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MASTER THESIS

**THE EFFECT OF EXCHANGE RATE VOLATILITY ON  
UNEMPLOYMENT AND GROWTH RATE IN TURKEY:  
1990-2019 PERIOD**

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## ABSTRACT

### THE EFFECT OF EXCHANGE RATE VOLATILITY ON UNEMPLOYMENT AND GROWTH RATE IN TURKEY: 1990-2019 PERIOD

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Exchange rate is basically the equivalent of the currency of a country in the currency of another country and is an important factor in determining the real value of a country's money. Beside, exchange rates are the indicator of the competitiveness of countries. However, the exchange rate is closely related to some macroeconomic variables such as exports, imports, inflation, interest, investments and so on. The changes in the exchange rates also affect economic growth as well as these macroeconomic factors in the short term.

Under the floating exchange rate system, exchange rates tend to show volatility. Since these volatilities increase the exchange rate risk, the prices of import and export goods, the values of international foreign exchange reserves, capital markets, open positions of the real and financial sectors, in short, economic growth and hence the labor market negatively, modeling the volatility in the exchange rate are great in terms of economic measures to be taken and economic policies to be followed is important.

The issue to be examined is whether real exchange rate volatility result in growth and unemployment rate. Basically, with a fixed exchange rate governments cannot allow the exchange rate to volatility in response to external shocks to the economy. If an external shock cannot be accommodated by real change rate in the flexible exchange rate, such shocks must be accommodated by changes in real economic activity, ie. changes in growth and unemployment.

This paper assesses the effects of real exchange rate volatility on growth and unemployment by considering quarterly data from 1990:Q1-2019:Q3. In this study, volatility of real exchange rate is modelled with rate of growth and unemployment by the help of highly correlated and lagged currency data.

**Key Words:** GARCH, Volatility, Real Exchange Rate, Growth, Unemployment

## ÖZ

### TÜRKİYE'DE REEL DÖVİZ KURU OYNAKLIĞININ İŞSİZLİK VE BÜYÜME ORANI ÜZERİNE ETKİSİ: 1990-2019 DÖNEMİ

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Ağustos 2020

Döviz kuru temelde bir ülkenin para biriminin başka bir ülkenin para birimindeki karşılığıdır ve bir ülkenin parasının gerçek değerini belirlemede önemli bir faktördür. Ayrıca, döviz kurları ülkelerin rekabet gücünün bir göstergesidir. Ancak, döviz kuru ithalat, ihracat, enflasyon, faiz, yatırımlar gibi bazı makroekonomik değişkenlerle yakından ilişkilidir. Döviz kurlarındaki değişimler kısa vadede ekonomik büyümenin yanı sıra bu makroekonomik faktörleri de etkilemektedir.

Dalgalı döviz kuru sistemi altında, döviz kurları oynaklık gösterme eğilimindedir. Bu oynaklıklar kur riskini, ithalat ve ihracat mallarının fiyatlarını, uluslararası döviz rezervlerinin değerlerini, sermaye piyasalarını, reel ve finansal sektörlerin açık pozisyonlarını, kısacası ekonomik büyümeyi ve dolayısıyla işgücü piyasasını olumsuz yönde etkilediği için döviz kurundaki oynaklığın modellenmesi alınacak ekonomik tedbirler ve izlenecek ekonomi politikaları açısından büyük önem taşımaktadır.

Bu çalışmada reel döviz kuru oynaklığının büyüme ve işsizlik oranları üzerine etkileri araştırılmıştır. Temelde sabit döviz kurunda hükümetler reel döviz kuru oynaklıklarının dışsal şok olarak ekonomiyi etkilemelerine izin vermezler ya da parasal / mali politikalar uygularlar. Eğer bir dışsal şok dalgalı döviz kurunda etkisi uyumlaştırılmazsa ekonomide ekonomik büyüme ve işsizlik gibi değişmelere neden olmaktadır.

Bu çalışma Türkiye için reel döviz kuru oynaklığının büyüme ve işsizlik oranları arasındaki ilişkiyi 1990:Q1-2019:Q3 arası verileri çeyrek dönemlik olarak araştırmaktadır. Bu çalışmada, yüksek oranda korelasyonu ve gecikmeli para birimi verileri kullanılarak reel döviz kuru oynaklığı büyüme ve işsizlik oranı ile modellenmiştir.

**Anahtar Kelimeler:** GARCH, Oynaklık, Reel Döviz Kuru, Büyüme, İşsizlik

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I would like to express my enduring love to my parents, who are always supportive, loving and caring to me in every possible way in my life.

Mohammad Mehran Rahimi

İzmir, 2020

## TEXT OF OATH

I declare and honestly confirm that my study, titled “THE EFFECT OF EXCHANGE RATE VOLATILITY ON UNEMPLOYMENT AND GROWTH RATE IN TURKEY: 1990-2019 PERIOD” and presented as a Master’s Thesis, has been written without applying to any assistance inconsistent with scientific ethics and traditions. I declare, to the best of my knowledge and belief, that all content and ideas drawn directly or indirectly from external sources are indicated in the text and listed in the list of references.

Mohammad Mehran Rahimi

Signature

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## **SYMBOLS AND ABBREVIATIONS**

**ACF:** Autocorrelation Function

**ADF:** Augmented Dickey-Test

**AIC:** Akaike Information Criterion

**AR:** Autoregressive Process

**ARCH:** Autoregressive Conditional Heteroskedasticity

**ARMA:** Autoregressive, Moving Average Model

**GARCH:** Generalized Autoregressive Conditional Heteroskedasticity

**EWMA:** Exponentially Weighted Moving Average Models

**GARCH:** Generalized Autoregressive Conditional Variable Variance

**IMF:** International Monetary Fund

**LB:** Ljung-Box Test

**LM:** Lagrange Multiplier

**MA:** Moving Average Process

**PAC:** Partial Autocorrelation Function

**P-P:** Phillips-Perron

**RER:** Real Exchange Rate

**ROM:** Reserve Option Mechanism

**Q:** Ljung-Box Statistics

**SQR (VOL):** Square Root (SQR) Stochastic Volatility Model.

**SIC:** Schwarz Information Criterion

**TCBR:** Central Bank of the Republic of Turkey

**VAR:** Vector Autoregression



## CHAPTER 1

### INTRODUCTION

Exchange rate refers to the index value against a basket created by weighing the local currency in various currencies according to various criteria. It shows how valuable the local currency is compared to the price traded in financial markets. According to another definition, the exchange rate is the equivalent of one country's currency in another country's currency and is an important factor in determining the real value of a country's currency. The exchange rate is expressed as a conversion tool, a coefficient or ratio, which depends on the direction of the conversion process. (Azid et al., 2005: 749-750). In addition to this, another indicator of countries' competitiveness is exchange rates. However, the exchange rate is closely related to some macroeconomic variables such as inflation, interest yield, investments, import and export. Changes in exchange rates affect these macroeconomic factors in the short term, as well as affecting economic growth (Ahmad et al., 2013: 741).

The relationship between exchange rate and economic growth is very important from the normative point of view. For a balanced economy, governments need to correctly determine their exchange rate policies. There are generally controversial views among economists about the relationship between exchange rate and economic growth, or in other words, there is no full consensus (Azid et al., 2005: 749-750).

Volatility means a change in the price of an investment instrument in the forex market. This change usually measures the risk of the financial instrument over a period of time. Volatility, a risk measurement indicator, is obtained by measuring the standard deviation or variance of the probability distribution of the returns. Volatility, foreign currency, stock etc. in a certain period of time. is the measure of price changes in the markets. In other words, volatility is also expressed as the standard deviation of the change in the price index or its logarithm over a period of time (Ünsal, 2005). Volatility means that the values of variables move away from a certain average in a short time (Akay & Nargeleçekenler, 2006: 5). volatility; It is defined as instability, uncertainty or indecision and is seen as a measure of risk. At the same time, volatility is considered as a measure of risk in asset pricing, portfolio optimization, option pricing and risk management. Therefore, volatility offers a risk measurement variable

that can be used as an input in various economic decisions. Exchange rate volatility is defined as uncertainty in international transactions in both the commodity market and financial assets market (Çelik, 2017).

The real exchange rate is the nominal exchange rate adjusted for price changes and is seen as an important macroeconomic policy variable showing the competitiveness of a country (Kogid et al., 2012: 7). As stated in many studies, the exchange rate can positively affect economic growth through two channels. First, the exchange rate reduces the risk of cash, thereby reducing interest rates. This situation increases investment and growth. Second, the exchange rate may affect growth by lowering international transaction costs in connection with international trade (Dornbush, 2001: 5). There are many studies in the literature investigating the question of exchange rate volatility investment and how it affects economic growth (Çiftçi, 2014).

According to the economic theory, the exchange rate can act as a monetary instrument, especially affecting long-term growth negatively (Miles, 2006: 92). It is generally accepted that exchange rate volatility has negative effects on foreign trade, tourism, international financial flows, investment and production (Güloğlu and Akman, 2007: 44). It is also stated that exchange rate volatility reduces trade and investment, which is important for economic growth (Eichengreen, 2007: 3). Real exchange rate volatility creates an uncertain environment for investment decisions and in such an environment, investors are delaying their investment decisions in order to get more information about the exchange rate. In this case, it creates a great negative power on economic performance (Chen, 2012).

The volatility experienced in exchange rates is thought to cause economic crises especially in recent years. South East Asia, Russia and Turkey were seen as problems generated by the crisis oynaklığı exchange rate and exchange rate movements has been the focus of theoretical and empirical studies. As the volatility in exchange rates increases the exchange rate risk, modeling the volatility in the exchange rate is of great importance for the economic measures to be taken and the economic policies to be followed since it negatively affects the prices of import and export goods, the value of international foreign exchange reserves, the open positions of the real and financial sectors, in short, economic growth and therefore the labor market (Engle, 2003; Keating 1990).

This research assesses the effects of real exchange rate volatility on growth and unemployment by considering quarterly data from 1990:Q1-2019:Q3. In this study, volatility of real exchange rate is modelled with rate of growth and unemployment by the help of highly correlated and lagged currency data. In the study, real GDP (RGDP) will be taken as a dependent variable representing economic growth.



## CHAPTER 2

### REAL EXCHANGE RATE

#### 1.1. Real Exchange Rate Determination

Foreign exchange refers to all foreign payment instruments in the broadest sense, and in a narrow sense only trade policies written on foreign currencies. In other words, in a broad sense, foreign currency is all foreign currencies and all kinds of payment instruments and securities valid abroad (Karluk, 1995). The change in the exchange rate changes the relative balance between the currencies of the two countries in question and affects the international goods, services, capital flows and therefore economic power. Generally, countries accept payments in their own national currency in exchange for the goods, services and production factors they sell. (Kutlu, 2000).

Exchange rate is generally defined as the rate of change that shows how much foreign currency can be bought with a unit of national currency (Ahmad et al., 2013: 741). According to another definition, the exchange rate is the price of a currency against another currency with which it is associated. According to this definition, the exchange rate is expressed as a conversion tool, a coefficient or ratio, which depends on the direction of the conversion process. (Azid et al., 2005: 749-750). The real exchange rate is the nominal exchange rate adjusted for price changes and is seen as an important macroeconomic policy variable showing the competitiveness of a country (Kogid et al., 2012: 7). As stated in many studies, the exchange rate can positively affect economic growth through two channels. First, the exchange rate reduces the risk of cash, thereby reducing interest rates. This increases investment and growth. Second, the exchange rate may affect growth by lowering international transaction costs in connection with international trade (Dornbush, 2001: 5). In case the general level of real incomes and prices in foreign countries increases or real interest rate increases, the exchange rate of a country increases compared to other markets (Oksay, 2001). Foreign exchange markets are the most approaching markets for full competition due to the large number of buyers and sellers, the foreign currency being homogenous, divisible due to the monetary currency, the perfect news and the entry and exit of the market (Ünlü, 2016).



In economies where free market principles are valid and foreign trade and capital movements are free, the exchange rate is determined freely in the market environment according to supply and demand conditions. Although the exchange rate is a “price”, this is quite different from the price of any good. It is obvious that the change in the exchange rates creates a different effect than the effects arising from the change in the price of any good. However, the change in exchange rates creates global changes in the economy by affecting the markets and prices of goods and services, which have been subject to international economic relations, and then other markets.

In order for a foreign currency to be considered as foreign currency, it must be acceptable to all countries in international payments. Today, the U.S. economy and the Western European states are strong. The national currencies of countries such as Canada, Japan, Saudi Arabia can be converted immediately without any limitation to other desired national currencies and they are convertible. Convertible national currencies are used as an international payment instrument. According to the IMF, full convertibility is the fact that real and legal persons who are established or not located in a country in a broad and absolute sense can freely acquire that country's money or other foreign currencies and exchange them with other foreign currencies (Kogıd, 2012). The extent to which the currencies of the countries cover the convertibility requirements is set forth by the IMF according to the following criteria;

- Abbreviation in the current account item of the balance sheet,
- The exchange rate applied to exports is different from the exchange rate applied to imports,
- Having more than one exchange rate for export and import transactions,
- Applying different currencies to invisible items with capital movements,
- Restricting capital movements,
- Differentiating between foreign currencies used in external payments,
- Bilateral payment agreements between countries that are members of the IMF and not.
- Making a guarantee for imports,
- Finding price payments in imports

Foreign exchange supply and demand are determined in the foreign exchange market of foreign exchange rates The need of a country's economy to foreign currency reveals the demand to import goods and services. From another point of view, the foreign

exchange price occurs in reverse connection with the foreign exchange demand. We can list the factors affecting the foreign exchange demand as follows:

- Price elasticity of the supply of goods that rival imported goods in the country,
- Price elasticity of import supply,
- The price elasticity of other country demands towards the goods imported by the country,
- The price elasticity of the country's demand for imported goods

Foreign exchange supply depends on exports by other countries. The exchange rate is determined by the demand, which is the export of countries. Contrary to the foreign exchange demand, the exchange rate is in direct proportion to the foreign exchange supply. It is possible to list the basic variables that affect the foreign exchange supply as follows:

- Price elasticity of domestic demand for goods exported in the country.
- Price elasticity of the supply of foreign goods competing with the country's export products
- The elasticity of the demand for the country's exports,
- The point where the foreign exchange supply and demand is equal is called the balance exchange rate.

### **1.1.1.Real Exchange Rate**

The real exchange rate, in its simplest definition, is the exchange rate calculated to take into account inflation differences between countries. Unlike nominal exchange rates that cannot be interpreted alone, real exchange rates contain more information about the country's economy and are seen as a more accurate indicator. (Akbulut, 2016; Barak and Naimoğlu, 2018). Its importance is that it is an indicator used in terms of competitiveness in a country's foreign trade. It is also taken into account in the formulation of monetary policies, which are monitored due to their impact on the Central Bank's balance sheet (Berument, 2002).

The real exchange rate is defined as the exchange rate equivalent to the relative prices of the goods between the two countries. In other words, the real exchange rate indicates the rate at which a country's goods are traded with the goods of another country. In this sense, real exchange rates are also called terms of trade. There are bilateral real

exchange rates in one country's relations with another country. Binary real exchange rate refers to a comparison made by converting the prices of domestic and foreign countries, representative production or consumption baskets into a common currency in local or foreign currency. Binary real exchange rate calculation is of greater importance in the countries of money blocks or in countries that carry out a large part of their trade with a country (Özkan, 2003).

The bilateral real exchange rate can be formulated as follows:

$$\mathbf{RER = ER (Pf/Pd)}$$

RER, dual real exchange rate in local currency; ER, nominal exchange rate; Pf foreign level prices general level; Pd, on the other hand, shows the general levels of the domestic country's prices. When the real exchange rates are analyzed in this respect, when the inflation rates of one country increase more than the inflation rates of another country, the national currency tends to lose value and vice versa. (Yıldırım, 2005).



Figure 1. Real Exchange Rate from 1980 to 2018 (based on CPI)

In Turkey, the TL was under controlled and fixed exchange rate regime between 1980-2001. In this period, the nominal exchange rate, which remained fixed for a certain period, was determined directly by the Central Bank. We can divide the fixed exchange rate monitored after the great devaluation on January 24, 1980 in two period. The first period was a period that lasted from 1980 to 1988, in which the real exchange rate was

continuously reduced in order to increase the competitiveness of Turkish goods and therefore exports and reduce imports in international markets. During this period, the real exchange rate, which was around 110 in 1980, was reduced to 64 in mid-1988 by devaluating TL at a higher rate than the inflation difference (Ünlü, 2016).

The Central Bank started to use the exchange rate as an anti-inflation tool after 1988 due to the risk of increasing inflation from the control in the late 1980s. For this, the nominal devaluation rate of TL should have been below the inflation rate difference of us and our partners. This meant an increase in the real exchange rate. Indeed, as a result of this policy approach, the real exchange rate, which was 64 in 1988, rose to 95 at the beginning of 1994. The real exchange rate, which has seen the historically lowest level of 58 with the great devaluation experienced in the 1994 crisis, has continuously increased during the fixed / controlled exchange rate regime between 1994 and 2001 and reached 111 in January 2001.

The more important difference observed in the movement of Real Exchange Rate (RER) in time before and after 2001 was the cycles that Real Exchange Rate (RER) followed in the short term under the floating exchange rate regime. Figure 2 Turkey's consumer price index (CPI) is calculated using the real exchange rate seen in September 2001 until June 2018, followed by short-term cycles (Pekmezci, 2016).

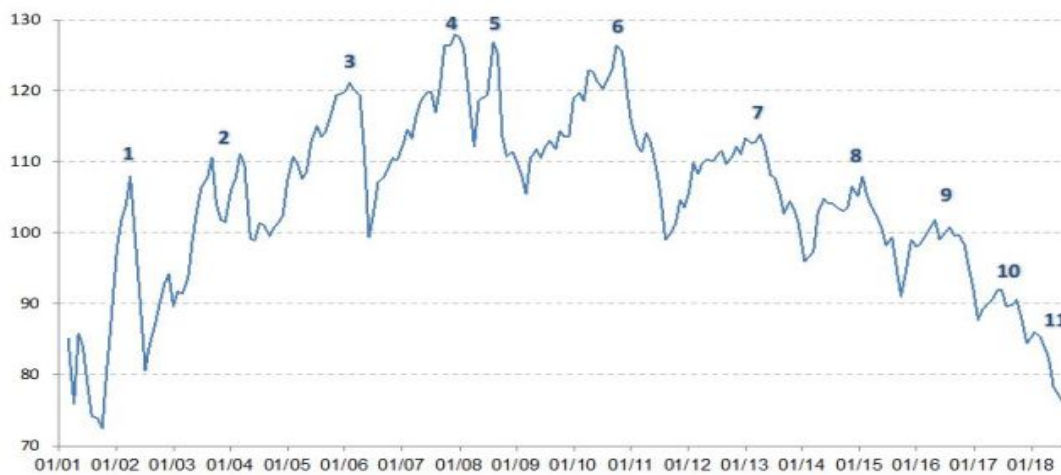


Figure 2. Real Exchange Rate from 2001 to 2018 (based on CPI)

The real exchange rate, in both rising and falling trends, sometimes experienced quite large fluctuations in the short term. Possible causes of these fluctuations include

important economic and political developments both inside and outside, as well as large and small crises in international financial markets (Pekmezci, 2016).

