ANALYSES OF AZERBAIJAN'S FOREIGN TRADE BY INTEGRATING VOLATILITIES OF RATES OF CHANGES IN OIL PRICES AND EXCHANGE RATES

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ABSTRACT

ANALYSES OF AZERBAIJAN'S FOREIGN TRADE
BY INTEGRATING VOLATILITIES OF RATES OF CHANGES
IN OIL PRICES AND EXCHANGE RATES

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Oil price and real effective exchange rate, which are the determining factors for export-import and Gross Domestic Product (GDP), have been the subject of much research in oil-exporting countries. Because of Azerbaijan's dependence on crude oil export, the fluctuations in oil prices, together with exchange rate movements, have implications for the Azerbaijanian economy. This research examines (a) the relationships between export-import growth and GDP growth, (b) impacts of rates of changes in oil price and real effective exchange rate (DLPOIL&DLREER), also the volatilities of DLPOIL and DLREER (VOLPOIL&VOLREER) on export-import growth and GDP growth using Vector Autoregressive (VAR) model on quarterly time series between 2001Q1-2020Q4. To find the volatilities of DLPOIL and DLREER, Autoregressive and Generalized Autoregressive Conditional Heteroskedasticity (ARCH&GARCH) models were employed. To determine the impacts of DLPOIL and DLREER, we used granger causality, impulse response functions, variance decomposition and dynamic multiplier function results of an unrestricted VAR model. Results of the VAR model show that (a) DLREER has a significant-negative effect only on GDP growth, (b)

DLPOIL has a significant-positive impact on export growth and GDP growth, a significant-negative impact on import growth. Moreover, to find out the impact of VOLPOIL and VOLREER on other variables separately, a new VAR model was constructed with implementation of analysis methods used in previous VAR model. The findings of new VAR model reveal that (a) VOLREER has significant-negative effect only on GDP growth, (b) VOLPOIL has a significant-negative impact on export growth and GDP growth, a significant-positive impact on import growth.

Keywords: Azerbaijan, oil prices, Export-Import, ARCH&GARCH, Vector Autoregression

ÖZ

PETROL FİYATLARI VE DÖVİZ KURLARINDAKİ DEĞİŞİM ORANLARININ VOLATİLİTELERİNİ BÜTÜNLEŞTİREREK AZERBAYCAN'IN DIŞ TİCARETİNİN ANALİZİ

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İhracat-ithalat ve Gayri Safi Yurtiçi Hasıla (GSYİH) için belirleyici faktörler olan petrol fiyatı ve reel efektif döviz kuru, petrol ihraç eden ülkelerde çok fazla araştırmaya konu olmuştur. Azerbaycan'ın ham petrol ihracatına bağımlılığı nedeniyle petrol fiyatlarındaki dalgalanmalar döviz kurundaki hareketlenmeler ile birlikte Azerbaycan ekonomisine yansımaktadır. Bu araştırma, (a) ihracat-ithalat büyümesi ile GSYİH büyümesi arasındaki ilişkileri, (b) petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının (DLPOIL&DLREER) ve ayrıca bu verilerin volatilitelerinin (VOLPOIL&VOLREER) ihracat-ithalat büyümesi ve GSYİH büyümesi üzerindeki etkilerini Vektör Otoregresif (VAR) modelini kullanarak 2001 ilk dönemden 2020 son döneme kadar üç aylık bir zaman serisinde incelemektedir. Petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının volatilite değerlerini bulmak için Otoregresif ve Genişletilmiş Otoregresif Koşullu Varyans (ARCH&GARCH) modelleri kullanılmıştır. DLPOIL ve DLREER değerlerinin etkilerini belirlemek için, kısıtsız VAR modelinin granger nedensellik, etki-tepki fonksiyonları, varyans ayrıştırma ve dinamik çarpan fonksiyonu sonuçlarını kullandık.

VAR modelinin sonuçları, (a) DLREER'ın yalnızca GSYİH büyümesi üzerinde anlamlı-negatif etkiye sahip olduğunu, (b) DLPOIL'ın ise ihracat büyümesi ve GSYİH büyümesi üzerinde anlamlı-pozitif etkiye, ithalat büyümesi üzerinde ise anlamlı-negatif bir etkiye sahip olduğunu göstermektedir. Ayrıca, VOLPOIL ve VOLREER'in diğer değişkenler üzerindeki etkisini ayrı ayrı bulmak için, önceki VAR modelinde kullanılan analiz yöntemleri uygulanarak yeni VAR modeli oluşturulmuştur. Yeni VAR modelinin bulguları, (a) VOLREER'in yalnızca GSYİH büyümesi üzerinde anlamlı-negatif etkiye sahip olduğunu, (b) VOLPOIL'in ise ihracat büyümesi ve GSYİH büyümesi üzerinde anlamlı-negatif etkiye, ithalat büyümesi üzerinde ise anlamlı-pozitif bir etkiye sahip olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Azerbaycan, petrol fiyatları, İhracat-İthalat, ARCH&GARCH, Vektör Otoregresif

