01-2019	5.34	21-02-2019	5.30	21-03-2019	5.47
22-01-2019	5.34	22-02-2019	5.31	22-03-2019	5.44
23-01-2019	5.35	23-02-2019		23-03-2019	
24-01-2019	5.31	24-02-2019		24-03-2019	
25-01-2019	5.27	25-02-2019	5.32	25-03-2019	5.53
26-01-2019		26-02-2019	5.31	26-03-2019	5.65
27-01-2019		27-02-2019	5.29	27-03-2019	5.49
28-01-2019	5.26	28-02-2019	5.29	28-03-2019	5.33
29-01-2019	5.28			29-03-2019	5.54
30-01-2019	5.33			30-03-2019	
31-01-2019	5.28			31-03-2019	

Appendix F: Actual and Forecasted USD/TRY values

Date	Forecast(USD/TRY)	Actual(USD/TRY)
01.04.2019	5.630008	5.6284
02.04.2019	5.651387	5.5986
03.04.2019	5.629341	5.5569
04.04.2019	5.647154	5.6067
05.04.2019	5.654561	5.6291
08.04.2019	5.670911	5.5923
09.04.2019	5.679667	5.6671
10.04.2019	5.694961	5.6576
11.04.2019	5.704718	5.6727
12.04.2019	5.719256	5.7112
15.04.2019	5.729757	5.7827
16.04.2019	5.743759	5.7852
17.04.2019	5.754818	5.7892
18.04.2019	5.768442	5.7427
19.04.2019	5.779924	5.8094