### **1.1.2 Purchasing Power Parity Approach**

The purchasing power parity theory is one of the most controversial topics in international finance literature. In most general terms, it states that the exchange rate between the two countries' currencies will be explained by the inflation rate differences of the respective countries (Krugman & Obstfeld, 2009). The theory is also called the "exchange rate inflation theory" because it expresses the price level changes as the main determinant of exchange rate movements (Rogoff, 1996).

Purchasing power parity is an exchange rate determination theory introduced into the literature by Swedish economist Gustav Cassel in 1918. It is an approach developed to reorganize the currencies of countries that experienced inflation in various scales during the First World War. During this period, Cassel encouraged the use of "purchasing power parity" as a tool for determining the relative gold parity. It basically suggests the necessity of calculating the consumer price index from the beginning of 1914 and using these inflation differentials to calculate the exchange rate changes required to maintain purchasing power parity (Karluk, 2003).

At the basis of the purchasing power parity approach, there is an idea that one unit of money can be bought in every country, so that the same amount of law will be valid. According to this approach, the price of a traded economic asset, translated from the current exchange rate to a certain national currency, must be the same everywhere in the world. When the same goods in different markets are expressed in a single currency, the price of the goods will be the same in each country (Pekmezci, 2016).

Time differences between exchange rate changes and price changes lead to low validity of Purchasing Power Parity in the short term. Also, in countries where floating exchange rate system is applied, theoretically, Purchasing Power Parity should be valid in the long term. With the collapse of the Bretton Woods System in 1973, efforts to determine the validity of Purchasing Power Parity in the long run have increased (Erdal, 2005). According to this approach, the value that the exchange rates will take

when freely determined is freely a measure of the relative price changes between countries. Therefore, the balance exchange rate has a linear relationship with the rate of price levels.

$$q_t = s_t - p_t - p_t^*$$

The long-term validity of the Purchasing Power Parity theory is tested with the help of real and nominal exchange rates and price indices.  $Q_t$  in the equation above refers to the logarithm of the real exchange rate, the logarithm of the  $s_t$  nominal exchange rate, the logarithm of the domestic price index, and  $p_t^*$  is the logarithm of the international price index. If the Purchasing Power Parity is valid in the long term, the logarithm of the real exchange rate becomes zero ( $q_t = 0$ ). As a result, the logarithm of the nominal exchange rate equals the logarithmic difference of price levels ( $s_t = p_t - p_t^*$ ). Therefore, in order for Purchasing Power Parity to be valid in the long term, the real exchange rate must return to the average. In case of unit root in the series, Purchasing Power Parity is not valid. The reason for this is that the deviation in the real exchange rate will not return to the average in the long run in the presence of the unit root. It is possible to sum up the importance of the Purchasing Power Parity theory under five main headings:

- 1) Deviations from Purchasing Power Parity, which occur with nominal and real shocks, are used to explain the movements in the real exchange rate.
- 2) Purchasing Power Parity helps to determine the degree of exchange mismatch.
- 3) Provision of purchasing power parity is one of the open economy balance assumptions.
- 4) Purchasing Power Parity aims to eliminate inflation differences for comparing income between countries.
- 5) Purchasing Power Parity is used as an auxiliary tool for creating parities.

In order for the purchasing power parity to be meaningful, a large number and variety of goods and services must be in the basket in question. Since data must be collected from many countries for this job, the size and complexity of the work to be done is large. Every three years, the World Bank publishes a report that includes comparisons

of countries by US dollar and purchasing power parity. The purchasing power parity theory is not a perfect theory, but it can give very distant results in the short-term approach. It is also doubtful that it can yield realistic results in the long term. However, since there is no better method to compare between countries, it continues to be the method applied despite all its shortcomings (Ünlü, 2016).

Purchasing power parity, according to Turkey's Gross Domestic Product and that the IMF is ranked 13th in the world according to calculations made by the World Bank. So both the IMF and the World Bank's accounts in 2017 and Turkey in 2016 is estimated that the world's 13th largest economy. However, when the same accounts are made without taking into account purchasing power parity calculations in both the IMF and the World Bank in Turkey in the world in 2017 and 2016 it is the 17th largest economy.

#### **1.1.2.1. Absolute Purchasing Power Parity**

In absolute terms, purchasing power parity implies that the price levels converted into national currencies according to exchange rates should be the same across countries. This theory is actually a form of the single price law applied to national price levels that cover all goods rather than individual prices. The price index measures the general average of prices at a given moment in an economy. In order to establish this price index, it is first decided which prices will be included in the index, that is, the prices of individual goods and services will be observed. Then these are given weights reflecting the importance of each in the total expenditure. Various indices such as consumer price index, producer price index and gross national product deflator are generally used in applications. Therefore, in order for the price indices between the two countries to be compared properly, these indices should include the same goods and services and each should be weighted similarly. Even though the single price law applies to a single good, price indices based on multiple goods and weights may not obey the single price law (Kutlar, 2000).

According to the absolute Purchasing Power Parity theory, the prices of a product group in countries should be the same at the determined exchange rate. If the Purchasing Power Parity theory is valid, it means that the purchasing power of any national currency is the same all over the world. According to this theory, real

exchange rates are fixed in the long run. In the short term, deviations from the Purchasing Power Parity play a key role in directing aggregate demand; however, it is accepted that there are no significant differences between the general level of domestic and international prices. In other words, the exchange rate must adapt to eliminate price variations in the world (Whploz, 2005). Absolute Purchasing Power Parity theory is expressed as follows:

$$P_t = P_t^* / e_t$$

In the equation above,  $P_t$  denotes domestic prices,  $P_t^*$  denotes foreign prices, and  $e_t$  denotes the nominal exchange rate. According to the absolute Purchasing Power Parity theory, the logarithm of the real exchange rate should be zero. Since the price indices of the countries may not contain similar goods, the similarity of prices loses its meaning and this situation loses its absolute Purchasing Power Parity power (Tatoğlu, 2009).

This theory is actually a version of the single price law, which applies to national price levels covering all goods rather than individual prices. The price index measures the overall average of prices at a given moment in an economy. In order to create this price index, it is first decided which prices will enter the index, that is, the prices of individual goods and services. Then they are given weights that reflect the importance of each of them in total spending. In practice, various indices such as consumer prices index, producer prices index and gross national product deflator are used. Therefore, in order to compare the price indices between the two countries in a healthy way, these indices should contain the same goods and services and each should be weighted similarly (Copeland, 2005: 60).

Although the single price law applies to a single good, the price indices based on a large number of goods and weights may not comply with the single price law. The statistics usually use the most appropriate weights to accurately calculate the inflation rate for each country. This causes differences between countries. Besides there are important quality differences in goods, there are many artificial obstacles to prevent price equality between countries. In such countries, although an important group of goods and services falls within the scope of price indices, it is not subject to



international trade. their prices also differ. all these counts limit the ability of price indices to be compared between countries (Dornbusch, 1985).

The more homogeneous a good is, the more valid single law is for that good. Such as gold, currency, wheat, crude oil. Price indices change as the prices of non-trade goods change, but there may be no change in exchange rates. Because the change in their prices does not affect the foreign trade flow and foreign exchange supply and demand. In practice, purchasing power parity is mostly dealt with relatively. However, in international per capita income comparisons, it is seen that it acts from the absolute purchasing power approach (Pilbeam, 2006: 127).

### 1.1.2.2. Relative Purchasing Power Parity

Any movement in exchange rates reflects the change in the relative prices of the two countries. The higher the increase in domestic prices, that is, the lower the purchasing power of money in the country, the more the foreign value of that country's money should be reduced. According to the relative purchasing power parity, the exchange rate between the national currency and any foreign currency changes to reflect the difference in price increases, ie inflation rates, rather than the absolute price levels of these two countries. That is, the percentage of the change in the exchange rate is equal to subtracting the foreign inflation rate from the domestic inflation rate (Gandolfo, 2002: 223). If we show it with the formula;

$$S_1 - S_0 / S_0 = p - p_f$$

$S_0$ : Exchange rate in the base year

$S_1$ : Current exchange rate in the next period

$S_1 - S_0 / S_0$ : Percentage change in exchange rate

$p$ : Inflation rate between two periods in Turkey,

$p_f$ : Inflation rate of the foreign country between two periods.

The rate indicated by the purchasing power parity hypothesis can be defined as the balance exchange rate. Exchange rates convert goods prices into a common currency, thereby balancing the supply and demand for goods and services traded in international markets. If there is no change in the exchange rate despite the increase in domestic prices in a country A, the goods and services of this country will now be more expensive. This means that the supply-demand balance of that country before the

domestic price increase in the international market has deteriorated. In order to maintain the balance from the beginning, there should be a depreciation in the country's money as well as the increase in domestic prices. Thus, the balance rate of the Purchasing Power Parity hypothesis is formed (Copeland, 2005: 63). The basis of the Purchasing Power Parity hypothesis is that price changes are eliminated by changes in the nominal exchange rate, that is, the real exchange rate is constant. The real exchange rate is the expression of the price level of one country in terms of the price level of another country and shows the competitiveness of the country in international markets. To assume that the real exchange rate remains constant is to assume the competitive power as constant. (Seyidođlu, 2001: 112; Ong, 2003: 3).

### **1.1.3 Monetary Approach**

Monetary approach, which is the first of the financial markets approaches based on stock variables; It appears as a new approach to explaining exchange rate behavior by including bond markets and expectations as well as goods markets (Müslümov et al. 2002, p. 45). They argued that the price of a good is determined by its supply and demand, according to those who advocate the monetarist approach. Since the money supply is determined by the central banks, in this approach, the demand for money is more important than the money supply (Pekmezci, 2016).

The formation of exchange rates in the monetarist approach is a result of the imbalance between money supply and demand. In the formation of the exchange rate, the rational expectations of those who demand foreign currency or financial assets should also be taken into consideration. While evaluating the monetary approach, it should not be overlooked that the predictions of the monetary approach regarding money demand are different from the predictions in alternative exchange rate analyzes. In this context, while the monetary approach (while the data is abroad) decreases the exchange rate of the domestic product, some economists argue that the increase in the product will increase the foreign exchange rate by increasing the imports (foreign exchange demand). (Seyidođlu, 2001).

The most important contribution of the monetarist approach to the literature regarding the determination of the exchange rate is that it takes into account the bond markets and expectations, as well as the commodity markets. With the participation of the

bonds in the analysis, the difference between interest rates has gained importance in terms of the variables discussed in determining the exchange rate (Mwinlaaru, 2017).

#### **1.1.4. Portfolio Approach**

In the portfolio approach, all monetary and financial assets in the world try to explain the formation of exchange rates through changes in the supply and demand of assets in the markets. In the portfolio approach, which is called the assets approach, it is accepted that individuals and firms hold their fortunes in the form of three financial assets such as money, domestic bonds and foreign bonds, and are valid in the unmet interest rate parity (Kogid, 2012).

According to the portfolio approach, economic units will prefer those with higher returns than those with a different distribution or those with a lower risk than those with the same return. If their expectations change, they will want to rearrange their portfolios. The increase or decrease of the share of foreign currency assets within the portfolio is affected by the change in interest rates and exchange rates. In addition to foreign trade and capital movements, changes in portfolio preferences affect foreign exchange supply and demand and lead to new balances (Javed, 2009).

#### **1.1.5. Balance of Payments Approach**

According to the balance of payments approach, if the internal and external balance are provided together, the exchange rates will also be in balance. He argues that while the internal balance assumes that the economy will be in full equilibrium in the case of full employment, the foreign exchange will be in equilibrium if the foreign balance balances each other with the foreign currency entry or exit due to current transactions and the foreign currency entry or exit due to capital transactions (Çiftçi, 2014).

With the balance of payments approach, both purchasing power parity and deviations from the parity can be explained. However, in this approach, there are problems such as not disclosing the exact natural unemployment rate and determining an exchange rate consistent with the external balance. Especially, it seems quite difficult to explain the short term exchange rate changes with this approach (Ahmad, 2013).

### **1.1.6. Productivity Based Approach**

According to this approach put forward by Balassa (1964) and Samuelson (1964), the increase in productivity in the sectors that are subject to foreign trade will be higher than the productivity increase in sectors that are not subject to foreign trade and have a relatively labor intensive production process. In other words, this approach explains the change in real exchange rates with the change in the relative yield rates of the sectors that are subject to foreign trade and are not subject to foreign trade (Ahmad, 2013).

The main basis of this approach is that, as a result of the increase in productivity in the sectors subject to foreign trade, workers' wages will increase, but since the price of the exported goods is determined in the international market, this wage increase will not be reflected in the prices. The existence of cross-sectoral worker mobility in the conditions of perfect competition will increase worker wages. Increasing wages will increase the general level of prices and cause the appreciation of the domestic currency and thus the appreciation of the real exchange rate (Chen, 2012).

### **1.2. Exchange Rate Regime in Turkey (1990-2019)**

Looking at the new exchange rate regime applied in Turkey, on the foreign exchange market for the purpose of direct supervision of 20/02/1930 Law No. 1567 on Turkey entered into force and we see that a significant portion of the decrees. With this law, the principles of the Turkish exchange rate regimes were determined and the Council of Ministers was deemed authorized. However, due to the lack of a central bank in those years, there was no effective success in the control of the foreign exchange market. Therefore, the Central Bank of the Republic of Turkey (TCBR) was established on 11.06.1930 and foreign exchange markets has tried to keep under control (Çelik, 2017).

As the effects of the Great Depression that emerged in 1929 began to deepen, measures were taken in 1933, and the Turkish Lira's convertibility was terminated by removing the free interest application with the "Lending Money Act". After this date, fixed exchange rate policy has been implemented for many years. Decision No. 28 on The Law on the Protection of the Value of Turkish Currency, which entered into force on December 29, 1983, and Decision No. 30 on The Law on the Protection of the Value

of Turkish Currency, which came into force on July 7, 1984 a year later, has been put into practice in August 1988, although the exchange rates were determined in market conditions. After this date, exchange rates; It is started to be determined with “daily exchange rate determination sessions” (Çelik, 2017).

With the Decision No. 32 published in the Official Gazette dated August 1, 1989, the transition to full convertibility was realized. With this decision, the import of Turkish money was completely released, and its issuance was subject to the Ministry's permission. The conclusion of this practice in terms of monetary policy applications is very clear. the short-term capital movements emerged along with the liberalization of capital movement in Turkey, the center has interfered with the fundamental monetary aggregates influences and directs the bank to substantially weakness (Ünlü, 2016)

After August 1989, with the liberalization of capital movements, foreign currency pressure on Turkish Lira started to occur. By 1991, the exchange rate was higher than the inflation rate in 1989 and 1990, causing the Turkish Lira to depreciate in real terms. With the right government devaluation at the end of 1993 to accelerate the devaluation in order to resolve differences that occurred between inflation on the one hand the international rating agencies of Turkey's credit rating is lowered to the direction of releases it has accelerated to escape from the Turkish Lira. In this framework, a series of economic measures were put in place by taking the Economic Stability Decisions of 5 April 1994 (Çiftçi, 2014).

The "Monetary Program" was first announced by the TCBR in 1990. The main features of this money program can be listed as follows (Erçel, 1996):

- The TCBR's balance sheet (statement of financial position) was made more transparent and rearranged.
- The sizes obtained from the TCBR balance sheet set the announced targets.
- Targets have been set on a medium-term plan. It is aimed to reach a balance sheet structure that has the flexibility to combat inflation better in the medium term.
- The targeted balance sheet structure included signals regarding which policy instruments the TCBR will use and in what direction. For example, it has been given importance to regulate the liquidity need in the market by moving away from the

financing of the public sector and in this direction, the use of rediscount credits has increased.

- It is aimed to balance the foreign exchange position in the balance sheet of the TCBR.

In 1992, another monetary program was announced by the TCBR. However, the program became impractical due to the deterioration of the public balance as a result of the Treasury's short-term advance use at the beginning of the year and high expenditures in the election (Sarı, 2007).

While the exchange rates were determined according to the Central Bank Circular in the Decree No. 20918 dated 3 July 1991 until April 5, 1994, the principle of determining foreign exchange rates was rearranged with the decisions of April 5. The loan relations between the TCBR and the Treasury and other public institutions were reorganized and restrictions were imposed on the loans used by the Treasury from the TCBR since 1995. On the other hand, with the law published on April 21, 1994, the regulation on the short-term account of the Treasury was introduced. According to this regulation, the upper limit of the advance account, which was previously determined as 15% of the general budget appropriations, was 12% for 1995, 10% for 1996, 8% for 1997, 1998 and for the following years, it was determined as 3%. Other measures taken by the TCBR in order to consolidate money control and restore confidence and stability in the markets are as follows (Kıpıcı and Kesriyeli, 1997: 11).

- With the provision for deposit reserve and disponibility system, the implementation of disponibility was started over the liabilities of the banks.

- The deposit reserve application, which previously worked in favor of foreign exchange, started to work in favor of the Turkish lira.

- New regulations were introduced to repo transactions in order to prevent unrequited repo transactions.

- The definition of flexible maturity types has been realized in Turkish lira deposits and all savings deposits in banks are secured

The policy implemented in half of 1994 continued to be used in the first ten months of 1995. The TCBR used the exchange rates as a nominal anchor while fighting inflation.

In order to increase the credibility of the exchange rate policy, foreign assets were tried to be increased, and domestic assets were limited in order to reduce the pressure of this increase on monetary aggregates. Open market transactions have been used in the sterilization of foreign asset growth (Kanyilmaz, 1999: 273). According to the “stand by” agreement made with the IMF, the “Net Domestic Assets” item has been determined as the main target in terms of monetary size. International reserves, which are among the IMF targets, increased more than expected. After entering the Customs Union, Turkey's economy has become a part of the global economy and economic policy has been shaped in this direction (Morgil, 1999: 157). However, uncertainties in the economy increased with the election at the end of the year, changes in government and the termination of the “stand by” agreement (Kıpııcı and Kesriyeli, 1997: 28).