To my family

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LIST OF ABBREVIATIONS

ACF	Autocorrelation Function
ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lag
ARMA	Autoregressive Moving Average
AZSTAT	State Statistical Committee of the Republic of Azerbaijan
CBAR	Central Bank of the Republic of Azerbaijan
CPI	Consumer Price Index
E-GARCH	Exponential General Autoregressive Conditional Heteroskedasticity
EIA	Energy Information Administration
FDI	Foreign Direct Investment
FPE	Final Prediction Error
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
GDP	Gross Domestic Product
GED	Generalized Error Distribution
GNI	Gross National Income
HQ	Hannan and Quinn
IMF	International Monetary Fund
IRF	Impulse Response Functions
LM	Lagrange Multiplier
LR	Likelihood Ratio
MA	Moving Average
MAE	Mean Absolute Error
MAPE	Mean Absolute Percent Error
ME	Mean Error
MSE	Mean Squared Error

NEER	Nominal Effective Exchange Rate
OLS	Ordinary Least Squares
PACF	Partial Autocorrelation Function
PP	Phillips–Perron
REER	Real Effective Exchange Rate
RMSE	Root Mean Square Error
SIC	Schwarz Information Criterion
SITC	Standard International Trade Classification
SOFAZ	State Oil Fund of the Republic of Azerbaijan
STL	Seasonal and Trend decomposition using Loess
SVAR	Structural Vector Autoregressive
USSR	Union of Soviet Socialist Republics
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
WDI	World Development Indicators

CHAPTER 1

INTRODUCTION

Exports and imports, which significantly impact on the economy, also have a mutual interaction with economic growth. Exports are considered a contribution to national income and the economy, while imports are considered an exit from the economy. As one of the most crucial indicators that both economists and countries emphasize, economic growth is at the forefront of macroeconomic debates in the globalizing world and changing economic conjunctures.

Countries rich in natural resources carry out their domestic economic activities depending on international commodity prices. It is generally accepted that fluctuations in raw material prices in developing countries can be the source of macroeconomic instability. Countries that are rich in oil reserves and whose economy depends on oil exports are affected by price fluctuations in international markets. Especially in countries like Azerbaijan, which are dependent on exports in terms of petroleum products, price changes in the international market affect the exchange rates and may cause the country to enter into a crisis.

Analysis related with the effect of shocks caused by volatilities of rates of changes in REER and oil prices on economic growth has been a vital preoccupation of academics and policymakers for the past few decades. In the literature, it has been accepted that the depreciation of the exchange rate tends to increase exports and decrease imports. In contrast, the exchange rate appreciation will deter exports and encourage imports for some countries. Therefore, the depreciation of the exchange rate allows a transfer of income between importing and exporting countries in terms of trade, which impacts both importing and exporting countries' economic growth. However, increases in oil prices have serious adverse effects on economies is largely based on the close relationship between the timing of oil price fluctuations and economic crisis.

Such as, in oil-importing countries, Hamilton (1983) found a negative correlation between macroeconomic activity and oil prices and interpreted that positive oil price changes reduced economic growth. Findings that higher oil prices impact economic growth negatively are also supported by McKillop (2004), who argues that this relationship generates panics in exchange rates and produces inflation which eventually causes financial crisis. Jin (2008), moreover, revealed that the instant increase in world crude oil prices and big changes in the exchange rate are the reasons for discouraging economic growth.

Whereas, from the perspective of oil-exporting countries, the oil price changes have different impacts. It is known that oil revenue plays important role on most oil-exporting countries' budget. Then, "a rise in oil prices means increasing the amount of money available for funding development projects. Therefore, monetary and fiscal policies function is considerably affected by oil price fluctuations" (Saddiqui et al., 2018). However, "the adverse effect makes the financial and real aggregates more uncertain due to the oil price volatility, particularly in the case of imperfect capital markets" (Hausmann & Rigobon, 2003). Conversely, governments cannot immediately pay their liabilities when the oil price is decreasing and can face a significant budget deficit. Therefore, macroeconomic performance in oil-exporting and oil-importing countries is directly correlated with oil price changes.

For example, in 2015, uncertainties of the world economy caused some instability in the Azerbaijan economy. Decreased oil prices affected macroeconomic variables such as the decline tendency in export and positive impact on import and caused the manat to depreciate. During the period when oil prices were high, pressures on the "manat" increased and the balance changed in the foreign exchange market. Meanwhile, severe risks for the international competitiveness of the Azerbaijan economy have created by high-rate devaluations in other countries.

This thesis aims to analyze the interactions between growth rates of exports, imports and GDP in Azerbaijan with the integration of the rates of changes in oil prices and real effective exchange rate (DLPOIL and DLREER), also the volatilities of these variables. The main objective of this research is to find the best feasible answer to the question: "What happens to Azerbaijan's economy when there are shocks in oil price

growth, the growth rate of REER, and the volatility of these variables? To answer this question, I examine the impacts of the volatilities of DLPOIL and DLREER, also oil price growth and growth rate of REER on the economy of Azerbaijan, such as on import-export and Gross Domestic Product (GDP). In the existing literature, no research materials precisely investigate this kind of relationship for the Azerbaijan economy. Therefore, this paper contributes to this scarce literature by expanding the analysis of the impacts of volatilities of DLPOIL and DLREER on import-export growth and GDP growth in the case of Azerbaijan.

In this thesis, as a first step, I employ ARCH/GARCH models to find volatilities of rates of changes in oil price and the REER of Azerbaijan for the quarterly period between 2001-2020. In the second step, I establish a Vector Autoregressive (VAR) model, implement Granger causality tests and get impulse response functions, dynamic multiplier functions and forecast error variance decompositions for (i) real GDP growth, (ii) real export growth, (iii) real import growth, (iv) real oil price growth, and (v) growth rate of the real effective exchange rate. The next step is about additional VAR analysis that oil price growth and growth rate of REER exempted and the volatility of DLPOIL and DLREER introduced. Generally, I explore the potential impacts of the volatilities of DLPOIL and DLREER, also oil price growth and growth rate of REER on import-export growth and GDP growth for the Azerbaijan economy.

The rest of this paper organized as follows: Chapter 2 provides a literature survey related to the relationship between import-export growth, GDP growth, oil price, and REER for Azerbaijan's economy, also for foreign oil-exporting and oil-importing countries. In chapter 3, macroeconomic issues such as the general outlook of the Azerbaijani economy, namely GDP, export, import, inflation, exchange rate, external debt, foreign direct investments, and the state budget investigated from 2001 to 2020. Chapter 4 provides volatility values of DLPOIL and DLREER over the quarterly period 2001-2020 using ARCH/GARCH models with EViews 12 student version program. In chapter 5, the relationship between export-import growth and GDP growth is analyzed, moreover, the impacts of oil price growth and the growth rate of REER on export growth, GDP growth and import growth are examined. Firstly, the information about variables and their sources are presented. Secondly, the econometric methodology was introduced. Then stability of the variables are analyzed and using

the Granger causality test results, the VAR models are constructed. Lastly, the impulse response functions, dynamic multiplier functions and variance decompositions are examined. In chapter 6, additionally, the impact of the volatilities of DLPOIL and DLREER on import-export growth and GDP growth is analyzed. The analysis methods used in chapter 5 are also acceptable for this chapter. Chapter 7 presents empirical results and interprets the sign of impacts. Finally, chapter 8 concludes the thesis. The bibliography is presented at the end.

CHAPTER 2

LITERATURE REVIEW ON THE RELATIONSHIP AMONG OIL PRICE, GDP, REER, AND EXPORT-IMPORT

There is a vast number of studies that investigate the relationship between crude oil prices, real effective exchange rates, and macroeconomic variables in the literature. However, we try to focus on studies that especially examine the impacts of the oil prices and the REER on import-export and GDP in oil-exporting economies like Azerbaijan, according to our purpose. Due to the narrow research direction and lack of literature about our aim, we are going to represent a brief literature survey of some studies which demonstrate how oil price fluctuations affect GDP, export, import, and the REER in the case of oil exporters and importers separately, since oil prices and the REER impact on various economies different ways.

In this chapter, the studies related to the relationship among oil price, GDP, REER, and import-export will be reviewed. Firstly, theoretical and empirical foundations on literature related with the relationship among GDP, oil price, REER, and import-export in Azerbaijan will be introduced. Then there will be a second section that encompasses the literature related to our research in external oil-exporting countries.

2.1 Literature Review on the Relationship among Oil Price, GDP, REER, and Export-Import about Azerbaijan's Economy

There is a weak body of literature that explores empirical and theoretical aspects of the relationship amongst oil price and REER as determinants for GDP and import-exports for Azerbaijan. Therefore, some theoretical and empirical studies are reviewed that investigate the impact of oil prices on the exchange rate, the impact of real oil price on economic growth, and the relationship between oil price, exchange rate and import-export separately in oil-exporting countries as Azerbaijan.

The empirical paper by Hasanov (2010) investigates the impact of crude oil prices on the real exchange rate of the Azerbaijan national currency, the Manat. Hasanov (2010) applies quarterly data between 2000-2007 and employs the Error Correction Model, also Johansen integration approaches to estimate this relationship. The study revealed that "there is a statistically significant and positive relationship between oil prices and Azerbaijan's real exchange rate, a 1% increase in oil prices causes a 0.7% rise in the REER". Besides, according to the paper, relative prices positively impact the REER of Azerbaijan manat is mostly related to fiscal expansion.

Niftiyev (2020) investigated the expansion of the relationship between nominal effective exchange rate (NEER), real effective exchange rate, agricultural exports and other export-related macroeconomic variables to determine Azerbaijan's non-oil sector dynamics from 2001 to 2018 with the OLS estimation technique. The paper's main findings represent that "NEER has negative impact on potato, fresh fruit, and fresh vegetable exports. Moreover, potato and fresh fruit exports demonstrated more stable export dynamics during the economic crisis".

Mukhtarov, Aliyev, and Zeynalov (2020) attempt to find how the change in oil prices affect inflation, exchange rate, economic growth, and export in Azerbaijan. By using data from 2005 to 2019 and applying Johansen cointegration, also the ECM methods, authors revealed that there is a statistically significant and positive relationship between oil price and economic growth, inflation, and export while oil prices impact negatively on exchange rate. In a similar study, Mukhtarov, Mammadov, and Ahmadov (2019) again verify "the relationship between oil price and inflation since a 1% increase in oil price leads to rising inflation by 0.58% in Azerbaijan".

Moreover, Majidli and Guliyev (2020) investigated the relationship between the real non-oil GDP growth of Azerbaijan, the exchange rate, and oil prices using OLS approach in 2005-2019. The results revealed that "the growth in oil price increases real non-oil GDP growth, and the increase in the USD/AZN exchange rate has a decreasing effect on it".

Elnur Alakbarov (2010) interpreted specific findings in the analysis of economic growth and foreign trade in Azerbaijan. Using VECM techniques for 1996-2008 for

Azerbaijan, the author wants to test the export-led growth hypothesis. Findings show that “the export-led growth hypothesis is not valid for Azerbaijan”.