In 1996, the TCBR started to pursue a monetary policy that restricted the increase in domestic assets and created TL in exchange for foreign assets. As long-term loans are not used, domestic assets remained within the desired limits. Due to the very high interest rates in the first months, a serious increase occurred in the foreign exchange reserve. European Customs Union in 1996, which included the increase was seen in Turkey's imports and exports, has been the increase in the trade deficit in foreign trade with the EU. The trade of luggage with Russia and the increase in net service exports prevented the current account deficit from reaching a serious level (Ünlü, 2016).

The exchange rate policy implemented between 1994-1999 was aimed at maintaining stability in real exchange rate changes. In this period, exchange rates were determined in the market under the intense intervention of policy makers. In 1999, an important development in terms of exchange rate systems and policies in this period was the "Exchange Rate Based Disinflation Program" which was launched on 9 December 1999.

Considering the recent exchange rate policies, on January 1, 2000, the fixed exchange rate policy, which was directed within the scope of the disinflation policy, was adopted. While the exchange rate adjustments from 1995 to 2000 were determined according to the expected inflation, exchange rate increase rates were determined according to the targeted inflation at the beginning of 2000. According to this system called "currency anchor" or "expanding band", what would be the exchange rate for

three years would be determined and announced before. This policy has been successfully implemented by using the daily exchange rates covering the period of January 1-December 31. In accordance with the three-year program, it was understood that the daily exchange rate, previously announced to be continued in 2001, could not be continued in the atmosphere of insecurity experienced on February 19, 2001, and the exchange rate application, which fluctuated freely, was initiated after the government changed the exchange rate regime (Korkmaz, 2015).

Following the crisis in November 2000, with the additional support of the IMF, interest rates began to decrease and capital inflows began to revive. However, the banking system was financially damaged and there was a shortening in the maturities of funds provided from both domestic and foreign markets. In February, the Turkish Lira faced a big attack and it was decided that the Turkish Lira will be fluctuated against foreign currencies, considering that the applied exchange rate system will cause losses in the future periods. The TCBR intervened in order to overcome the problems in the payments system, to ensure financial stability and to improve the banking system (Kibritçioğlu, 2004).

With the transition to the floating exchange rate regime in 2001, there was a change in the TCBR's monetary policy strategy. According to the new regime, exchange rates will be determined based on supply and demand in the market, and the TCBR can only intervene to prevent excessive fluctuations in the short term. These interventions will usually be carried out by the foreign exchange auction method. Since the importance of international reserves will increase in periods when capital inflows decrease suddenly, this situation is considered as an issue that the TCBR should pay attention to. After switching to the floating exchange rate regime, excessive volatility occurred in the exchange rate. The fact that the banking system had a significant open position when the February crisis started was one of the most important reasons that triggered this volatility. Accordingly, bonds were issued to the nation and SDIF (Savings Deposit Insurance Fund) Banks in May, and debt was exchanged with private banks in June. However, as the banking system is financially damaged and banks do not want to take risks, domestic and foreign loan acquisition has become difficult and the payment of net foreign debt has been imposed on the banking sector. In this period, there was a 21.572 million-dollar deterioration in capital movements and this situation caused exchange rate movements (Korkmaz, 2015).



During the period from February 2001 to January 2002, which has been switched to the floating exchange rate regime, the interest rates fluctuated significantly. In this context, conditions have started to improve in order to provide depth in the money market and to establish a “Turkish Lira reference interest rate” between banks. In addition, in August 2001, the forward exchange market, an important factor for the successful exchange rate regime, was opened in the ISE. Efforts have been made to develop these markets, which help reduce uncertainty for the coming periods (Kutlar, 2000)

2001 crises are financial crises. The reflections of this type of crisis on the money market are the increases in interest rates and exchange rates. After these crises experienced in Turkey's economy it has made significant progress towards macroeconomic stability. Within the economic program revised to cover the 2002-2004 period, a framework was introduced that gradually passed the open inflation targeting regime. In this context, while short-term interest rates are used as the main monetary policy tool under the wavelength regime, on the other hand, the base money, which is part of the program carried out with the IMF, has served as the nominal anchor (Korkmaz, 2015).

In the floating exchange rate regime system, the TCBR also stated that the exchange rates are not used as a monetary policy, the central bank does not have any exchange rate targets and can directly intervene in the market in case of excessive volatility in both directions.

In 2002, a decision was made to continue with the floating exchange rate regime and to intervene in foreign exchange only when there was excessive fluctuation by keeping interventions to a minimum. Implicit inflation targeting strategy started to be implemented in 2002, which followed a policy focused on future inflation, and this practice continued until the end of 2005. In the first half of 2002, there were positive developments in inflation and a continuous interest rate cut was made. However, due to political instability and the exchange rate is showing a downward trend since 2002, Turkey's credit risk has increased markedly (Özatay, 2009: 53-54).

TCBR, changes in the price index published by the Turkey Statistical Institute and conducted due to the currency reform, did not exceed the inflation targeting regime in

2005. In 2005, which was accepted as the last preparation period for the transition to inflation targeting regime, efforts were made to make monetary policy more institutional and to increase transparency. The TCBR is planned to move to the inflation targeting regime in 2006 and it is aimed to move from the falling inflation process to the price stability process (Ünlü, 2016).

As predicted earlier in 2006, the implementation of the inflation targeting regime was initiated. In this period, when many supply shocks were encountered and deviated from the inflation target, the TCBR stated the reasons for moving away from the inflation target by writing open letters to the Government. Necessary measures have been taken to reach the desired level of inflation, evaluations regarding the process have been shared with the public, and great steps have been taken in the areas of transparency, accountability and predictability. In 2006, the TCBR intervened once in foreign currency and three times in foreign exchange because of volatility in exchange rates. Since the supply of foreign currency decreased and volatility in exchange rates, it was decided to temporarily stop the daily foreign exchange buying auctions as of May 16, 2006 (Korkmaz, 2015).

The TCBR reviewed its monetary policy practices after major shocks such as the market fluctuations in May and June. Measures were taken in June, and a restrained monetary compression was made in the rest of 2006. In 2007, monetary policy implementation continued in line with the inflation targeting regime, and the Monetary Policy Committee meetings were held within the annual meeting calendar. Inflation values remained within the uncertainty range that was consistent with the target in the first three quarters, but could not show the desired downward trend in the last quarter due to the increase in food prices and adjustments in price management due to drought and global conjuncture. Inflation started to rise globally in 2007 and after, as food and energy prices rose rapidly in international markets. Among the countries that have implemented the inflation targeting regime, the inflation value of other developing countries except Brazil has been above the targets (Kutlar, 2010).

With the bankruptcy of Lehman Brothers and the global crisis on September 15, 2008, the effects of the crisis started to appear in Turkish markets. However, the TCBR has succeeded in making quick and effective decisions with its recent crisis experience. On 16 October 2008, it was decided to stop foreign exchange buying auctions and

aimed to provide liquidity in the foreign exchange market. In addition, the TCBR aimed to increase the liquidity in the market with foreign exchange selling auctions as of October 24, 2008 due to the negativities in price formation. The daily foreign exchange amount envisaged in the auction was 50 million US dollars and it was announced that this amount could be changed according to the situation. The aforementioned sales auctions were held for two working days and it was decided to cease the sales auctions on 30 October 2008 due to the improvement in the markets. With the interventions made in 2008, foreign currency sales amounted to USD 100 million, while foreign exchange purchases amounted to USD 7.584 million (Çiftçi, 2014).

TCBR, on 14 April 2010 "Central Bank of the Republic of Turkey Monetary Policy Exit Strategy" published the announcement. With this announcement, it has been announced that the values related to foreign exchange liquidity provided since October 2008 have been brought to levels before the crisis with the normalization of global markets. In addition, by making amendments regarding repo auctions, the amount of overnight borrowing in the ISE Repo - Reverse Repo Market and the Interbank Money Market within its body was reduced (Çiftçi, 2014).

The TCBR started acting in line with a new policy and started using new policy tools in November 2010 in order to prevent financial risks after the global crisis and to support financial stability by reducing the negative effects of capital flows. Required reserves and other necessary measures in line with the credit policy; weekly repo rates within the framework of interest policy; Within the framework of the liquidity policy, it was decided to apply the interest rate corridor and various funding methods. As of November 2011, in line with these policies, an approach signaling that the exchange rate will not be indifferent to excessive volatility has been acted, the reserve option mechanism has been implemented and additional monetary tightening has been made by actively using the upper limit of the interest rate corridor. With these policy instruments, it is aimed to limit the possible overvaluation or depreciation pressure on TL against volatile capital flows (Değerli and Fendioğlu, 2013: 2).

In 2013, Turkish lira depreciated significantly and this created unwanted effects on inflation. The TCBR tried to minimize these effects by moving forward with a sound monetary policy target in 2014. After the transition to the floating exchange rate

regime in 2001 at the end of 2015, a cumulative increase of around USD 91 billion in TCBR's foreign currency and gold reserves from 2001 to 2015 through the use of tools such as direct net purchases, export rediscount credits and ROM (Reserve Option Mechanism) is provided.

A strict liquidity policy was adopted in 2015, and as a result of the studies on interest rates, overnight repo interest rates between banks started to occur at the upper limit of the interest rate corridor. Inflation slowed down in 2015 due to the measures taken, monetary policy and import prices. Within the framework of changing global and local financial market conditions, as of May 5, 2015, banks and financing companies have started to pay interest payments to reserve reserves, reserve options and free accounts held at the Central Bank Of The Turkish Republic (TCBR) in US dollars. These interest rates are announced daily according to market conditions (Ünlü, 2016).

During the transition from the flexible exchange rate regime to the free exchange rate regime, many exchange rate regimes have been tried, and there has been no change after the exchange rate regime adopted since 2001. The TCBR decided to continue implementing the floating exchange rate regime in 2016. However, although the floating exchange rate regime was applied in this process, macroeconomically different exchange rate and interest policies were followed over the years. In the first years of the floating exchange rate regime, low exchange rate-high interest rate application took place and this application suppressed exchange rates for a long time. In recent years, it has been observed that the application of low interest-high exchange rate was effective (Çiftçi, 2014).

### **1.3 Foreign Exchange and Economic Relations**

As the volatility in exchange rates increases the exchange rate risk, modeling the volatility in the exchange rate because of the negative effects on the prices of import and export goods, the value of international reserves, the open positions of the real and financial sectors, in short, the economic growth and therefore the labor market, is of great importance in terms of the policies to be followed and the investments to be made. In this context, economic theories based on the major exchange rate in the economic literature will be discussed in this section.

### **1.3.1. Marshall-Lerner Condition**

The Marshall-Lerner condition, also known as critical elasticities in the economic literature, took the first step by applying A. Marshall's price elasticity approach to foreign trade. Later, with the contributions of the economist named Lerner, this concept was fully explained and this concept entered the literature as a combination of the names of the two economists. The Marshall-Lerner condition used to balance the foreign trade under the free-floating exchange rate mechanism, when there is a decrease in the value of the domestic currency, the goods produced domestically are cheaper than the goods produced abroad. (Kogid, 2012). As a result of the decrease in the value of the domestic currency, the real exchange rate rises, thereby increasing the foreign demand for domestic goods. According to the Marshall-Lerner condition, whether the foreign exchange market is stable under the assumption that the supply elasticities of imported and exported goods are infinite depends on whether the domestic demand elasticity ( $E_m$ ) of imported goods and the foreign demand elasticity of exports ( $E_x$ ) are greater than one or more. .

Briefly as follows;

$$(E_m + E_x) \geq 1$$

is expressed. According to the operability of this formula, the supply elasticities of imported and exported goods are infinite while the demand elasticities are equal to or greater than one, the depreciation of the national currency (devaluation) affects the foreign trade deficit, and the appreciation of the national currency (revaluation) affects the excess foreign trade. The Marshall-Lerner condition only gives the "critical value" necessary for the rise in exchange rates to positively affect the balance of payments. The smaller the elasticities, the greater the exchange rate required to provide external stability.

### **1.3.2. Mundell-Fleming Model**

In the early 1960s, the Mundell-Fleming Model was developed by Robert Mundell and Markus Fleming. This model is actually the open economy adapted version of the classic IS-LM model. The model's assumptions are:

- There is full capital mobility.
- Foreign and domestic securities are full substitutes for each other.
- The central bank has no interference with the foreign exchange market.
- Full competition conditions apply in the foreign exchange market.
- The nominal value of wages and prices is fixed.
- The relationship between total demand public spending level with exchange rate and foreign output is positive and the relationship with domestic interest rates is negative.
- The positive function of the domestic income level and the negative function of the domestic interest rate express the demand for money.
- When the exchange rate changes according to the expected level, the money supply is negatively affected.
- The trading account is determined by the level of domestic output.
- Determination of the capital account depends on domestic and international interest rate differences.

The real exchange rate calculated according to the Mundell-Fleming model can be expressed as follows.

$$\mathbf{MFR_f = E_f \times (GNPD_d)/GNPD_f}$$

**MFR<sub>f</sub>** = Real exchange rate in foreign currency calculated with Mundell - Fleming model

**E<sub>f</sub>** = The nominal rate expressed in foreign currency.

**GNPD<sub>d</sub>** = Domestic gross domestic product deflator

**GNPD<sub>f</sub>** = Foreign gross domestic product deflator.

When the Mundell Fleming model was put forward, the idea that internal and external imbalances could be eliminated at the same time emerged. Under the assumption of unlimited capital mobility, a small difference in interest rates causes capital flows to a large extent. In other words, there is a complete substitution between domestic and foreign securities. Again, under this assumption, the main purpose of economic policies should be towards the elimination of internal imbalances, since external equilibrium will automatically balance with foreign capital inflows and exits.

Capital inflows and outflows, which change the foreign currency amount of the country, have a significant effect on the exchange rate. Capital movements are the most important factor affecting the volatility of exchange rates in the short term. With the formation of freedom in goods and capital movements, developments in any region have effects on other countries. Therefore, problems arising in foreign exchange markets in countries gain an international dimension. It is necessary to create an event in the international goods, services and capital flows and balance of payments. In this context, the Mundell Fleming model takes into account the capital movements and the effects of economic policies are taken into account in determining the exchange rate (Seyidođlu, 2003).

The effects of economic shocks are also taken into account in the Mundell Fleming model. When the capital movements are free, the floating exchange rate has an effect on real shocks and the fixed exchange rate on nominal shocks. In the absence of capital mobility, the efficiency of the fixed exchange rate on real shocks is higher than the floating exchange rate. In this context, the determination of the exchange rate system depends on capital mobility and economic shocks (Fischer, 1977).

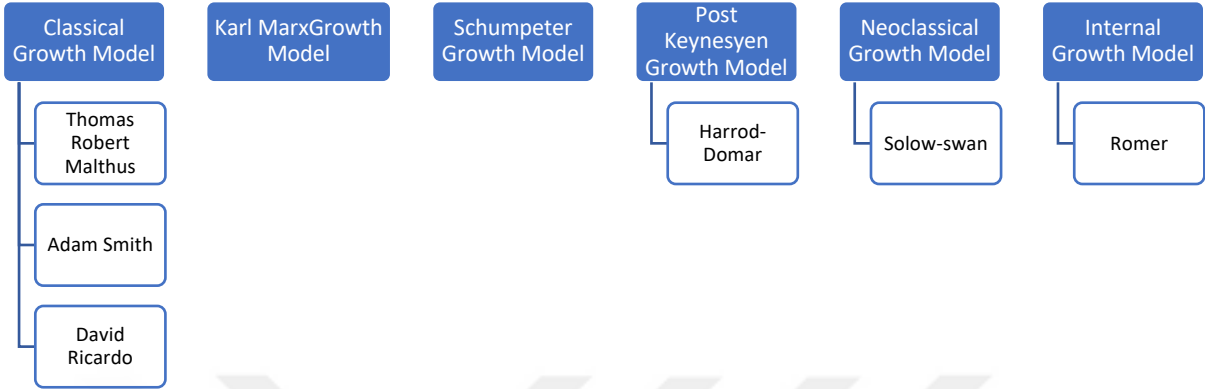
#### **1.4. Concept of Economic Growth**

While there is no complete consensus among economists about when growth theories emerge, according to some economists (Robert J. Barro, Xavier Sala-i Martin, Philippe Aghion, Peter Howitt and Aykut Kibritçiođlu), while some economists saw the views of classical economists about economic growth. (Robert Solow and Tuncer Bulutay) accept the Post Keynesian Growth Theory as the pioneer of growth theories. Some economists (Rudiger Dornbusch, Stanley Fisher and Charles Jones) see Neoclassical Growth Theory as the pioneer of growth theories (Kıbrıtcıođlu, 2004)

Economic growth is defined as the income increase provided in any economy during the year compared to the previous year. These increases can only be brought about in the long run by expanding the country's production scale or potential or using it more productively (i.e. increases in the quantities and / or productivity of production factors). Economic growth can also be defined as continuous increases in the basic data of economic life, production factors, which increase per capita real national

income. As can be understood from this definition, growth should not be temporary, it should be continuous (Artan, 2000).

We can express historical growth models as follows:



The first one of the growth models is the Classic Growth Model. Although Thomas Robert Malthus was one of the economists working on the first system of growth models, he looked quite pessimistic to the future. According to Thomas Robert Malthus, labor has two prices: "natural wage" and "market wage". Whereas the market wage is determined by the supply and demand of labor, the natural wage is the wage rate that does not cause population increase and enables the generation to continue. Malthus's growth model underlies the mismatch between population and output-output growth rates. According to Malthus, while the population increases geometrically, the amount of output increases rapidly. The fact that the population increases uncontrolled geometric speed does not cause the per capita product to decrease continuously and approach zero. The economy is in equilibrium at a minimum level of living per person, which makes the population growth rate zero in the long run (Kogid, 2012)

Adam Smith is the first economist to systematically study the phenomenon of economic growth. The growth model he developed in his essay entitled An Experiment on the Nature and Causes of the Wealth of Nations published in 1776, is the industrial growth rate of industrial revolution (innovations and innovations, It is built on features such as a significant increase in the division of labor. According to Adam Smith, the division of labor constantly increases the revenues of countries that have a structure that encourages growth and renews itself constantly. Labor productivity will increase as the increase in the division of labor will bring specialization. According to Smith's



growth model, the law of increasing efficiency for labor and the law of decreasing efficiency for capital are valid. In the short term, the market wage will rise above the natural wage level, as the law of increasing productivity applies to labor. The increase in wages will cause the population to increase in the long run due to the population-income relationship (Mahmood, 2011).