Another notable paper by Niftiyev and Katarzyna (2021) examines the correlation between Azerbaijani and Kazakhstani exchange rates and oil price volatility. The author implements the Structural Vector Autoregressive (SVAR) model. According to the author, “the impulse response functions suggest that the rise of crude oil prices is associated with the exchange rates decrease and thus with an Azerbaijani manat and Kazakhstani tenge appreciation against the U.S. dollar”.

Furthermore, Mehmet and Bayram (2017) used the VAR model and the Toda-Yamamoto causality test to estimate ties between GDP, oil prices, and exchange rates. Results demonstrate a one-way causality between oil prices and GDP for Azerbaijan and Kazakhstan. In addition to these papers, Dikkaya and Doyar (2017) investigated causal relationships for both Azerbaijan and Kazakhstan separately between quarterly time series of oil prices, GDP and exchange rate with the help of Toda-Yamamoto causality. Based on the results for Azerbaijan’s economy, “there are unidirectional causalities from exchange rate to oil prices, also, from oil prices to GDP, and from GDP to exchange rate”.

Hasanov and Samadova (2010) explore the real exchange rate’s effect on non-oil exports in Azerbaijan by applying the VECM method. Thanks to the results, “the real exchange rate negatively impacts on non-oil export performance while non-oil GDP positively affects in the long- and short-run”. Based on the findings of this paper, appreciating the real exchange rate is one of the significant factors that hamper non-oil export growth.

In addition, Zulfigarov (2020) conducted a research on the impact of oil prices on Azerbaijan’s economy in a quarterly basis from 2001 to 2018. The findings of his research state that “decreases in the real oil prices are found to have a larger adverse impact on all macro variables of Azerbaijan. Both positive and negative oil price shocks cause to the appreciation and depreciation of the exchange rate”.

2.2 Literature Review on the Relationship among Oil Price, GDP, REER, and Export-Import in Oil-Exporting Countries

In this part of the literature, we want to give a review of external resources, mainly from oil-exporting countries. One of the existing literature, which is about the impact of an oil price shock and volatility of exchange rate on macroeconomic growth in Nigeria, gives valuable information as an oil-exporting country. According to the paper, Aliyu (2009) did an empirical investigation quarterly between 1986-2007 and examined the effect of real economic variables to oil price fluctuations and real exchange rate volatility using the VAR-based Johansen cointegration approach. As the findings of this paper, "it is depicted that oil price shock and appreciation in the level of exchange rate exert a positive impact on real economic growth in Nigeria".

Eltony and Al-Awadi (2001) explore the effect of oil price fluctuations on macroeconomic variables, namely, government development expenditure, oil revenue, consumer price index (CPI), government current expenditure, money demand, and the value of imports of goods for Kuwait's economy. The Kuwait economy significantly relies on oil income as Azerbaijan does, so we have expected a similar pattern. The main outcomes of this study revealed that "there is strong causality running from oil prices to oil revenues and government expenditures".

The study about oil prices and terms of trade by Azar Mirfacihi (2006) wants to analyze the effect of an increase in oil price on the terms of trade between 1970-2004 with the implementation of OLS regressions. The regression results reveal that "an increase in oil price shock has a negative impact on the terms of trade for Saudi Arabia as an oil-exporting country".

The empirical study by Farzanegan and Markwardt (2009) investigates the effects of oil shocks on the Iranian economy, as Iran is another leading oil exporter whose economy is considerably vulnerable to oil price fluctuations. By applying the Var model, the authors proved that "the rise in oil prices raises the REER and appreciates the Iranian Rial in the mid-run. This trend is considered one of the primary syndromes of Dutch Disease". Besides, the empirical findings of the paper show that economic growth is significantly affected by oil price changes. Furthermore, Mehdi Taghavi, Elham Masoudi, Masomeh Goudarzi, and Haid P. G. (2012) examined the relationship

between export, import, and economic growth in Iran over the period 1962-2011 with the VAR method. Based on the findings, "exports had a direct and positive correlation with economic growth in the long-run. Also, imports had a significant and negative relationship with economic growth in the long term".

In one existing paper, by using the VECM model and annual data from 1970 to 2003, Koranchelian (2005) explored the long-run real exchange rate path and how oil prices affect the real exchange rate of the Algerian Dinar. Koranchelian (2005) found that the actual oil price combined with relative productivity impacts the REER statistically substantially and positively.

Khuram Shafi (2015) identified the effect of oil price fluctuations and exchange rate volatility on economic growth with annual data for 1971-2012 in France. The author applied the cointegration technique in order to check the effect of oil price fluctuations and exchange rate volatility on economic growth. His findings represent that rise in oil prices affects France's GDP positively and France's GDP negatively affected by the exchange rate. Also, it is revealed that "foreign direct investment and import of the country have significantly positively related to the exchange rate while the exports and other factors have negatively related to the REER".

Although Turkey is an oil-importing country, it is useful to investigate the effect of exchange rates and oil prices on GDP and import-export for this country. According to Şengönül (2018), "Turkey is one of the oil importer countries affected by the oil price shocks". The author, in her paper, wants to examine the impacts of the changing oil prices on Turkish foreign trade with the Autoregressive Distributed Lag Bound (ARDL) method between 2000-2016. She found that "an increase in oil prices affects Turkish export positively".

Moreover, Altıntaş (2013) estimated export for Turkey function by using export, the REER, real oil prices and foreign real income by applying the ARDL method and Granger causality tests for the period 1987-2010. Owing to the results, a one percent increase has no impact on export for the period examined.