The Ricardo growth model, which has an important contribution to the establishment of the classical growth model, also belongs to David Ricardo, who is shown among the founders of classical economics. The Ricardo growth model is both a growth model and a revenue distribution model. The Ricardo growth model, unlike Smith's growth model, is the law of declining returns on both capital and labor (Mubarik, 2005).

Ricardo divided his field of economic activity into three as landowners, capitalists and workers. They earn rent, profit and wage income, respectively. In the long run, total rent and total wage payments increase as production increases. After a while, the product is equalized to the payments of rent and wages, so that the capitalist's profit becomes zero. Capitalists cannot invest because they cannot accumulate capital when their profits are zero, and the economy is stagnating. In the analysis of Ricardo, there is no change in the situation of workers in the long run in the growth process. Landowners are constantly increasing their income, while the situation of capitalists is deteriorating. Ricardo's growth model is based on a potential conflict of interest between landowners and capitalists (Mughal, 2012).

Karl Marx, Smith, especially Ricardo; it was influenced by their thinking of labor as the cause of value. According to Ricardo and Marx, the source of capitalist accumulation is profit. The growth model of Karl Marx, the second of growth models, is based on the theory of labor-value. According to Karl Marx, the value of a good is determined by the labor-time units required for the production of that good. Marx labor value; fixed capital (used in production), variable capital (human capital), and surplus value (excessive value over labor and capital). According to Marx, the capitalists exploit this surplus and accumulate capital. As a result of the competition among the capitalists, they are turning from labor-intensive techniques to capital-intensive techniques. These changes in the production technique lead to an increase in productivity in production and a decrease in labor demand. The drop in demand for labor increases the bargaining power of the capitalists, and wages fall to the rate of

natural wages. According to Marx, if the economy increases while the average product of labor increases, the wage rate decreases and the rate of profit increases. In other words, the process that determines the growth is the change of the inputs received from the total product (Mwinlaaru, 2017)

The third growth model is the growth model of Joseph Schumpeter. Schumpeter describes the capitalist economy as an endless creative process of destruction. Schumpeter built the foundation of the model on two important concepts. The first is that each firm in the capitalist system is superior to other firms, increases its market share, produces a new product to dominate the market, applies a new production technique, uses a new input, etc. efforts are the concept of creative innovation. The other is the concept of entrepreneurs who implement these creative innovations and thus dynamic the capitalist system. According to Schumpeter, economic growth starts with an entrepreneur realizing an innovation in economics. With this innovation, the entrepreneur becomes a monopolist and makes high profit. The entrepreneur will continue to innovate as long as there is high profit, and as a result, a growing economy will occur (Mughal, 2012).

The fourth growth model is the Harrod-Domar Growth Model. The growth model Harrod and Domar developed independently of each other is a study aiming to analyze the argument that Keynes' market mechanism cannot come to full employment by itself. In the Harrod model, based on underemployment, full employment conditions, and Domar, based on full employment, investigated the factors that can sustain this employment. The Harrod-Domar growth theory is based on two concepts while determining the growth rate of the economy by explaining the relationships between total demand, production and employment. These concepts are marginal savings rate and capital-product coefficient. The growth rate in an economy is positively correlated with the marginal saving rate and negatively with the capital-product coefficient. In other words, the greater the marginal saving rate in an economy and the smaller the capital yield coefficient, the greater the growth rate of that economy. The actual growth rate realized by the investment rate must be equal to the required growth rate in order to achieve a stable and balanced growth. The necessary and sufficient condition for such a balance is investment-saving equality (West, 1995).

The fifth growth model is the Solow-Swan Growth Model. This model is also called neoclassical growth model, since Solow has conducted studies on the economic growth phenomenon of neoclassical economics. Solow criticized the Harrod-Domar Model at two points. The first of these criticisms is that it uses wrong analysis tools to explain economic growth. The second criticism stems from the deviation between the required growth rate and natural growth rate in the Harrod Domar Model, that production is made under the assumption of fixed factor rates. The basic assumptions of the Solow model; are the assumptions that the returns on a scale are fixed, the marginal productivity of capital decreases, the technology is determined externally, inter-factor substitution is possible and there is no independent investment function (ensuring savings-investment equality). In the Solow model, the economy is turning to a steady state where the output per capita is constant in the long run. Therefore, capital accumulation in the Solow model does not cause growth. According to this model, population growth and technological progress are the sources of growth (Neeley, 2001).

The sixth model is the Internal Growth model. The internal growth model, pioneered by Paul M. Romer, developed after the mid-1980s. In this model, it is seen that three of the main assumptions in the Solow growth model are completely abandoned. The basis of this model is the idea that externalities arising from research and development expenditures, investments in human capital, or investments of the government in technological infrastructure will ensure that working under conditions of (1) increased marginal factor productivity and (2) increased returns to scale. The internal growth model, called the “EC Model”, claims that if the increase in capital through research and development can compensate for the declining marginal return of capital, the saving rate will affect the internal growth rate at rest. According to the internal growth model, it is possible for the economy to grow continuously regardless of the growth rate of the population and the rate of external technological development in case the return on inputs in production does not decrease (Jakop, 2015).

### **1.5.The Concept of Unemployment**

In the economic literature, there are many different views on how unemployment occurs and why. However, the common view is that the most effective policy in reducing unemployment is employment-generating economic growth. According to

the definition of unemployment Turkey statistical institute has used at least one of the job search channels in the last three months to search for jobs from people who are not in employment during the reference period (not for profit, casual, paid or unpaid, and are not connected to such a job) and will be able to start work within 2 weeks. All people in the situation are unemployed. Economists do not have a common view on the emergence and causes of unemployment. As regards unemployment, classical economists have suggested that any intervention to the market mechanism will reduce the flexibility in wages and prices and cause unemployment in the market. The balance in the labor market occurs spontaneously without any external intervention. A small unemployment occurs when the market is in balance, either voluntary or frictional unemployment (Jakop, 2015).

Neo-Classical economists, like classical economists, suggested that the labor market would not allow unemployment. According to Neo-Classicists, there is full knowledge in the economy and labor mobility is complete. The workforce can be substituted precisely and perfectly. Under the assumption that the wage is fully flexible, the wage level occurs at the point where labor supply and demand intersect. In this full employment situation, unemployment will not occur. In the case of unemployment based on labor demand surplus in the economy, real wages will decrease and unemployment will disappear (Kogid, 2012).

Classical and Neo-Classical economists acknowledge that thanks to the properly functioning market mechanism, all production factors will be put into production, that is, full employment will occur. According to the Classical and Neo-Classical economists, the troubles that take the economy away from full employment are temporary. The automatic employment of full employment is explained by the Say law, which states that each supply will create its own demand, the interest theory based on the assumption that interest is determined by savings supply and demand, the theory of wages determined by labor supply and demand, and finally the quantity theory that links the general level of prices in the economy to the increase in money supply (Kearny, 2000).

Keynes, who revolutionized the economic literature, argued that unemployment is due to wage rigidity and lack of demand. According to Keynes, there is underemployment in the economy. In order for the economy to recover from underemployment, total

demand in the economy must be increased. In Keynesian theory, nominal wages are downward rigid as they are determined by contracts between unions and employers. Even if prices drop at the general level, workers will not accept the reduction of wages, instead they will fall into the illusion of money and prefer higher nominal wages. In this case, according to Keynes, with the expansionary monetary or fiscal policies, prices are increased more than the increase in nominal wages, real wages are reduced and thus unemployment is known to the disabled.

Structuralist economists, shaped towards the end of the 1950s, are the main factors affecting the unemployment problem; insufficient capital accumulation, low domestic saving rate, rapid population growth etc. They argued that there are such factors and unemployment can be reduced by using these factors. Phillips suggested in his study in 1958 that there was a reverse relationship between increases in nominal wages and unemployment rate. Structuralist economists have argued that the policies between the inflation and unemployment in the Phillips curve can be broken in some way with the policies for developing workforce diversity, increasing factor mobility and reducing inter-regional disparities (Hsieh, 1989).

In the 1970s, the relationship between unemployment rate and inflation rate started to be questioned again. The monetarist theory that emerged in these years criticized the formation of real wages in the labor market of classicalists. Friedman and Edmund Phelps argued that it was wrong to base nominal wages in Phillips' analysis, instead the expected rate of change in real wages should be taken. Friedman and Edmund Phelps have reinterpreted the Phillips analysis considering the expectations of workers and employers.

According to the monetarist theory, the Phillips curve will be valid in the short term, but in the long term, it will return to the natural unemployment rate again. The New Classical Economists, like the Monetarists, argue that the Phillips curve will be valid in the short term. According to new classicalists, macroeconomic policies are completely ineffective in eliminating unemployment. Fluctuations in employment can be explained within the framework of people's will. A demand shock, thought to be temporary and raising wages, will further expand the supply of labor compared to a permanent demand shock. However, in the face of a sudden demand shock, employees only see (direct) rising monetary wages; they decide whether this is an increase in real

wages but in line with their expectations regarding the general level of prices (Kasch-Haroutounian & Price, 2001).

## **1.6 Growth, Unemployment And Exchange Rate**

Before examining the effect of real exchange rate volatility on growth, the relationship between growth and foreign trade should be examined. While an export made increases the national income, it has a positive effect on growth, while an import decreases the national income and has a negative effect on growth. Therefore, a volatility that may occur in the real exchange rate will affect the growth through the export channel. Therefore, studies investigating export-based growth models should be examined.

In most of the studies (Balassa (1973), Balassa (1982), Fosu (1996)), they concluded that exports affect growth positively. In this regard Turkey as an example of viewing Taxation (2002), 1990 - the exchange rate volatility experienced from 2000 showed that the negative impact on Turkey's exports.

Sekmen (2004) found in her doctoral thesis that the volatility in the exchange rate negatively affects bilateral trade between developed and developing countries. In his study, monthly nominal exchange rate data between 1985 and 2000 were used, and volatility in the exchange rate was determined by the GARCH method.

Öztürk (2006) summarized the studies examining the effect of exchange rate volatility on foreign trade in the article “Exchange Rate Volatility and Trade: A Literature Review”. According to Öztürk, the results of different studies emphasized that the effect of exchange rate volatility on the level of foreign trade was evident in studies with wide range of data, although it is not possible to make comparisons between studies due to sample range, model determination, and differences in countries and risk variable. Öztürk's research concludes that the volatility that may occur in the real exchange rate affects foreign trade. In this context, the volatility that may occur in the real exchange rate affects the exports to be made, and as the exports affect the growth, the volatility in the real exchange rate is expected to affect the growth. In the study of Ahmad on 2012 on economic growth and development, the relationship between

Pakistan's GDP and total investment was examined by using time series analysis for the period of 1971-2011 and a positive and significant relationship was found between investment and economic growth. In the study, it was stated that 1% increase in investment increased GDP by 0.89% (Ahmad et al., 2012: 680).

According to He, China has implemented a fixed exchange rate policy and achieved rapid economic growth. He also stated that the application of the fixed exchange rate creates efficiency in the long run (He, 2010: 36).

Tarawalie investigated the effect of the real exchange rate on the economic growth of Sierra Leone. He used quarterly data and Granger causality test between 1996-2006. As a result of his research, he found a positive correlation between real exchange rate and economic growth. (Tarawalie, 2010: 8).

Rodrik researched asymmetry between developed and developing countries using data from 184 countries between 1960-2004 and found that having a value below the real exchange rate had a much stronger and meaningful effect on economic growth compared to developed countries (Rodrik, 2008 : 365). Using the data of 28 states in China for the period 1992-2008, Chen researched the relationship between exchange rate and economic growth. As a result of his study, he stated that the valuation of the real exchange rate had a positive effect on the economic growth of the provinces in China (Chen, 2012: 1). In the study of Vieira et al. In 2013, the effect of real exchange rate volatility on long-term economic growth was investigated using data from the 1970-2009 period and panel data set of 82 developed and developing countries. As a result of the study, a real volatility rate with a higher volatility has a negative and significant effect on economic growth. In other words, a less volatile real exchange rate has a positive and significant effect on economic growth (Vieira et al., 2013: 3733).

If we examine the relationship between inflation and economic growth, it is seen that there is a discussion environment where each economist presents different views. Some economists claim that there is no relationship between inflation and growth. While some economists state that there is a positive and significant relationship between inflation and economic growth, there are also opinions that claim that there is a reverse relationship between inflation and economic growth. (Ahmad et al., 2013:

742). When we look at the academic studies on inflation, it was found that there was a positive relationship between GDP and inflation in the study in which Ahmad and Joyia investigated the relationship between Pakistan's GDP and inflation. 1% increase in inflation increases GDP by 0.45%. According to this study, inflation promotes output level and efficiency. However, inflation needs to be managed, otherwise it may have harmful consequences. (Ahmad and Joyia, 2012: 38), Ahmad and Luqman conducted a research in 2012 using data from 1971-2011, using Pakistan's GDP as a dependent variable, and inflation, export, investment and population growth as independent variables. As a result of the study, a negative and significant relationship was found between the economic growth of Pakistan and the inflation rate. (Ahmad and Luqman, 2012: 180). Shahzad and Malik (2012: 262), Naseer et al. (2012: 4000) and Mubarik (2005: 35); found a positive relationship between economic growth and inflation in their work. Bruno and Easterly (1998: 3), Huybens (1999: 283), Quartey (2010: 180), Ghosh and Phillips (1998: 662) and Barro (1995: 2), a negative and significant result between inflation and economic growth in their work It was found. Mughal et al. (2012: 6108) found no relationship between inflation and economic growth.

Foreign direct investments (FDI), on the other hand, are another variable that has an impact on economic growth. Many researchers emphasize that FDI works as the driving force of a country's economic growth. According to this view, it is not possible to achieve sustainable growth without sufficient foreign direct investment. In his study, Ahmad used Pakistan's GDP as a dependent variable, FDI, national capital and workforce as independent variables, and found a positive and significant relationship between FDI and economic growth in Pakistan. He stated that Pakistan should withdraw FDI for development (Ahmad et al. (B), 2012: 21). In another study, Carkovic and Levine stated that Direct Fixed Foreign Investment has an exclusionary effect on national capital and therefore its effect on economic growth is meaningless or negative (Carkovicve Levine, 2005: 196,219). He dismissed the views of Direct Fixed Foreign Investment on the Venezuelan studies in Venezuela in Aitken and Harrison in 1999 (Aitken and Harrison, 1999: 605).

While the fixed exchange rate encourages growth in small economies with low interest rate international capital flows, countries allow volatility and crisis to pass into capital markets with speculative capital flows. The macroeconomic policies that have not



been heard in some Latin American countries have been implemented in the crises experienced in the developing market economies in the 1970s and 80s, and this constitutes the interdependent macro-economic policies and the first crisis model generation. On the contrary, the economies of East Asian Crisis are an example of sudden rising and falling cycles with the understanding of “good management”, which applies macro-economic policies under the fixed exchange rate regime. Before the Asian crisis, these countries attract international capital flows for two reasons. The first reason is to ensure the sustainability of appropriate macroeconomic policies (for example, low inflation and low external debt). The second is the low exchange rate fixed to the dollar attracts investments. These two causes affected each other and caused the East Asian Crisis.

When we look at the studies investigating the effect of real exchange rate volatility on unemployment, real exchange rate volatility affects unemployment through the foreign trade channel. Belke and Setzer (2003) revealed in their panel data study for Central and Eastern European countries that high volatility in the real exchange rate caused low employment growth. They determined that Hungary and Poland, one of the Central and Eastern European countries that they examined, were the countries most affected by the volatility in the euro exchange rate.

### **1.7. Literature Review**

In recent years, interest in studies on the effects of central bank intervention on exchange rate volatility has increased. The intervention is considered to be effective only if it helps to control exchange rate volatility, otherwise it is said to be ineffective. There are several studies for developed and developing countries to demonstrate the effectiveness of these interventions. Akıncı et al (2005) examined the period 2001-2005 for the activities of the foreign exchange market interventions in Turkey. They concluded that using the statespace model and the Kalman filter technique, purchasing interventions were more effective when financial markets stabilized. A similar study was conducted for Pakistan using the GARCH-X technique and it was concluded that interventions for exchange rate volatility were effective (Shah et al., 2007).

Hsieh (1988) found that the average and variances of the exchange rate series have changed over time in his study using five daily exchange rates against the US dollar. ARCH model was used to model the series in question and it was seen that this model represents the behavior of the exchange rate series quite well.

Hsieh (1989) modeled the daily data of the five currencies with ARCH, GARCH and EGARCH and compared the performance of these models. According to the results of the study, it has been observed that GARCH and EGARCH models are quite successful in capturing the conditional changing variance present in daily exchange rate movements. He also claims that the performance of the EGARCH model is somewhat better than the GARCH model, based on many diagnostic test results.

Beine, Bénassy-Quéré and Lecourt (1999) claimed that traditional GARCH models tend to underestimate the impact of central bank interventions and suggested the FIGARCH model against this.

One of the important studies evaluating the performance of exchange rate prediction models belongs to West and Cho (1995). In this study, using weekly data from 1973-1989 for five different currency series, univariate fixed variance model, GARCH model, sequential dependent and nonparametric conditional variance models were estimated. One, 12, and 24-week forecasts of these models were produced and performance measurement was done using the RMSE criterion. According to the results of the study, although the GARCH model was more successful than other models in the one-week forecast horizon, it was not possible to determine the best prediction model in the long run. In addition, Figlewski (2004) stated that ARCH models are not designed for long-term forecasts, and the prediction performance of the models deteriorates rapidly as the forecast period is extended.

Andersen et al. (2004) propose the simple and useful GARCH model, which models the volatility, which is the basic dynamics of returns, by taking into account properties such as return to average, long memory and asymmetric response.

Neeley and Weller (2001) stated that although the genetic program estimates performed better than the GARCH model estimates according to the MAE method, GARCH model made more successful estimates when the R2 and MSE criteria were taken into consideration.

Bautista (2003) examined the relationship between the exchange rate and the interest rate in the Philippines, using weekly data from 1988 to 2000. According to the results of the study, it has been found that the relationship between the two variables varies according to the periods, and policies applied as the cause of the structural change observed in the correlation or measures applied against external shocks have been proposed. The shift observed in 1993 in correlation with market liberalization is given as an explanatory example.

Kearney and Patton (2000) investigated the transition between French franc, German mark, Italian lira, British pound and ECU with 3, 4 and 5 variable GARCH models. Daily and weekly data were used in the study using the BEKK model. Although the results differ depending on the size of the data set used, the German mark was least affected by external shocks, while the volatility permeability was observed as the highest rate. The ECU transfers volatility in covariance terms, rather than transmitting it directly in its variance. On the other hand, when the weekly data is used instead of daily, it is stated that volatility is almost never transferred. This finding is consistent with the suggestion of Ghose and Kroner (1996) that the transfer of volatility decreases as clustering increases over time.

Rahman and Serletis (2009) investigated the effect of uncertainty in the exchange rate on imports with the multivariate average-GARCH (MGARCH-M) model. In the study covering the period of 1973-2007, monthly import data of the USA was used and it was stated that the uncertainty of the exchange rate had a significant negative effect on imports.

Kočenda and Poghosyan (2009), on the other hand, examined the effects of inflation and consumption on exchange rate returns for countries that have recently joined the European Union (Czech Republic, Poland, Hungary and Slovakia) using the MGARCH-M model. According to the results obtained, both consumption and inflation are significant factors in explaining the volatility in exchange rate returns.

Kasch-Haroutounian and Price (2001) used the multivariate GARCH model to study the flow of information between these countries. According to the study, conditional correlations between Hungary and Poland and Hungary and the Czech Republic were

found significant. In addition, according to the bivariate BEKK model, Hungary and Poland returns have the highest conditional correlation.

Goeij and Marquering (2004) examined the relationship between stock and bond markets using the diagonal VEC model. Asymmetric effects in conditional variance and covariance were allowed in the study using S&P 500 index, NASDAQ index, 1-year and 10-year US treasury bill interest data. According to the results obtained, both variance and covariance respond asymmetrically to shocks. It has been observed that conditional covariance increased more than positive news in both treasury bond and stock markets after negative news.

Frank and Hesse (2009) investigated the interactions of emerging economies during the global financial crisis, focusing on the movements of stock, bond and credit markets, and argued that emerging economies did not move away from developed economies.

Aysoy et al. (1996) investigated exchange rate volatility for Turkish Lira equivalent US dollar and German mark series in the period of January 1988 - December 1995 and the effect of the days of the week in these series. According to the GARCH (1,1) model results, which are estimated using the dummy variable for the financial crisis, low volatility was observed in the foreign exchange market, excluding the crisis periods, and the effects on weekdays in the US dollar and German mark return series were remarkable.

Akçay et al (1997) studied substitution of foreign currency using the exchange rate instability in Turkey the impact on the market in January 1987 to March 1996 period EGARCH-M models. According to the results obtained, it was observed that the exchange rate volatility increased with the increase in dollarization.

Guleryuz (1998) analyzed the period of January 1989 - April 1998 by using different models, and the significance of the parameters was the highest explanatory model of ARMA (2,2) -ARCH (2) model, which was dummy variable for Thursday in variance equation according to R<sup>2</sup>, AIC and SBC. It was detected. On the other hand, Tuna (2002) examined the relationship between TCBR monetary policies and exchange rate volatility using the ARCH (1) model. According to the TCBR monetary policies, Tuna (2002) divided the period from April 1988 to October 2000 and used dummy variables

for each period in conditional variance equation. According to the results obtained, exchange rate volatility was most affected by the TCBR policies in the January 1990-March 1994 period.

Aysoy and Balaban (1996) compared the implicit volatility with models using high frequency data using daily dollar / TL and Mark / TL data under the random walk hypothesis. According to the results of the study, the maturity structure of the volatility of the exchange rate does not match the predictions of the random walk hypothesis. However, although the exchange rate volatility of both exchange rates remained below the volatility level stipulated by the random walk model, in the long term, both exchange rate volatility was above the volatility level suggested by the random gait model.

Demiröz (2001) examined the possible relationship between exchange rate and interest rate volatility using Dollar / TL and repo interest rates. In the study covering the period between 4 January 1999 - 26 December 2000, the multivariate GARCH (1,1) model was used by defining dummy variables for stability programs. According to the results of the study, although the covariances are high in absolute value, the decrease in the volatility of one of the assets due to the negative sign causes an increase in the volatility of the other. In addition, the effect of random shocks on the interest rate is more permanent than its effect on exchange rates.

Berument and Dincer (2004) investigated the effects of real exchange rate risk on Turkey's economic performance. The ratio of total foreign currency liabilities to: (1) total reserves, (2) TCBR reserves and (3) total TL liabilities was used as the representative variable of foreign exchange risk and risk measurement was carried out with VaR model. According to the model results, while the exchange rate risk lowers economic growth, inflation increases and the real exchange rate devalues.

Unal (2009), moving average models were compared univariate time series models and different ARCH process of Turkey foreign exchange markets by applying these models to estimate the volatility of non-sampling performance predictions. The study also investigated the effects of the recent global financial crisis on risk measurement techniques. According to the RMSE criterion, GJR\_GARCH (1,1) model was found to be more successful in modeling the volatility prediction of TL / Dollar and TL /

British Pound series compared to other models, and the most successful model for TL / Euro series was EGARCH (1.1). In addition, while the financial crisis did not change the performance order of the models, it was found that the performance of the models converged with the worst performance model together with the financial crisis. The case of Turkey as a reflection of the intensity of studies investigating the effectiveness of foreign exchange intervention had been the subject of many studies: Domaç and Mendoza (2002), Agcaer (2003), Guimaraes and Karacadağ (2004), Akıncı et al (2005a) and (2005b), and Ozturk (2006). In these studies, an empirical analysis of the exchange rate interventions for the period in which the floating exchange rate was applied after February 2001 was performed.

Taşçı et al. (2009), on the other hand, investigated whether money substitution has an effect on exchange rate volatility and whether this volatility has an effect on money demand. The results of the study showed that reversing the currency substitution in line with the theoretical expectation reduced exchange rate volatility.

Razin and Collins (1997) examined the relationship between real exchange rate and economic growth for 93 selected countries. In the study, panel data analysis was carried out using the period data of 1975-1992. As a result of the research, while the overvaluation in the real exchange rate had a negative effect on economic growth, it was also reached that there was a statistically significant effect. Another result of the research is that there is no clear relationship between excessive depreciation and growth of the real exchange rate.

Erbaykal (2007) examined whether the exchange rate and economic growth had an impact on the current account deficit. For Turkey, 1987: 1-2006: 3 period using data Toda and Yamamoto Causality Analysis was conducted. As a result of the research, economic growth and exchange rates were determined as the cause of the current account deficit. At the same time, there was no causal relationship between the current account deficit and economic growth and the exchange rate.

Javed and Farooq (2009) examined the relationship between economic growth and real exchange rates in Pakistan. In the study, ARDL Limit Test was performed using 1982: 1-2007: 4 period data. According to the results of the research, it has been found that

national economic performance is very sensitive to exchange rate volatility in the long run.

Dursun (2015), Turkey in the relationship between the share in GDP and real exchange rates of the 1988-2013 period, total fixed capital investments have been viewed through obstacles Granger Cointegration test and vector error correction model and statistical significance between variables are significant, and negative determination-way relationship it has. The fact that the real exchange rates are uncertain concerns investors and creates an obstacle to the growth of fixed capital investments.

Barbosa, Jayme Jr. and Missio (2018), based on the general theory of Kaltenbrunner, applied panel data analysis to 48 developing countries for the period 1990-2008 using foreign portfolio flow, interest rate differences, external fragility measure and international liquidity data. As a result, financial factors came to the fore as the determinants of the real exchange rate. Barbosa, Jayme Jr. and Missio (2018) acknowledge that financial factors are more effective than economic fundamentals and that financial variables are the main determinant of the long-term real exchange rate.

The relationship between real exchange rates and economic growth was examined by Balassa and Samuelson (1964). These economists have revealed that the changes between the two variables are due to the price differences between the traded and non-traded goods in the long term. They also argued that there were productivity differences in the emergence of price differences. Balassa and Samuelson argued that it is necessary to know what factors are caused by the fluctuations in the real exchange rate to explain the relationship between the two variables in the most accurate way.

In the study of Ahmad on 2012 on economic growth and development, the relationship between Pakistan's GDP and total investment was examined by using time series analysis for the period of 1971-2011, and a positive and significant relationship was found between investment and economic growth. In the study, it was stated that 1% increase in investment increased GDP by 0.89% (Ahmad et al., 2012: 680).

In the study of Ahmad et al. in 2013, he said that the relationship between Pakistan's inflation and exchange rate had a negative and significant effect on economic growth. He stated that a 1% increase in inflation decreased GDP by 0.29%. He stated that a 1% increase in the exchange rate decreased GDP by 0.55%. In addition, he stated that the

capital stock did not significantly affect economic growth. He stated that Foreign Direct Fixed investments had a positive and significant effect on Pakistan's economic growth. The 1% increase in FDI increases the GDP by 0.37% (Ahmet et al. 2013: 740).

In his study, Chen (2012) tried to investigate how the real exchange rate affected the economic growth in China. In the study, panel data analysis was carried out using data from 1992-2008. As a result of the research, a positive relationship was found between real exchange rate and economic growth.

Khondker others (2012) examined the relationship between economic growth and exchange rate for Bangladesh. In the study, 1980-2012 period data were used. According to the research result, a 10 percent impairment in the real exchange rate in the long term is associated with a 3.2 percent increase in total output.

Kogid et al. (2012) examined the relationship between economic growth and exchange rates in Malaysia. In the study, ARDL Boundary Test was carried out using the period data of 1971-2009. As a result of the research, both real and nominal exchange rates were found to have an impact on economic growth.

Mwinlaaru and Ofori (2014) examined the relationship between economic growth and exchange rate in Ghana. In the study, ARDL Cointegration test was carried out using data from 1984-2014. According to the results of the research, low real exchange rate has a significant and positive effect on economic growth. Farmer (2014) current account deficit in Turkey, has examined the relationship between economic growth and the exchange rate. In the study, Johansen cointegration analysis based on the VAR model was made using 2001: 1-2012: 3 period data. As a result of the research, it was determined that there are two cointegration relations between the variables.

Jakop (2015) examined the relationship between economic growth and exchange rate for 74 countries. According to the results of the study using 2012 data, there is a positive and significant relationship between the fixed exchange rate and GDP.

Korkmaz (2015) examined the relationship between economic growth and exchange rate. In the study, panel data analysis was carried out with the data of 2002-2011 with 9 randomly selected European countries. According to the results of the research, it



has been found that there is causality for the nine European countries from the exchange rate to economic growth.

Pekmezci and Booth (2016) examined the relationship between the exchange rate and economic growth for the tourism sector in Turkey. In the study, time series was created by using 2005: 1-2015: 6 period data. As a result of the research, no causality and cointegration relation could be determined between the US Dollar and tourism revenues. It is also concluded that there is a long-term relationship between the euro and tourism revenues.

Unlü (2016) examined the relationship between economic growth and the exchange rate for Turkey. In the study, ARDL Limit test was performed using 1998: 1-2014: 3 period data. As a result, Turkey has been reached that have a negative impact on output fluctuations in the real exchange rate.

## CHAPTER 3

### MODELING OF THE EXCHANGE RATE VOLATILITY

#### 2.1. Modeling Of Exchange Rate Volatility

Volatility is defined as a logarithmic alternating price or a standard deviation of the price index within a given time period (Taylor, 2005: 189). Exchange rate volatility can be defined as unexpected changes in exchange rates.

Measurement and estimation of volatility has become an important issue since the exchange rate volatility affects foreign trade, investment, production and international financial flows negatively. It can be said that exchange rate volatility is very important, especially for two main reasons. One of them is the effect of exchange rate volatility on national states' monetary policies. The effects of exchange rate volatility in the export-based countries are vital. Another reason is the increased participation of investors in international portfolios and the use of the asset market approach model (Sengupta, 2002).

Since sudden changes in exchange rates increase the risk of exchange rates, it is very difficult to make investment decisions and make international trade in countries with high exchange rate volatility. Many financial hedging tools and techniques such as derivative instruments and futures have been developed over time to eliminate this emerging exchange rate risk and to perform desired activities more easily. By using financial protection tools and techniques in the most appropriate way, the exchange rate risk should be reduced. However, the less use of financial instruments in underdeveloped and underdeveloped countries and the underdeveloped derivative markets make it more vulnerable to the exchange rate. In these countries, efforts should be made for the growth of derivative markets and for investors to actively use financial instruments in these markets (Önder, 2007: 20).

Exchange rate volatility occurs when the exchange rate value cannot be determined and there are many external factors that affect the exchange rate. These factors, which are named as basic economic factors, can be counted as inflation, interest rate, balance of payments, international capital movements, developments in information and communication technologies, monetary and financial policies, policy news and

expectations, market speculations and financial stability. Unexpected changes both in the current period and in future periods affect the exchange rate and increase the currency volatility (Hakkio, 1984: 23).

In addition to the main economic factors leading to exchange rate volatility, there are many factors, both external and internal. While foreign exchange movements, wars, increases in oil prices in foreign markets are among the external factors; Developments such as changes in the way of management, civil wars, political instability are among the internal factors. In an environment where the country's industry is dependent on foreign inputs, the increase in exchange rates increases input prices and therefore production costs. The inflationary process is gaining momentum as the increase in product prices along with the increase in production costs will affect other industries that the industry is connected to. Rising prices of exported goods cause exports to slow down, and the decrease in exports while imports increase, and the balance of payments deficits increase. As this situation creates pressure on exchange rates, the process becomes a cycle and serious unforeseen deviations are observed. Thus, the country has entered an environment of economic instability (Duygulu Abuk, 1998).

**Inflation Rate:** The most important factor in determining the exchange rates is the inflation rates. Differences between country inflation greatly affect the determination of exchange rates. For example, in countries where inflation is high, the decrease in the trust in the national currency causes the demand for the country's money to decrease. Therefore, the national currency is losing value. In other words, having higher inflation compared to the inflation of foreign countries causes exchange rates to increase (Yılmaz, 2002: 30). Inflation and exchange rate are in constant interaction with each other. In case the economy is open to foreign countries, with the increase of inflation of a country and therefore the level of prices will increase, the goods of the country will be more valuable than the goods of other countries with which foreign trade is carried out. Therefore, the country in question should increase the value of its money as much as inflation. The theory of purchasing power explains the relationship between inflation and exchange rates. The purchasing power theory states that the prices of the two countries should be adjusted according to the difference in inflation rates (Yıldırım and Tanyeri, 2006: 58).

**Interest Rate:** Interest rates have an important effect on the formation of exchange rates. This effect can be explained by interest rates parity. According to interest rates parity, if the two countries' spot and forward exchange rates are compatible with each other, investors will invest in the country with high interest rates. The difference between countries' interest rates determines the relationship between the spot exchange rate and the forward exchange rate by providing arbitrage opportunities. The difference between the exchange rate premium and the interest rates of the countries is equal. However, this is valid in an environment where there is no transaction costs and free market conditions (Yıldıran & Tanyeri, 2006: 57-58). In addition, foreign investors who want to make a high profit invest in a country with high interest rates according to the relationship between the interest rate and the exchange rate, helping to close the savings gap of the invested country. In such an environment, the securities market is moving, the demand for national currency is increasing, and therefore the exchange rates are decreasing.

**Balance of Payments:** One of the most important reasons affecting currency movements is the balance of payments. The balance of payments is a balance sheet showing economic movements between one country's settlements and other countries' settlements. In the balance of payments consisting of three main sections: current account balance, capital account and official reserve changes, statistical difference account used for equalization or net defect deficit account is also included (Yıldıran & Tanyeri, 2006: 54). It can be said that the current account balance is more effective on exchange rates than other balance of payments elements. Because the current account balance is related to the transactions of companies that directly export and import. The differences between imports and exports affect the foreign exchange supply and demand (Yıldıran and tanyeri, 2006: 55). The deficit in the balance of payments causes the exchange rates to rise. For example, the demand for national currency in the economies of countries that purchase more than sales in foreign trade will decrease and the country currency will lose value. Thus, the exchange rate will rise with the devaluation of the national currency. Countries with a trade deficit reduce the value of money with devaluation, allowing goods to be sold cheaper and gaining competitive advantage. (Yılmaz, 2002: 29-30)

**Economic Growth:** The impact of economic growth on the exchange rate varies depending on the source of the growth. Whether the source of growth is domestic

consumption and budget deficits or investment, it must be known first (Uzunoğlu, 2007: 18). For example, when there is an increase in income, consumption increases and demand for foreign goods increases. This situation causes an increase in the demand for foreign currency and thus the exchange rates increase. When an increase in investment occurs, the demand for the country's goods increases with the effectiveness of resource use and an increase in exports occurs. Increasing exports will lead to foreign currency gains and foreign currency gains will lead to appreciation of national currency (Walther, 2002: 76-77). With the regularization of growth, ensuring economic stability will create an environment of trust and confidence in the national currency will increase (Ayhan, 2016: 13).

**Foreign Trade:** Foreign trade causes exchange rate movements to occur because it affects the supply and demand of foreign currency. Since the increase in export activities will increase the amount of foreign currency entering the country, a decrease in exchange rates will occur. In this case, while the value of the foreign currency decreases, the value of the national currency will increase. In case of increasing import activities, the exchange rates will increase due to the increase in foreign exchange demand. Applications such as quotas and tariffs are brought to foreign trade by countries. These practices lead to the exchange of goods that are subject to trade between countries. The change in the choice of goods causes changes in trade flows. In order to protect a certain industry, a country's introduction of tariffs and an increase in foreign goods prices will cause a decrease in exports in the foreign country. Accordingly, the balance of trade between countries will change and some methods will be developed to prevent foreign trade in those countries. Therefore, countries' implementations such as tariffs and quotas will decrease the export of foreign countries and the exchange rate movements will increase in the countries where these practices are realized (Ayhan, 2016: 14).

**News Impact:** News related to the economy and policy statements affect the foreign exchange supply and demand, therefore the exchange rate volatility. Explanations on economic management lead to the formation of expectations about exchange rates and the shaping of the economy. When a policy-related change occurs or when statistical data on the exchange rate are published, the exchange level changes by being affected by these news (Copeland, 2000: 320). Changes in future expectations related to monetary growth affect exchange rates, causing currency volatility to increase. The

thought that monetary growth will create an inflation environment causes an increase in interest rates, and an increase in interest rates causes a decrease in exchange rates (Hakkio, 1984: 25). Unexpected changes in money stocks cause volatility of exchange rates. In addition, unlike the TCBR, the information disclosure about money stock causes currency movements (Hakkio, 1984: 25). If there is a expectation that the TCBR will increase the interest rates, the demand for national currency will increase and exchange rates will decrease (Walter, 2002: 85).

**Real Income Level:** One of the factors affecting exchange rate volatility is the real income level. With the increase in the income level in the national economy, changes in foreign exchange supply and demand occur and the exchange rate is shaped accordingly. With the increase in the real income of the country, there will be an increase in the demand for the goods of the other country, and foreign currency supply will increase by entering foreign currency into the exporting country while the money from the country with income increase. With the increase in foreign currency demand, national currency will lose value against foreign currency and exchange rate will increase (Engel & Hakkio, 1993: 48-49).