Turning to another oil-importing country, Ricardo Faria (2009) identified the relationship between oil prices and Chinese export. The author employed the ARDL

model for Chinese exports using Rodrik (2006)'s measure of export competitiveness, together with the real exchange rate, oil price, foreign industrial production and productivity in 1992-2005. According to the results, "there is a positive relationship between oil prices and exports, and the expected negative elasticity for the real exchange rate".

CHAPTER 3

OVERVIEW OF AZERBAIJAN'S ECONOMY IN PERIOD 2001-2020

3.1 Introduction

The social and political process that began in the mid-1980s in the world resulted in the collapse of the USSR, withdrawal of the Communist Party from the stage of history, and the independence of each union republics. One of the world's oldest trade and cultural centers, with an area of 86.6 thousand square kilometers and a population of more than 10 million, Azerbaijan, located in the eastern part of the South Caucasus on the shores of the Caspian Sea, was among the first countries to gain independence.

Azerbaijan declared its independence on October 18, 1991. Thus, as an independent state, Azerbaijan began to be an element of balancing country in international, economic, and political relations. This feature stems from Azerbaijan's rich natural resources and geopolitical position. Azerbaijan, bordering Georgia and Russian Federation to the north, Armenia to the west, Iran to the south, and Turkey with the help of the Nakhchivan Autonomous Republic, also has a geopolitical position that pursues a pro-Western course of political and economic development through Turkey.

This chapter provides a macroeconomic overview for Azerbaijan economy and presents the main features of its foreign trade. The examined period is limited to 2001-2020 due to the availability of data.

3.1.1 First Period after the Independence (1991-1994)

The period from 1991 to 1994 is the first period after the independence. With the collapse of the USSR, the economic structure based on specialization and the division of labor in Azerbaijan ended, and the country lost its common markets. Due to the organization of the old central planning for raw materials, semi-finished products,

supply and equipment, market, finance and enterprise management, production in many enterprises has either stopped or remained idle. Along with the disappearance of economic ties with enterprises in the former USSR and the loss of the country's market in other republics, there was a decrease in production level with the reduction of subsidies. The Armenian war and the Chechnya problem have led to the closure of import routes for the country's industry.

The early 1990s were years of economic stagnation and a growing crisis in Azerbaijan because there were no serious steps in order to solve the problems. During this period, the country experienced a significant economic crisis due to political instability, high unemployment and hyperinflation.

The country has been under Armenian aggression since 1988 and lost 20% of its territory by 12 May 1994, when the ceasefire was signed.

Shortcomings such as failure to implement necessary reforms for the overall balance of the economy, spending a large part of the state budget on the war, the occupation of 20% of the land and the displacement of more than 1 million people, the inability to attract foreign investment led the economy into a serious crisis.

As a result of these situations, during 1991-1994, the GDP decreased twice, inflation increased to four-digit numbers, and sharp decline in production, rising prices, as well as a serious deficit in the state budget accelerated the economic crisis.

3.1.2 Second Period after the Independence (1995-2003)

During this period, certain attempts were made to develop a program of economic reforms in order to stop the negative economic trend. Along with efforts to create free-market conditions in the economy, necessary steps have been taken to liberalize prices, foreign trade, and exchange rates. During this period, inflation has declined significantly, and budget deficits have been minimized.

The essential oil contracts were signed with the largest oil companies during this period, called the "Contract of the Century". With the signing of the "Contract of the Century" in 1994, the country began to receive large amounts of foreign investment.

In short, after achieving a ceasefire on the front and stability at home, it was time for economic reforms. Since 1994, the country has taken tough economic measures, with close cooperation with the IMF and a tight monetary policy with the introduction of IMF programs. As a result, since 1996, the period of decline in the Azerbaijan economy has begun to slow down. The created development model began to yield accurate results. Thus, between 1995-2003, GDP increased by 138%, the population's welfare doubled, and the share of the private sector in the economy increased from 29% to 68%.

As one of the fastest-growing economies in the former USSR, Azerbaijan's economy obtained large amounts of foreign investment in the oil sector. The growth rate in GDP was 12% in 1998 and 15% in 2000.

On the other hand, the exchange rate and monetary policies during this period prevented high price increases, while the local currency, the manat, achieved a stable position against foreign currencies. In fact, inflation rose to 1,662% in 1994 and fell to 1.8% in 2000.

Foreign direct investment also has played a key role in Azerbaijan's economic recovery. The main part of foreign direct investment was spent on oil production and extraction. While the foreign direct investment was US$ 330 million in 1995, it was more than US$ 1 billion in 1998.

Since 2000, economic relations have been established with 122 countries, with more than US$ 2.9 billion trade volume. This value was 2.1 times more than in 1994.

An important point to consider in the country's economic development is that this transition and development were achieved in extremely difficult conditions. Such as, 20% of the lands were under Armenian occupation, and a very large part (1/5) of the production potential was lost due to this occupation. 300,000 jobs were lost with this occupation and the people living in these lands (about 12% of the population) were forced to relocate.

3.1.3 Third Period after the Independence (After 2003)

As a result of the meetings of the Azerbaijan government with international organizations, one of the targets was to increase the level of welfare. For this reason, the development of the non-oil sector has been set as a main goal for the economic policies to be implemented during this period.

Oil refining, chemistry, the petrochemical industry, and electricity, which are dominated by oil and oil products, increased the role of oil in the economy. Large amounts of foreign investment have recently been attracted to these strategically important areas.