**Financial Crises:** One of the reasons for fluctuations in exchange rates is financial crises. In times of financial crisis, it is observed that local currency has depreciated significantly. The currency crisis that occurs especially when the trust in the national currency decreases and the speculative funds leave the country causes the national currency to be devalued or left to fluctuate completely (Yıldırım & Tanyeri, 2006: 61). As global capital seeks a safe environment in crisis processes, rising market economies, which are considered to be at high risk, are reduced and this causes pressure on exchange rates. Many financial crises that occurred in the 1990s and 2000s, especially the 2008 global crisis, affected the exchange rates significantly, and there were great losses in the financial markets of many countries (Çiftçi, 2014).

They tend to show sudden deviations in exchange rates under a floating exchange rate system like financial markets. When the exchange rate data are analyzed, their averages do not have a relationship between the terms of error, but their variances are not. Since the assumption of fixed variance in traditional econometrics models is abandoned, models with such data can be resolved better with ARCH (Autoregressive Conditional Variable Variance) - GARCH (Generalized Autoregressive Conditional

Variable Variance) models and the volatility of the data is better detected. In order for volatility to be used in analysis, it must first be measured. Volatilities are included in the model as the standard deviation or variance of the variables of interest. Volatility of variables such as exchange rates, interest rates, inflation and stock market indices is an indicator of how much they deviate from their expected values. Although autoregressive conditional variable variance models and many variants have been developed, methods that do not take into account the variable variance feature are also used (Shah, 2007).

### **2.1.1. Historical Volatility Models**

The simplest method used in modeling volatility, historical volatility models, is the calculation of the average of the historical values of the variables. In this method, variance or standard deviation of the series is calculated for the specified period. This calculated value is considered the future volatility of the series. This method, however, contains unrealistic assumptions that the observations in the series used are independent of each other and that these observations occur as a result of a linear process with coefficients independent of the historical values of the process (Shah, 2007).

The most important advantages of historical volatility are that it is not dependent on a model and is calculated on the prices realized in the market. However, the calculation of past prices is the most important disadvantage as mentioned above because it is the current values that are important for investors.

### **2.1.2. Implied Volatility Models**

All of the models used in option pricing use a volatility prediction or prediction as input. Therefore, using the prices formed in the option market, the volatility that is accepted in the market or, in a better way, can be calculated. For example, if Black and Scholes (1973) used the model they produced by creating an open or excessive position in case of pricing without error, the price of the option, the time to maturity, the interest rate accepted risk-free, the contract price and the current value of the value written on it will either be determined by agreement or these values will be available from the market. Therefore, once all these data have been obtained, it will be possible to model the volatility with a few simple calculations. For this reason, the

price and the implied volatility of an option are directly related, and investors and brokers often use implied volatility instead of price. (Hull, 2006).

An important point to consider when describing the concept of implied volatility is the VIX index. VIX is the shortened version of the Chicago Option Exchange Market Volatility Index and is also commonly known as the fear index in the market and represents the volatility expectation of the stock market within 30 days.

It was developed in 1993 by Professor Robert E. Whaley. On March 26, 2004, it was first traded on future contracts, and then on February 24, 2006, VIX option contracts began to be traded. VIX aims to calculate implicit volatility by using heavily the prices of various options based on the S&P 500 index. This index has more functions for investors than being an investment tool in their portfolios because it is also used by investors around the world to understand the course of the markets and provide a basis for investment decisions. This shows how important the concept of volatility is in the world of finance.

### **2.1.3. Exponentially Weighted Moving Average (Ewma) Models**

In the standard deviation method calculated by Exponential Smoothing, the decreasing weight is given to the past periods as in the weighted moving average method and an average is calculated accordingly. The difference is due to the way of weighting. An exponential weighting was used in this method, while previously nonlinear weighting was achieved.

Exponentially Weighted Moving Average, which is called EWMA (Exponentially Weighted Moving Average) method, which is one of the methods that use conditional variance in measuring volatility, was developed by J.P. Morgan inspired by the historical volatility model. In the exponential moving average method,  $t$  period conditional variance is calculated by giving weight to the conditional variance of the previous period and the square of the returns.

While the last value realized in this method has the highest weight, the weight of the realizations decreases exponentially. This model differs from the historical volatility model in two main features. The first is that volatility is indeed more affected by recent



values, as the model suggests. The other is that the effect of an observation on volatility decreases exponentially, not linearly over time.

#### **2.1.4. Stochastic Volatility Models**

The stochastic volatility model assumes that unknown volatility has changed stochastically over time. The difference of this model from ARCH-GARCH type models; While ARCH-GARCH type models model conditional variance as a function of an observable variable; In the stochastic volatility model, variance is modeled as an invisible variable.

#### **2.1.5. Autoregressive Conditional Heteroskedascity (ARCH)**

ARCH model was first introduced by Engle. This model allowed data to determine the best weight used in estimating the variance. It was then generalized as a GARCH model by Bollerslev. In addition to the lagged values of the error terms of conditional variance, Bollerslev also included its lagged values in the model. As such, GARCH allows both more flexible latency and longer term information. The GARCH model tries to reveal the volatility, expressed as uncertainty, by allowing delayed conditional variances to enter the model. The strength of the ARCH technique in estimating volatility is that the conditional mean and variance can be estimated together using traditionally defined models, and the weakness is that the predicted conditional variance is biased if the model is incorrectly determined (Shah, 2007).

### **2.2. Time Series**

While time series can be defined as the series obtained by ordering the values taken by the observed variables according to time, the time series analysis is expressed as an analysis for making predictions about the future with the help of the observation values of the past periods. While making these predictions, it is assumed that the past movements of the time series will be in the same trend in the future.

The fact that the data are mostly expressed in different measurement units in the time series prevents the comparison of the data in the analysis to be made. For this reason, the data forming the series must be expressed in the same unit of measure before proceeding with the analysis of time series (Engle, 2001).

We can classify the time series as non-stationary or non-stationary according to the deviation from the averages. Stability is an important issue in time series, as it results in erroneous results in the analysis of non-stationary series. Since the economic time series are generally not stationary, the series should be stabilized

### 2.3 Time Series Analysis

A time series is a series of measurements of a magnitude of interest sorted over time. The purpose of this analysis related to the time series is to understand the truth represented by the observation set and to accurately predict the future values of the variables in the time series. Time series analysis, which started to be used more with the studies of Box and Jenkins in the 1970s; consists of sequential observations for any variable that are obtained at specific time intervals, monthly, quarterly or yearly. Time series consists of four components,

**Trend Component;** It is the stable situation that occurs after the falling and rising processes of time series. Time series have a tendency for long term decline or rise.

1. Determistic Trend: It refers to the long-term trend in a certain direction between the ascension and descent zigzags that appear in a fairly long period. It can be estimated by the whole trend in the time series. In order to stabilize the series, a linear trend must be added to the series.

2. Stocratic Trend: The fact that the increasing trend in the series is not continuous means the situation where decreases are also observed in a series where there are generally increases. In order to stabilize the series, it is necessary to apply a difference operation.

**Season Component;** It refers to the changes according to the seasons in the time series. Some periods of data used in terms of time series differ from other periods.

**Conjective Surge;** In the economy, they are periodic changes that are not related to seasonal changes. For example, short-term expansion or contraction, independent of the general trend in the economy, describes the cyclical process.

**Random Effect;** It is the changes that can be expressed with the term error, which are not certain like other elements.

The main purpose of time series analysis and modeling can be summarized at two points;

(1) trying to understand the dynamic or time-dependent structure of the observations of a single series in univariate time series analysis,

(2) In multivariate time series analysis, it is to reveal the prioritization, delay and feedback relationships between two or more series.

What is expressed as the time series being stationary is that the variance and mean over time is constant and the covariance of the variables in two lagged time periods is dependent on the delay between the variables and not on the time.

Economic time series are generally not stationary. If the time series are not stationary, the series will contain the trend. In this case, false regression-like situations will arise in the forecasting and regression equations where time series will be used. However, the existence of a long-term deterministic trend on the series is different from the trends that appeared in irregular models over time and disappeared after a while. In the case of pseudo-regression, even if there is no significant relationship between the variables, a high may occur. Therefore, whether regression expresses a real relationship or a false relationship is closely related to whether the time series are stationary or not.

### **2.3.1 Testing Stability**

The average, variance and constant covariance of a series over time is an important condition for future predictions. There are three different approaches to testing stability Graphical Analysis Test, Correlation Test and Unit Root Test. In practice, unit root test is widely used to test stationarity. In this study, Augmented Dickey-Fuller (ADF) Test was used.

### **2.3.2 Augmented Dickey – Fuller (ADF) Test**

Augmented Dickey-Fuller test is a test used to determine whether the presence of the unit root (whether the series is stationary) or not in the observed series. The first announcement of this method is Dickey D.A. and W.A. Fuller's articles published in the journal 'Journal of American Statistical Association' in 1979. Since the test's first appearance, it has not been sufficient in various areas since today, and therefore auxiliary methods created to cover the deficiencies have emerged.

The relationship between the value of  $Y_t$  variable in this period and  $y_{t-1}$ , which is a year ago,

$$Y_t = \rho y_{t-1} + e_t$$

In a simple first-order autoregressive model:  $y_t$  ( $y_t$  is the observed value,  $t$  is the time index) when  $y_t = \rho y_{t-1} + u_t$ . If it can be shown to be  $|\rho| \geq 1$ , the existence of the unit root is mentioned.

The regression model is written as  $\Delta y_t = (\rho - 1) y_{t-1} + u_t = \delta y_{t-1} + u_t$ . Here  $\Delta$  represents the 1st difference operator. Once this model is estimated, the hypothesis  $\delta = 0$  can be tested. Since the change between periods will depend on a random variable when  $\delta = 0$ , the empty hypothesis can also be perceived as a unit root. However, since this test is applied on terms now, not on raw data, not the standard  $t$  distribution and  $t$  statistics, but the  $\tau$  statistics that take their critical values from a special table called the Dickey Fuller table.

### 2.3.3. Philips-Perron Test

One of the assumptions of the Dickey-Fuller test is that the distribution of random shocks is independent of each other and the variance is constant. In other words, there is no autocorrelation between random shocks. Phillips and Perron observed that the random shocks of many time series are weakly dependent and heterogeneously distributed and developed a test with the thought that there may be autocorrelation between error terms (Kutlar 2000).

As in the P-P test, the Dickey-Fuller test, three auxiliary regressions are organized: fixed term-trendless, constant term-trendless and constant term-trend. For these regressions, the critical table value is the "z" test, which is the P-P version of the tests used for ADF tests.

Due to the presence of positive moving average parameter of Philips - Perron test, it has been observed that it gives more successful results compared to ADF test. On the other hand, if the parameter was estimated as negative, it was observed that the Philips - Perron test tended to reject the unit root hypothesis. So there is no advantage in using

this test. In this case, performing both tests and applying them together would be the best option. (Sevüktekin 2007).

## 2.4. Vector Autoregressive Models (VAR)

In a model, the variables whose value is determined in the model are called internal variables, and those that are determined outside the model are called external variables. In simultaneous joint systems, it is necessary to distinguish which variables are included in the model internally and which are externally. Sometimes we cannot determine which of these variables are internal and which are external, and therefore some restrictions are required on the model. In this case, the preliminary assumptions of the model during the model establishment phase are affected by these limitations. The VAR model is an alternative model that eliminates such restrictions on the structural model. In 1980, he presented an alternative solution based on VAR models to the constraints in systems of equations that were concurrent with the previous article published by Sims (Sevüktekin 2007).

VAR models can reveal dynamic relationships without requiring any restrictions on the structural model and are therefore frequently used in time series analysis.

The VAR model is a technique in which a large number of variables in the system are expressed in their past values and each equation is solved by the Least Squares (OLS) method. This simple structure, provided by the use of past knowledge, has created an opening to interpret relationships by adding dynamism to time series.

When we consider a model with two equations that are affected by each other, that is, that explain each other ( $y_t, x_t$ );

$$y_t = \beta_{10} - \beta_{12}x_t + \gamma_{11}\gamma_{t-1} + \gamma_{12}\gamma_{t-1} + e_{yt}$$

$$x_t = \beta_{20} - \beta_{21}y_t + \gamma_{21}\gamma_{t-1} + \gamma_{22}x_{t-1} + e_{xt}$$

It can be expressed as. In the model,  $x_t$  and  $y_t$  variables are assumed to be stationary series.  $e_{yt}$  and  $e_{xt}$ ;  $\sigma_y, \sigma_x$  are disruptive terms with standard deviation and no white correlation process. Equations are called first order vector autoregressive (VAR) models, because the equations have a maximum lag length. This two-variable and first-order regressive VAR model can also be used to explain multivariable and higher order models. The standard VAR model can be expressed as follows.

$$y_t = \alpha_{10} - \alpha_{11}y_{t-1} + \alpha_{12}x_{t-1} + u_{1t}$$

$$x_t = \alpha_{20} - \alpha_{21}y_{t-1} + \alpha_{22}x_{t-1} + u_{2t}$$

In the VAR model, each variable is a linear function of the lagged values of itself and other explanatory variables. More consistent predictions can be made for the future by including the lagged values of the explained variable in the model.

#### **2.4.1. Integration Testing**

One of the most important problems encountered in time series is that the series bear the effect of time on them and tend to increase with time. In this case, fake regression problem arises in the models that are installed and accordingly t, F etc. Test statistics such as improves their reliability. In order to reveal the true relationships free from the time effect between the series, the differences are removed until the series become stationary. Making the series stationary with the method of discrimination is a practical method, but it is not an ideal solution. Because making a difference causes loss of long-term information to the variable and in this case, it will hinder future predictions. In order to overcome this deficiency, models that combine the long-term features of the series and at the same time ensure the stability of all variables have been developed. Our co-integration concept has entered the time series field since the 1980s and has been used in many empirical studies. In fact, long-term relationships between variables can be revealed by cointegration analysis, where linear combinations of the time series, which are not stand-alone on their own, at a certain level of lag constitute a stationary process.

With the article published in *Econometrica* magazine by Engle and Granger in 1987, they made an important contribution to making economic analyzes with non-stationary variables (Engle 1987). According to Engle-Granger, in the first stage, the error term is estimated by using the least squares method of one of the long term equations. In the second stage, the unit root test is performed by pulling the error term obtained. As a result, if it comes to a stationary, spouse integration is mentioned. In addition, if the two series are stationary at I (0), it can be said that these series are co-integrated. So their level values and regressions will be meaningful. In this case, there will be a long-term equilibrium relationship between them. While cointegration analysis examines

the long-term relationship between the series, it does not give detailed information about the direction of the relationship at the same time. Therefore, the Granger causality test is more effective in indicating the direction of the relationship (Kutlar 2000).

### **2.4.2 Impulse Response Functions**

Since the VAR model is estimated, it is very difficult to interpret the obtained parameters, and the future responses can be made by measuring the responses of the variables against the shocks to be given to the systems of equations. The effects of both the related variable and other variables on the shocks given to each variable in the model in order are measured by Impulse-Response Functions. The impulse-response analysis shows the response of the other variable in response to a one-unit standard deviation shock that will occur in one of the variables within the system of equations. Since impulse-response analysis is a technique built on structural shocks, it is important to have a Granger causality relationship between variables. Because one unit of standard deviation shock on a variable that does not cause each other will have no effect on the other variable (Sevüktekin 2007).

### **2.4.3 Variance Decomposition**

Variance Decomposition is a technique used in the analysis of residues in the VAR model, such as effect-response functions. Thanks to this developed technique, the numerical effects of a standard deviation shock given to the variable on the other variable will be seen.

Variance decomposition is also important in terms of providing information about dynamic interactions between variables and how much of the proportional change that occurs in a variable over a period of time is caused by itself and how much is caused by other variables in the system. Thus, it can be determined whether the variables are internal or external (Oltular, 2006).

**CHAPTER 4**  
**THE EFFECT OF EXCHANGE RATE VOLATILITY ON**  
**UNEMPLOYMENT AND GROWTH RATE IN TURKEY: 1990-2019 PERIOD**

**3.1. Purpose of the research**

Exchange rate is generally defined as the rate of change that shows how much foreign currency can be bought with a unit of national currency (Ahmad et al., 2013: 741). According to another definition, the exchange rate is the price of a currency against another currency with which it is associated. According to this definition, the exchange rate is expressed as a conversion tool, a coefficient or ratio, which depends on the direction of the conversion process. (Azid et al., 2005: 749-750). The real exchange rate is the nominal exchange rate adjusted for price changes and is seen as an important macroeconomic policy variable showing the competitiveness of a country (Kogid et al., 2012: 7). As stated in many studies, the exchange rate can positively affect economic growth through two channels. First, the exchange rate reduces the risk of cash, thereby reducing interest rates. This increases investment and growth. Second, the exchange rate may affect growth by lowering international transaction costs in connection with international trade (Dornbush, 2001: 5). In case the general level of real incomes and prices in foreign countries increases or real interest rate increases, the exchange rate of a country increases compared to other markets (Oksay, 2001). Foreign exchange markets are the most approaching markets for full competition due to the large number of buyers and sellers, the foreign currency being homogenous, divisible due to the monetary currency, the perfect news and the entry and exit of the market (Ünlü, 2016).

The purchasing power parity approach suggests that the equilibrium exchange rate (balance rate of exchange), especially in fixed exchange rate systems, depends on the domestic price levels of countries (in other words, domestic purchasing powers (Karluk, 2003). At the basis of the purchasing power parity approach, there is an idea that one unit of money can be bought in every country, so that the same amount of law will be valid. According to this approach, the price of a traded economic asset, translated from the current exchange rate to a certain national currency, must be the same everywhere in the world. When the same goods in different markets are expressed in a single currency, the price of the goods will be the same in each country.



The volatility experienced in exchange rates is thought to cause economic crises especially in recent years. This paper assesses the effects of real exchange rate volatility on growth and unemployment by considering quarterly data from 1990:Q1-2019:Q3. In this study, volatility of real exchange rate is modelled with rate of growth and unemployment by the help of highly correlated and lagged currency data. In the study, real GDP will be taken as a dependent variable representing economic growth. The independent variables of the model are real exchange rate volatility, inflation, foreign direct investment and gross fixed capital formation.