From a macroeconomic point of view, the distance covered in the country can be summarized as follows: in 2003-2019, the country's GDP increased by 560%, GDP per capita by 5.4 times, and the volume of foreign trade increased by 6.3 times. The values of the manat were stable except for devaluation in 2015, inflation was at a single-digit level for most of the years, and the budget deficits were very low.

3.2 Gross Domestic Product (GDP)

In the 21st century, due to the the tecnological developments, foreign trade has become a structure that needs to be monitored carefully for every country. First of all, export and then import provide great benefits to countries.

Foreign trade has a very strong positive impact on economic growth. In general, foreign trade has many benefits, such as specialization, efficiency in resource use, technology transfer, the discovery of good practices, increasing efficiency and productivity of companies, increasing the benefit of consumers and intercultural dialogue, as well as bringing direct income to countries.

Figure 3.1 represents the GDP of Azerbaijan between 2001-2020 years. In general, it is seen that there is a growing trend in GDP except for declining certain years. In fact, until 2015, it is apparently seen that GDP shows rapid growth except for declining between 2008 and 2009 due to the financial crisis. As a result of the inflow of oil revenues into the country and the steps taken under the Development Programs, the GDP in 2014 reached roundly $75 billion.

Figure 3.1 Azerbaijan's Nominal GDP in US Dollars (Billions) in the Quarterly Period 2001-2020

Source: AZSTAT

But there is a huge reduction in 2015 and 2016 because of the sharp drop in oil prices and devaluation in the manat. Starting at the end of February 2015, the manat, the Azerbaijan currency, has been depreciating against the dollar. The official rate of the manat against the dollar was 0.78 in January 2015, and fell to 1.05 on February 21, 2015. This depreciation continued to the beginning of 2017 and the official rate of the manat against the dollar was fallen to 1.91.

GDP per capita can be measured as one of the main indicators of economic prosperity. As we see from Figure 3.2, there is a similar positive growth trend in both GDP and GDP per capita. The reasons for these reductions are the same as the reduction in GDP in Figure 1. GDP per capita, which has been growing every year since 2001, finally reached $7,891 in 2014, an increase of 0.2% over the previous year.

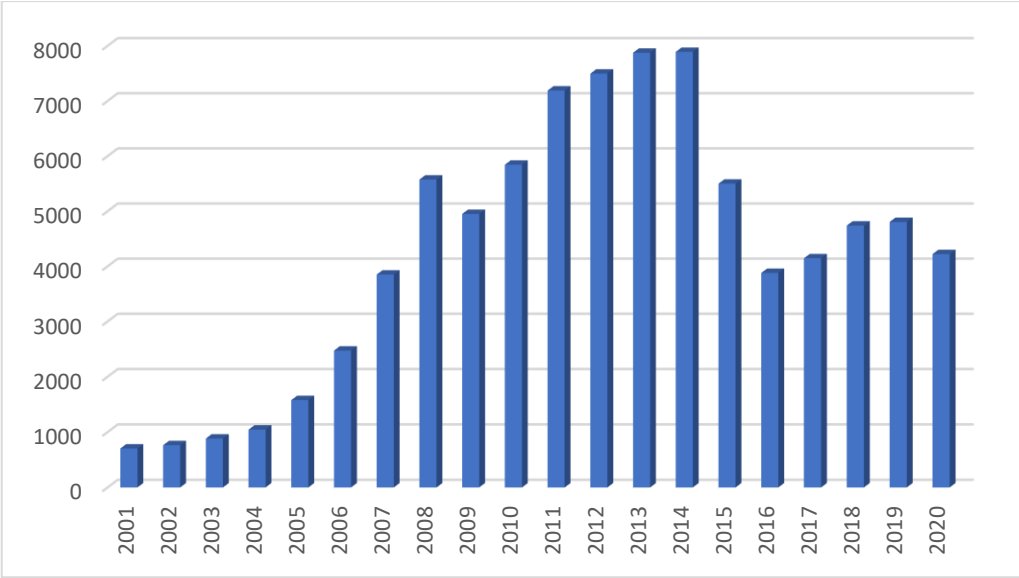


Figure 3.2 Azerbaijan's GDP Per Capita in US Dollars in the Period 2001-2020

Source: World Bank WDI

The increase in income has been one of the factors that led to an increase in people's purchasing power. However, in 2015, Azerbaijan's foreign exchange earnings declined because of the sharp drop in oil prices, and the Central Bank was forced to devalue twice. One of the reasons for the sharp decline in GDP and GDP per capita is the exchange rate of the manat against the dollar.