### **3.1.1. Significance of Research**

In Turkey, import substitution policy was applied until the 1980s. The increasing globalization trend in the 1980s made the economies more dependent on each other and more open to external shocks. policy to be implemented by Turkey, has become unsustainable with the effects of the global oil crisis. In this context, in Turkey, the foreign trade deficit, current account deficit and growing inflation increased significantly and turned negative (Rose and Ekinçi, 2006: p.166). with 1980s liberal economic transition process in Turkey has started. Between 1980-1989 fixed exchange rate system was applied and devaluations were frequent during this period. A controlled free exchange system was implemented between 1989-1999 and a fixed exchange rate system in which daily increases were determined and limited in 2000-2001 (Barışık and Demircioğlu, 2006: p.72). the scope of approaches and experiments concerning Turkey's exchange rates in 1994, 2000 and 2001 and is experienced in crisis due to the devaluation of the exchange rate has risen sharply made. In 2001, Turkey floating exchange rate system was introduced with the crisis. Thus, although various interventions were made from time to time, the exchange rates started to be determined according to the supply and demand balance in the free market.

In this study, the effects on unemployment and growth rates, volatility in the real exchange rate in Turkey has been determined. This paper assesses the effects of real exchange rate volatility on growth and unemployment by considering quarterly data from 1990: Q1-2019: Q3. Few studies have investigated the effect of volatility in real exchange rates on unemployment and growth rates in the literature. Our study is important because we think it will contribute to the researchers and literature in the field.

### **3.1.2. Research Hypotheses**

The hypotheses of the study are as follows;

H0: Exchange rate volatility has negative effect on unemployment reduction and economic growth.

H1: Exchange rate volatility has a positive effect on unemployment reduction and economic growth.

### **3.1.3. Data Collection Method**

In order to examine the relationship between volatility in real exchange rate on growth and unemployment; Real GDP (RGDP), manufacturing industry labor force change rate and manufacturing industry growth rate, Independent variables CPI, Foreign direct investments (FDI), gross fixed capital formation (GFCF) and Real Exchange Rate (RER) data and rate variables will be used. Among these variables, the Real Exchange Rate is published on the TCBR website (<http://www.tcbr.gov.tr/>) Electronic Data Distribution System and the Turkish Statistical Institute website ([www.tuik.gov.tr](http://www.tuik.gov.tr)) and IMF International Financial Statistics (IFS) will be taken from the database. Examined period is 1990: Q1-2019: Q3 period and quarterly data will be used.

Volatility in the real exchange rate will be estimated by the GARCH method. Conditional variance values of the GARCH model established through Real Exchange Rate (RER) data will be used as the volatility variable in the model. Real exchange rate volatility reflects unpredictable risks on production, especially due to the impact of imported goods on domestic costs. As it is an unobservable variable, real exchange rate volatility will be measured by the conditional variance values we will obtain from the GARCH model (Bollerslev, 1986).

The most common problem when testing non-stationary time series is that unit root tests have very low impact. For this reason, especially in recent years, ARDL border testing approach developed by Pesaran and Shin (1999) and Pesaran et al. (2001) is used to test long-term relationships. The most obvious feature of this method is; To test the long-term relationship between variables, each variable does not have the condition that the degree of integration is the same. In other words, whether the variables are I (0) or I (1) is no longer a prerequisite for testing the long-term

relationship. In addition, long and short term coefficients can be estimated simultaneously, and a dynamic error correction model (ECM) can be obtained through a simple linear transformation through the ARDL model.

#### **3.1.4. Research Sample and Limitations**

In order to examine the relationship between volatility in real exchange rate on growth and unemployment; real exchange rate, manufacturing industry labor exchange rate and manufacturing industry growth rate variables were used. From these variables, the real exchange rate was taken from the TCBR website (<http://www.tcbr.gov.tr/>) Electronic Data Distribution System and the Turkish Statistical Institute website ([www.tuik.gov.tr](http://www.tuik.gov.tr)).

Examined period 1990: Q1-2019: Q3. period and limited to quarterly data. Work only on the relationship between the real exchange rate volatility between periods of growth and unemployment in Turkey is determined researched is another limitation of the study. For the limitations there has been unavailability of pure data and limited access to those data accept some verified web sites. Through out the research papers analysed common methods are used for checking exchange rate volatility on unemployment and growth rate.

## CHAPTER 5

### Empirical Results

#### 4.1. Descriptive Statistics

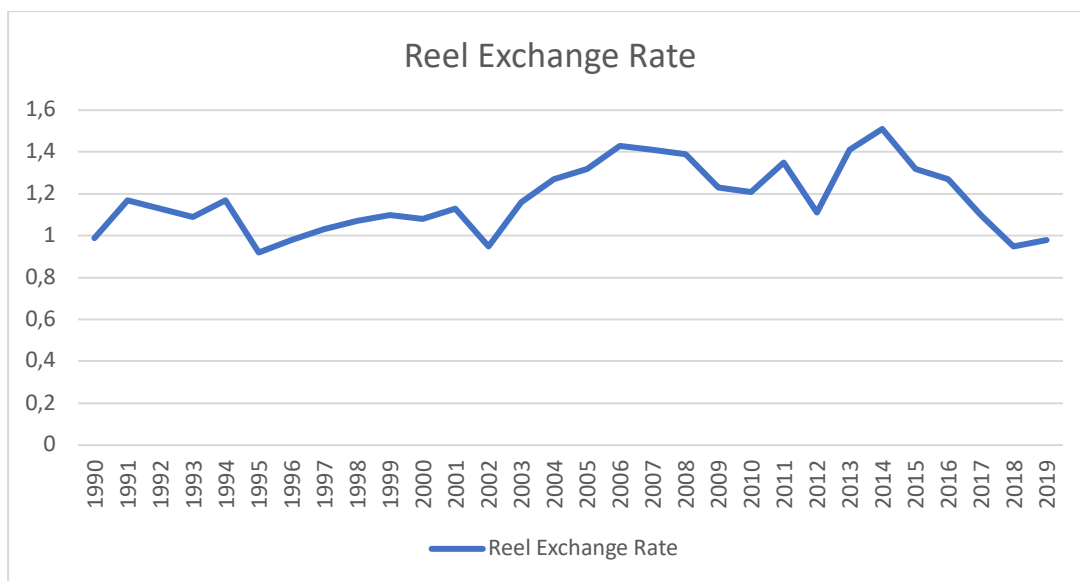
In order to examine the relationship between volatility in real exchange rate on growth and unemployment; real exchange rate, manufacturing industry labor exchange rate and manufacturing industry growth rate variables were used. From these variables, the real exchange rate was taken from the TCBR website (<http://www.tcbr.gov.tr/>) Electronic Data Distribution System and the Turkish Statistical Institute website ([www.tuik.gov.tr](http://www.tuik.gov.tr)).

Examined period 1990: Q1-2019: Q3. period and limited to quarterly data.

#### 4.2. Autocorrelation

In this part of the study, econometric analysis of real exchange rate, manufacturing industry labor exchange rate and manufacturing industry growth rate variables will be done respectively. Then, the volatility in the real exchange rate will be estimated by the GARCH method. First, the real exchange rate, manufacturing industry labor exchange rate and manufacturing industry growth rate series are discussed.

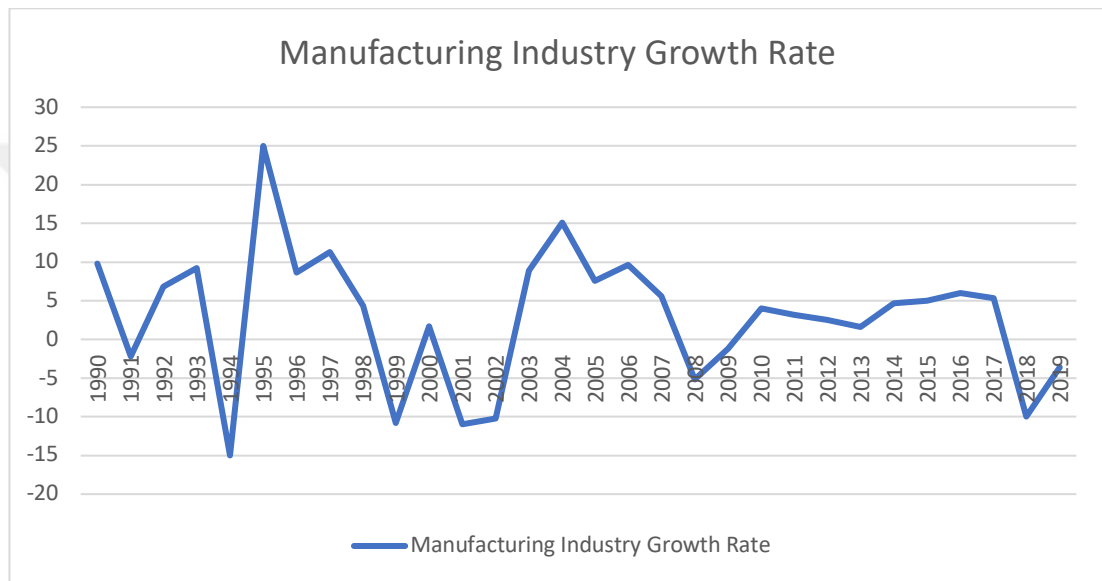
**Figure 4.1.** Time-dependent change graph of real exchange rate between 1990-2019



**Source:** TCBR, Electronic Data Distribution System

Figure 4.1 shows the changes in the real exchange rate between 1990-2019. With the effect of the economic crises experienced in real exchange rates over the years, there have been decreases from time to time, but they have shown an increasing trend in recent years.

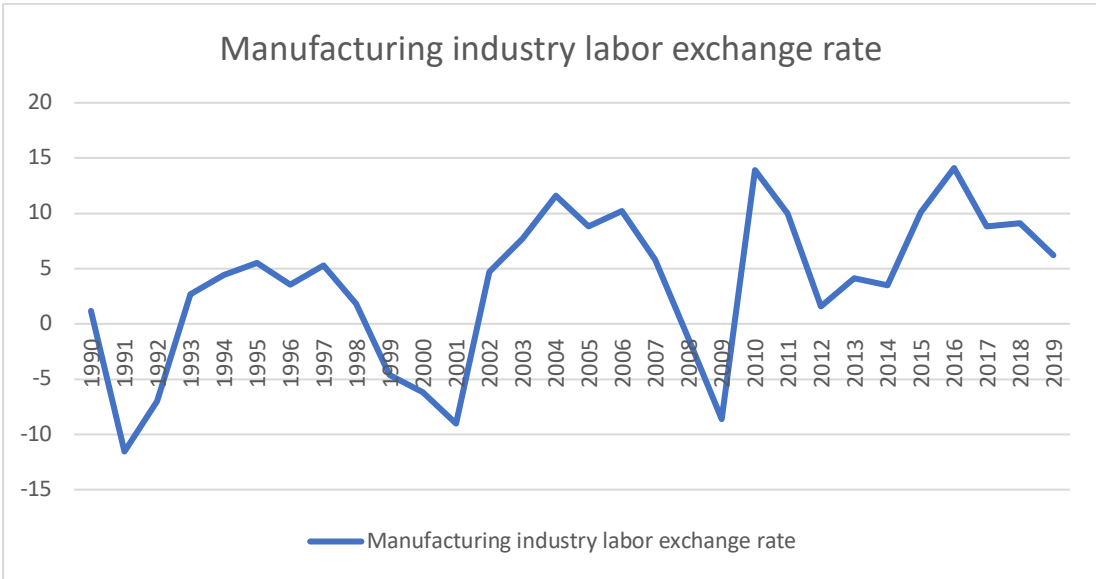
**Figure 4.2.** Time-dependent change graph of Manufacturing Industry Growth Rate between 1990-2019



**Source:** Turkstat, 2020

Figure 4.2 shows the changes in the growth rate of the manufacturing industry between 1990-2019. The manufacturing industry growth rate has declined in 1994, 1999, 2001 and 2018 due to the effects of the economic crises experienced over the years. In certain periods, rapid gains and losses are observed in the growth rate of the manufacturing industry.

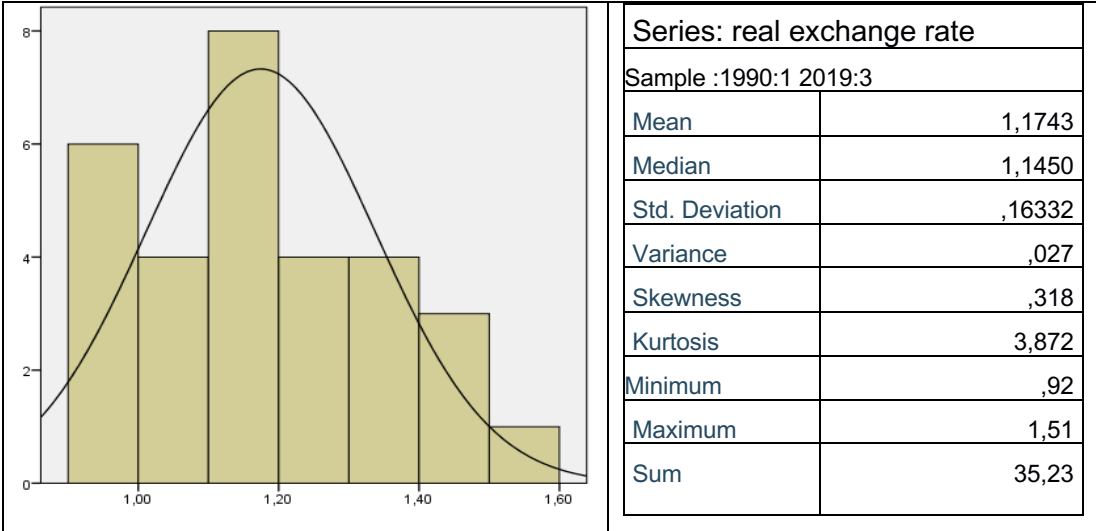
**Figure 4.3.** Time-dependent change graph of Manufacturing Industry Labor Exchange Rate between 1990-2019



Source: Turkstat, 2020

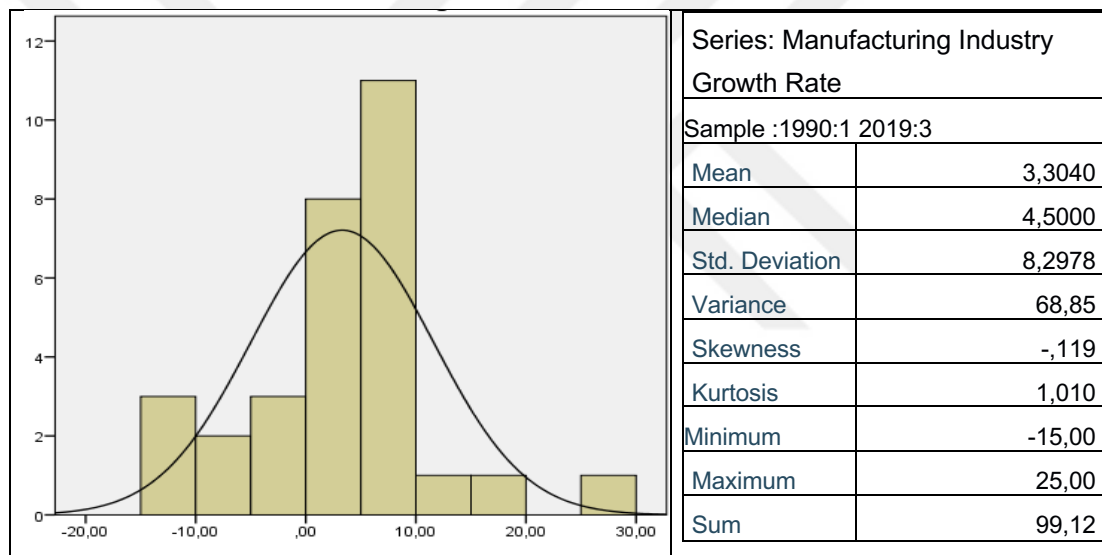
Graph 4.3 shows the changes in the Manufacturing Industry Production Workers Index between 1990-2019. In the Manufacturing Industry Production Workers Index, declines occurred in years 1991, 1999, 2001 and 2008. In certain periods, rapid gains and losses are observed in the manufacturing industry production workers index. It is understood from the chart that it was affected by the last global economic crisis that emerged in the USA in 2008 and spread to the world in a short time.

**Figure 4.4.** Real Exchange Rate Histogram and Distribution Chart



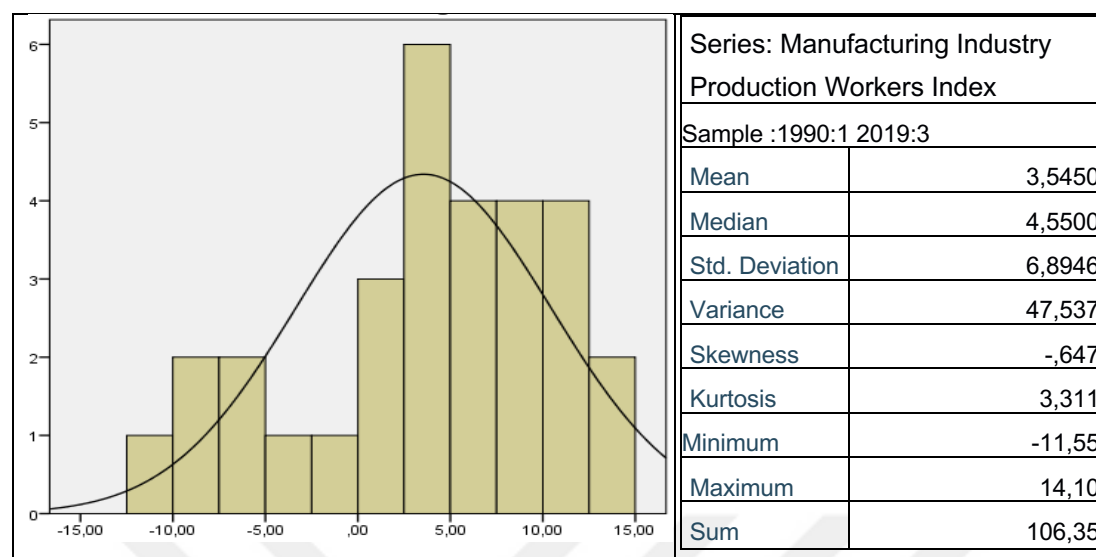
In Fig.4.4, the values of the basic statistics such as average, maximum, minimum and standard deviation of the real exchange rate series are also given. Skewness and kurtosis results provide information on the distribution of the real exchange rate. According to these results; It reveals that it has a pointed structure since the skew value is  $0.31 > 0$ , which gives information about the asymmetry in the distribution of the real exchange rate over the years, and the poverty value is greater than 3,872 and 3. Since the kurtosis value approaches 3, it can be said that the error terms show a normal distribution.