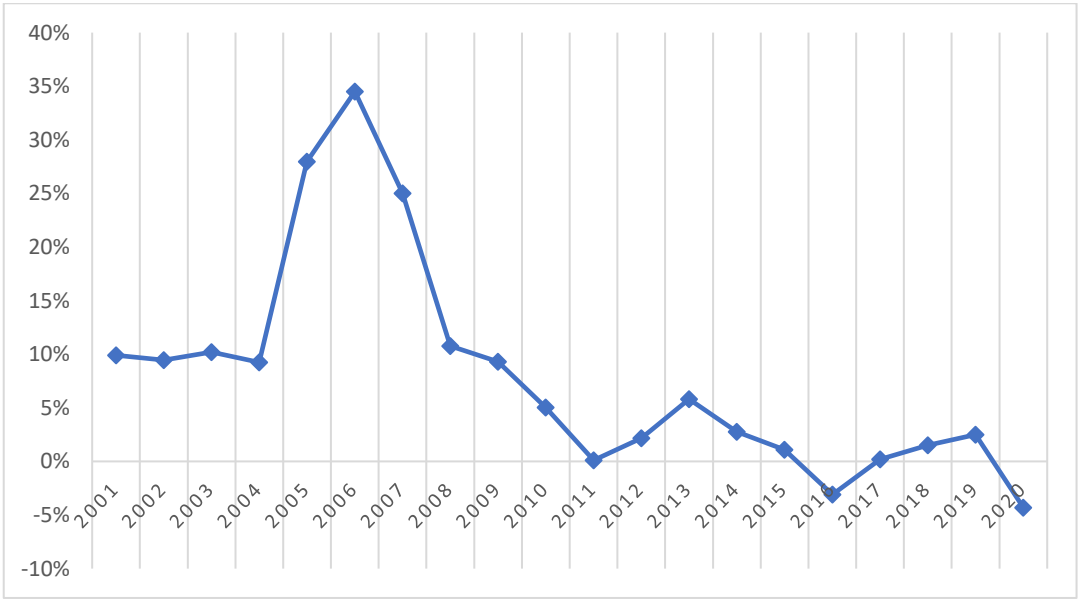


Figure 3.3 Azerbaijan's GDP Growth in the Period 2001-2020 (Annual %)

Source: World Bank WDI

Figure 3.3 shows Azerbaijan's annual GDP growth rate from 2001 to 2020. As the features of data expressed in the World Bank source, the annual percentage growth of GDP at market prices based on constant local currency and aggregates are based on constant 2015 prices, expressed in U.S. dollars. As can be seen, Azerbaijan's annual GDP growth rate fluctuated mainly in the positive section. In particular, the annual GDP growth in 2001 was estimated at around 9.9% and became stable till 2005. In 2006, the growth rate reached its peak at 34.5%, while it plunged to 10% in 2008 because of the global financial crisis. The GDP growth rate was -3% in 2016 due to the decreased oil prices and devaluation against the dollar. Then this rate shows a growing tendency in the positive direction, however, again, in 2020, there was a sharp decline of -4.3% because of the global pandemic disease.

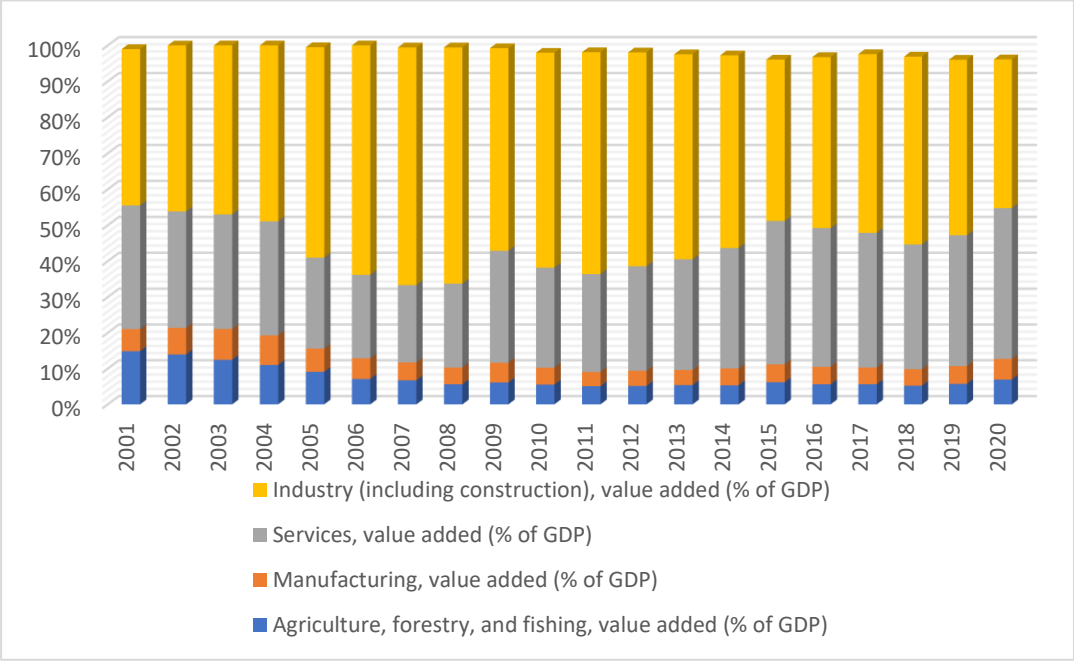


Figure 3.4 Sectoral Structure of Azerbaijan Economy in the Period 2001-2020 (as % of GDP)

Source: World Bank WDI

We can see the sectoral structure of the Azerbaijan economy as a percentage of GDP over the period 2001-2020 in Figure 3.4. In 2001, the agricultural sector contributed approximately 14% of Azerbaijan's GDP, while in 2020 the contribution of this sector decreased to 6.9% approximately. The decline, moreover, is observed in the

manufacturing sector. In 2001, the manufacturing sector accounted for 6.2% of GDP, while this percentage was 5.8% in 2020.

However, the other two sectors encompassed a huge part of GDP and represented a growth trend over the years. The industrial and service sector, in 2020, contributed to almost 41.4% and 42% of GDP, respectively.

Figure 3.5 shows the variation process of the structure of imports and exports of goods and services as a share of GDP over the period 2001-2020. It is quite visible that the percentage of exports of goods and services dominates the percentage of imports of goods and services most of the years. This dominance reached its peak at 65% of GDP in 2008.