**Figure 4.5.** Manufacturing Industry Growth Rate Histogram and Distribution Chart



In Fig.4.5, the values of the basic statistics such as average, maximum, minimum, and standard deviation of the Manufacturing Industry Growth Rate series are also given. Accordingly, in the distribution of the Manufacturing Industry Growth Rate series over the years, the skewness value that gives information about the asymmetry is  $-0.119$  is less than zero, and has a skewed structure because it is less than  $1.010$  and  $3$  is flatness. It can be said that these results do not show normal distribution of error terms.

**Figure 4.6.** Manufacturing Industry Production Workers Index Histogram and Distribution Chart



In Fig.4.6, the values of the basic statistics such as average, maximum, minimum, and standard deviation of the Manufacturing Industry Production Workers Index series are also given. According to these results, the skewness value - which gives information about the asymmetry in the distribution of the Manufacturing Industry Production Workers Index series over the years, is skewed to the left because it is less than 647 zeroes. It has a pointed structure since the kurtosis value is greater than 3,311 and 3. It can be said that these results do not show normal distribution of error terms.

#### 4.2.1 Examining Autocorrelation Function

One of the methods used to reveal the characteristics of the stochastic process is to examine the autocorrelation function. Autocorrelation coefficients, which are obtained as a function of  $k$ , constitute the autocorrelation function. After sample autocorrelation coefficients are found, their graph with  $k$  is also called the sample autocorrelation function or correlogram.

**Table 4.1.** Real Exchange Rate Series Correlogram

	AC	PAC	Q-Stat	Prob
1	-0,806	-0,806	51,359	0,000
2	-0,626	-0,071	62,381	0,000
3	0,580	0,168	92,504	0,000
4	-0,435	-0,393	109,310	0,000



5	-0,391	-0,170	113,310	0,000
6	-0,354	-0,129	129,332	0,000
7	0,342	0,427	131,734	0,000
8	0,328	-0,021	143,768	0,000
9	-0,259	-0,169	151,926	0,000
10	0,224	0,053	164,308	0,000
11	-0,222	0,036	179,472	0,000
12	-0,158	-0,054	181,648	0,000
13	0,109	-0,238	189,652	0,000
14	-0,098	0,121	190,656	0,000
15	0,056	0,009	193,856	0,000
16	-0,016	-0,093	195,874	0,000

The

sampling autocorrelation function of the real exchange rate series calculated for  $k = 1, 2, \dots, 16$  delay is given in Table 4.1. When the table is analyzed, it is seen that the function has statistically significant values and the AC values are outside the confidence limits at 5% significance level and the AC coefficients show a decreasing trend. Accordingly, it was observed that the series was not stationary.

**Table 4.2.** Manufacturing Industry Growth Rate Series Correlogram

	AC	PAC	Q-Stat	Prob
1	0,556	0,556	59,922	0,000
2	0,140	0,244	60,578	0,000
3	0,096	0,089	60,898	0,000
4	0,348	0,324	65,257	0,000
5	0,237	0,216	67,364	0,000
6	0,271	0,425	70,227	0,000
7	0,224	0,180	72,270	0,000
8	0,021	0,159	82,289	0,000
9	-0,024	-0,029	92,314	0,000
10	-0,019	-0,229	93,332	0,000
11	0,024	0,008	94,362	0,000
12	-0,021	0,038	95,385	0,000
13	-0,105	0,016	96,005	0,000
14	0,085	-0,010	98,437	0,000
15	-0,021	0,207	98,464	0,000
16	-0,088	-0,027	102,002	0,000

The sample autocorrelation function of the manufacturing industry growth rate series calculated for  $k = 1, 2, \dots, 12$  delay is given in Table 4.2. When the table is analyzed, it is seen that the function takes statistically significant values and remains outside the

confidence limits at 5% significance level for AC values, and the AC coefficients show a rapidly decreasing trend. Accordingly, it can be said that the series is stationary.

**Table 4.3.** Manufacturing Industry Production Workers Index Series Correlogram

	<b>AC</b>	<b>PAC</b>	<b>Q-Stat</b>	<b>Prob</b>
1	0,843	0,843	39,328	0,000
2	0,662	0,375	43,616	0,000
3	0,320	0,299	43,118	0,000
4	0,075	0,073	43,319	0,000
5	0,005	0,170	52,320	0,000
6	0,072	-0,276	53,524	0,000
7	-0,109	-0,393	54,007	0,000
8	0,266	-0,086	67,034	0,000
9	0,042	0,243	71,112	0,000
10	0,062	-0,064	87,295	0,000
11	-0,116	-0,240	87,968	0,000
12	-0,030	0,130	88,015	0,000
13	,095	-,020	8,518	0,000
14	-,020	,021	8,543	0,000
15	-,153	-,035	10,040	0,000
16	-,021	-,063	10,069	0,000

The sample autocorrelation function of the Manufacturing Industry Production Workers Index series calculated for  $k = 1, 2, \dots, 12$  delay is given in Table 4.3. When the table is analyzed, it is seen that the function takes statistically significant values and remains outside the confidence limits at 5% significance level for AC values, and the AC coefficients show a rapidly decreasing trend. Accordingly, it can be said that the series is stationary.

#### **4.2.2 Determining the Stability Order of the Series**

The starting point of the time series analysis is to analyze the stationarity of the series. Stability analysis has great importance in time series modeling. It means that a time series is stationary; The mean, variance, and common variance of this series means that it does not change over time. If the series are not stationary; the variance of the series will depend on time and increase over time. If the series are stationary, the shocks to be delivered to the series are temporary and the effects of these shocks disappear over time. In this case, the series return to their long-term average levels.

When the series are not stationary, they have a continuous component. Stationary process; the average and variance are determined as the process that does not change over time. Also in this process, the common variance between the two periods; it depends only on the distance between the two periods, and the period when the common variance is calculated does not affect this variance. If there is a static time series; the mean, variance and common variance of this series are the same over time (Gujarati, 2001). Time series generally increase due to the common trend. When regression is calculated between the series; Even if there is no significant relationship between the series in question,  $R^2$  value may be high in general. This situation is called false regression. In other words, although there is not any relationship between the series, it seems that there is a relationship between them because they act in a similar way due to the common trend. This shows how important the stability analysis between series is (Ertuğrul, 2012: 17).

The ADF test introduced by Dickey-Fuller was applied to the series to determine the stationarity of the variables and the results are given in table 4.4. All variables, ADF tests were applied with constant terms and without trends.

### Hypothesis Tests

Ho:  $\alpha_1 = 0$  There is a unit root (Series is not stationary.)

H<sub>1</sub> :  $\alpha_1 < 0$  No unit root (Serial is Stable.)

**Table 4.4.** Unit Root (ADF) Test for Variables (k=1)

Variables	Unit Root (ADF) Test Statistics Results	
	Level	1. Difference
Real Exchange Rate	-2,345719	-7,752549**
Manufacturing Industry Growth Rate	-3,401786	-5,546394**
Manufacturing Industry Production Workers Index	-4,351863*	

\* Serial MacKinnon (-3.660) does not contain unit root at 1% significance level according to its critical values.

\*\* Serial MacKinnon (-3.665) does not contain unit root at 1% significance level according to critical values.

According to the ADF test results, only the Manufacturing Industry Production Workers Index series was stationary. Although other series are not stationary at level level, they have become stationary after their first differences were taken.

#### 4.2.3 Determining the Autoregressive Moving Average Model

ARMA model, which is one of the models suitable for the structure of the variables discussed in the study, was chosen as the most suitable model that provides statistical significance at 5% significance level and satisfies the conditions of stability and transformation. Estimation results of the model are given in table 4.5.

**Table 4.5.** The estimated ARMA model for Real Exchange Rate

Dependent Variable: Real Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic rob.	Prob.
<b>C</b>	1.16412	0.03931	35.9274	0.0002
<b>AR</b>	0.24405	0.01632	2.12783	0.0016
<b>MA</b>	0.26159	0.19832	2.01568	0.0933
<b>R-squared</b>	0.68415	<b>Mean dependent var</b>	1.13621	
<b>Adjusted R-squared</b>	0.62314	<b>S.D. dependent var</b>	0.05824	
<b>S.E. of regression</b>	0.10212	<b>Akaike info criterion</b>	-1.75632	
<b>Sum squared resid</b>	0.63253	<b>Schwarz criterion</b>	-1.69852	
<b>Log Likelihood</b>	73.54817	<b>F-statistic</b>	34,521	
<b>Durbin-Watson stat</b>	1.100017	<b>Prob(F-statistic)</b>	0.000	

#### 4.2.4. ARCH-LM Test

ARCH-LM test was applied to the residues of the ARMA model in Table 4.5, which was determined to be suitable for the Real Exchange Rate series, and whether the fixed variance assumption was valid in the residues. ARCH-LM test results are shown in Table 4.6.

**Table 4.6.** ARCH-LM test results for Real Exchange Rate

Delays	Chi-square critical	T R <sup>2</sup>	P
<b>K=1</b>	3.62541	6.74598	0.00753
<b>K=2</b>	5.47122	7.45912	0.02468

<b>K=3</b>	6.66985	7.01654	0.00372
<b>K=4</b>	9.35281	11.14276	0.01963

\* Chi-Square Critical Values are at 10% significance level

As seen in Table 4.6, ARCH-LM statistics calculated for the residues obtained from the model reveal the presence of ARCH effect in the residues obtained from the model since it is larger than the chi-square critical values.

### 4.3. Modeling Real Exchange Rate Volatility

The GARCH model, which is created by including the delayed values of the conditional variance in addition to the lagged values of its own lagged values, is the most common method used in the modeling of volatility. In our analysis, Real Exchange Rate series was analyzed as ARCH and then the square root of the variances of the real exchange rates estimated in the GARCH model was calculated.

#### 4.3.1. ARCH MODEL

In the analysis of the ARCH model, first of all, the significance of the statistics of the predicted conditional variance model and whether the stationary condition was met with the condition that the parameters of the variance expressed as  $\alpha_0 > 0$ ,  $0 < \alpha_1 < 1$  were positive and the results are shown in the following table 4.7.

**Table 4.7.** ARMA-ARCH model for Real Exchange Rate

Dependent Variable: Real Exchange Rate

Variable	Coefficient	Std. Error	Z-Statistic rob.	Prob.
<b>C</b>	1.22417	0.03599	41.3256	0.0000
<b>AR</b>	0.78451	0.03158	11.5123	0.0000
<b>MA</b>	0.15423	0.07896	3.4879	0.0201
	Variance Equation			
<b>C</b>	0.03215	0.02145	4.6358	0,0269
<b>ARCH</b>	1.59863	0.00536	5.6477	0,0012

<b>R-squared</b>	0.66315	<b>Mean dependent var</b>	1.12874
<b>Adjusted R-squared</b>	0.58879	<b>S.D. dependent var</b>	0.06325
<b>S.E. of regression</b>	0.10532	<b>Akaike info criterion</b>	-1.67231
<b>Sum squared resid</b>	0.7723	<b>Schwarz criterion</b>	-1.58745
<b>Log Likelihood</b>	64.875	<b>F-statistic</b>	41.356
<b>Durbin-Watson stat</b>	1.12478	<b>Prob(F-statistic)</b>	0.00000

The predicted ARMA-ARCH model

$$h_t = 0.03215 + 1.59863 \Sigma^2_{t-1}$$

it can be written as. In the conditional variance model, it is observed that  $\alpha_1$ , which is the constant term and ARCH parameter, is statistically significant with 5% margin of error and both parameters ( $\alpha_0$  and  $\alpha_1$ ) satisfy the condition. However, the stationary condition cannot be met with the ARCH parameter greater than 1.

#### 4.3.2.GARCH MODEL

In the analysis of GARCH, firstly, the significance of the statistics of the predicted conditional variance model and whether the stationary condition was met with the condition that the variance parameters expressed as  $\alpha_0 > 0$ ,  $\alpha_1 \leq 1$ ,  $\beta_1 \geq 1$ ,  $\alpha_1 + \beta_1 < 1$  were not negative and the results below are 4.8 It is given in

**Table 4.8.** ARMA-GARCH model for Real Exchange Rate

Dependent Variable: Real Exchange Rate

Variable	Coefficient	Std. Error	Z-Statistic rob.	Prob.
<b>C</b>	1.18213	0.02547	33.64743	0.0000
<b>AR</b>	0.66324	0.06241	8.42256	0.0000
<b>MA</b>	0.25863	0.03476	4.21968	0.0002
	Variance Equation			

<b>C</b>	0.00423	0.00485	2.34556	0,1036
<b>ARCH</b>	0,56312	0.12478	4.41256	0,0589
<b>GARCH</b>	0,71963	0,11473	5.63632	0,0003

R-squared	0.62314	Mean dependent var	1.22145
Adjusted R-squared	0.51236	S.D. dependent var	0.12355
S.E. of regression	0.10336	Akaike info criterion	-1.77853
Sum squared resid	0.7715	Schwarz criterion	-1.53562
Log Likelihood	69.454	F-statistic	22.41523
Durbin-Watson stat	1.01358	Prob(F-statistic)	0.000000

The predicted ARMA-GARCH model,

$$h_t = 0.00423 + 0.56312 \Sigma^2_{t-1} + 0.71963 h_{t-1}$$

it can be written as. When the results in Table 4.5 are examined, it is seen that the estimation results of the GARCH model are significant with 5% error margin of the parameters. In addition, in the conditional variance model, both parameters appear to meet the non-negative condition. The GARCH model is stationary, with the condition that the sum of the parameters ( $\alpha_1 + \beta_1 < 1$ ) of stationarity condition is less than 1. The sum of the regression parameters ( $\alpha_1 + \beta_1$ ),  $0.56312 + 0.71963 = 1.28275$  express the current volatility effect. This value is mostly close to 1, and if it is close to 1, the effect of volatility will be greater.

#### 4.4.VAR MODEL

In predicting the variables in the study in the Vector Autoregressive Model (VAR); Manufacturing industry labor exchange rate and manufacturing industry growth rate series are internal as models, square roots of the estimated variances (sqr (vol)) of the real exchange rate series refer to the volatility series and are added to the model as external variables. The results of the model are shown in Table 4.9. accordingly, when the results obtained in Table 4.9 are examined, the effect of real exchange rate volatility tested in the VAR model on the growth rate of the manufacturing industry was statistically determined. When the relationship between

the real exchange rate and the growth rate of the manufacturing industry is analyzed, it was seen that the calculated t-statistic value is higher than the t-table value.

When the relationship between the real exchange rate and the rate of workers in manufacturing industry production is analyzed, it is seen that the calculated t-statistic value is smaller than the t-table value.

**Table 4.9.** VAR Model Created for Manufacturing Industry Growth Rate, Manufacturing Industry Labor Exchange Rate and SQR (VOL) Series.

	<b>D (manufacturing industry growth rate (-1))</b>	<b>Manufacturing industry labor exchange rate</b>
<b>D(manufacturing industry growth rate (-2))</b>	-0.52479 (0.10233)	0.98634 (0.31245)
<b>D(manufacturing industry growth rate (-3))</b>	-0.14596 (0.11123)	0.33845 (0.32658)
<b>Manufacturing industry labor exchange rate (-1)</b>	0.33547 (0.06312)	0.82589 (0.12571)
<b>Manufacturing industry labor exchange rate (-2)</b>	-0.30963 (0.05891)	-0.52147 (0.12436)
<b>C</b>	0.47125 (0.43795)	0.38456 (0.11581)
<b>SQR(VOL)</b>	-0.92468 (8.45260)	24.80763 (16.2549)
<b>R-squared</b>	0.524789	0.567145
<b>Adj. R-squared</b>	0.442369	0.533328
<b>F-statistic</b>	13.59087	18.77111
<b>Log likelihood</b>	-175.9623	-241.1978



## CHAPTER 6

### CONCLUSIONS AND RECOMMENDATIONS

In this study, in this study, which araştrıl of the effects of exchange rate volatility, unemployment and growth in Turkey, TURKSTAT, and TCBR compiled from electronic data distribution system monthly data 1990: 1-2019: 3 period of the real exchange rate, Manufacturing Industry Growth Rate and Manufacturing Industry Labor Exchange Rate An empirical analysis was made using the variables. ADF model, one of the traditional unit root tests, in the analysis. ARCH and GARCH models are used.

In general, in our study, it was examined whether the time series that were handled were stationary or not. If the time series are not stationary, the series will contain the trend. In this case, similar situations such as false regression will arise in the forecasting and regression equations where time series will be used.

For this reason, stationarity determination for the series to be used in models was made by ADF test. As a result of the test, it has been determined that the real exchange rate and manufacturing industry production indexes are not stationary at their levels, while the manufacturing industry growth series is at a stable level. In order for non-stationary series to come to stationary station, the first differences were taken and it was observed that they became stationary.

After real exchange rate was made stable by taking the first difference, modeling of the volatility in real exchange rate was started. Theoretically, in order to model the volatility in the exchange rate, it must first be estimated. Volatility is estimated as the standard deviation or variance of the variable of interest. A good volatility model is the model that best predicts volatility. When the exchange rate data are analyzed, there is no relation between the average and fixed terms of averages, but their variances are not fixed. Since the fixed variance assumption in traditional econometrics models is abandoned, models with such data can be resolved better with ARCH (Sequential Dependent Conditional Variance) -GARCH (Generalized Sequential Dependent Conditional Variance) models and the volatility of the data is better detected.

When we look at the results of the volatility model determined with the help of the GARCH model, the sum of parameters ( $\alpha_1 + \beta_1$ ), 1.28275, took a value close to the

number 1. This value indicates that the effect of volatility will be great in case of volatility experienced in real exchange rate. The square roots of the variances obtained from the GARCH model will express the volatility series in our VAR model, which will be installed later.

Different results have been obtained in studies on exchange rate intervention in developed countries. Many of these studies used ARCH or GARCH techniques. Connolly and Taylor (1994), Dominguez (1998), Cheung and Chinn (1999) find that central bank intervention leads to an increase in conditional exchange rate volatility, while Eijffinger and Grujters (1991), Dominguez (1993) tend to reduce exchange rate volatility. It showed. In contrast, Baillie and Humpage (1992) concluded that central bank interventions did not have a significant effect on exchange rate volatility.

The effect of this variable, obtained from the GARCH model and defined as the volatility in the exchange rate, on the rate of workers working in the manufacturing industry production and the growth rate of the manufacturing industry was examined in the VAR model. As a result of VAR modeling, the effect of real exchange rate volatility on the growth rate of the manufacturing industry was found statistically significant.

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