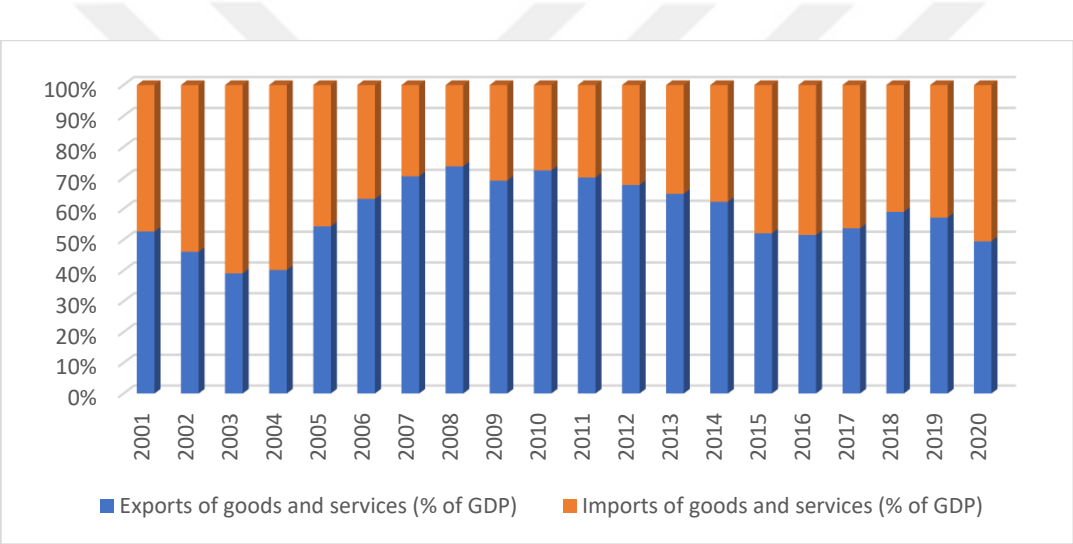


Figure 3.5 Structure of Exports and Imports of Goods and Services of Azerbaijan Economy in the Period 2001-2020 (as % of GDP)

Source: World Bank WDI

We see the change in the ratios of imports of goods and exports of goods to GDP over the quarterly period 2001-2020 in Figure 3.6. As we can see in this figure, despite mostly the small ups and downs, the ratio of export of goods to GDP has remained mainly over the ratio of import of goods to GDP.

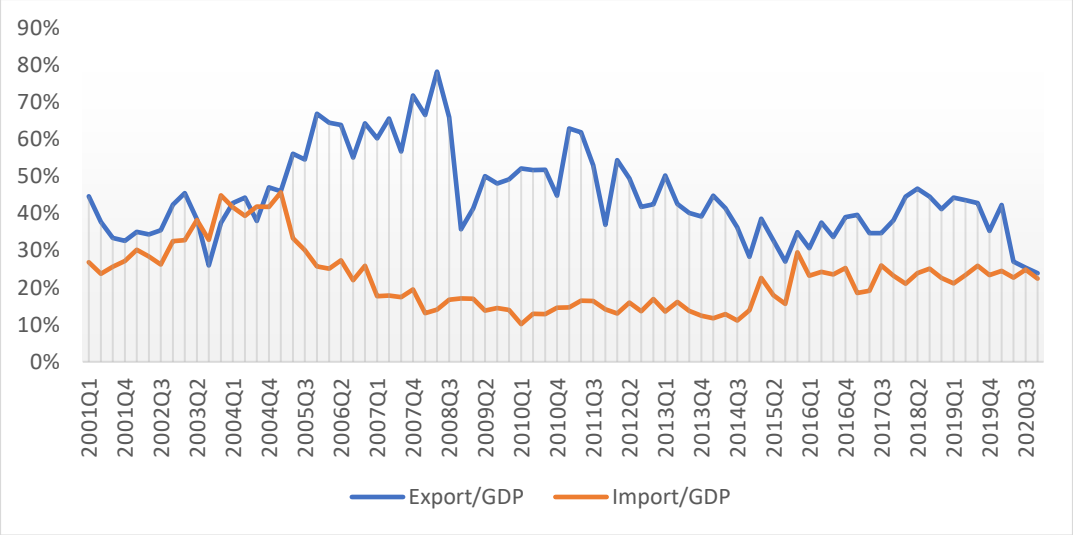


Figure 3.6 Ratios of Import of Goods and Export of Goods to GDP in Azerbaijan in the Period 2001-2020

Source: AZSTAT

The ratio of export to GDP reached its peak value in 2008, which could explain by high oil exports. The ratio of goods to GDP started from 27% at the beginning of 2001 and reached 46% in the first quarter of 2005 with a steady increase. However, from 2005 to the first quarter of 2010, there was a decline process, and afterward, this decreasing trend switched to a growing trend.

3.3 Export

In Azerbaijan, where the National Bank of the country has regulated the balance of payments since 1995 to meet international standards, accelerated the decline of domestic production and complex industries have been achieved after the independence. After gaining independence, between 1994 and 1999, Azerbaijan's foreign trade balance experienced deficits. As a result of the implementation of economic policy, which began with the signing of the "Contract of the Century" in 1994, social and political stability began to be achieved and then successfully continued in the country. The increase in exports, especially in the oil sector, has changed deficits into surpluses, and Azerbaijan has become one of the fast-growing countries in the world.

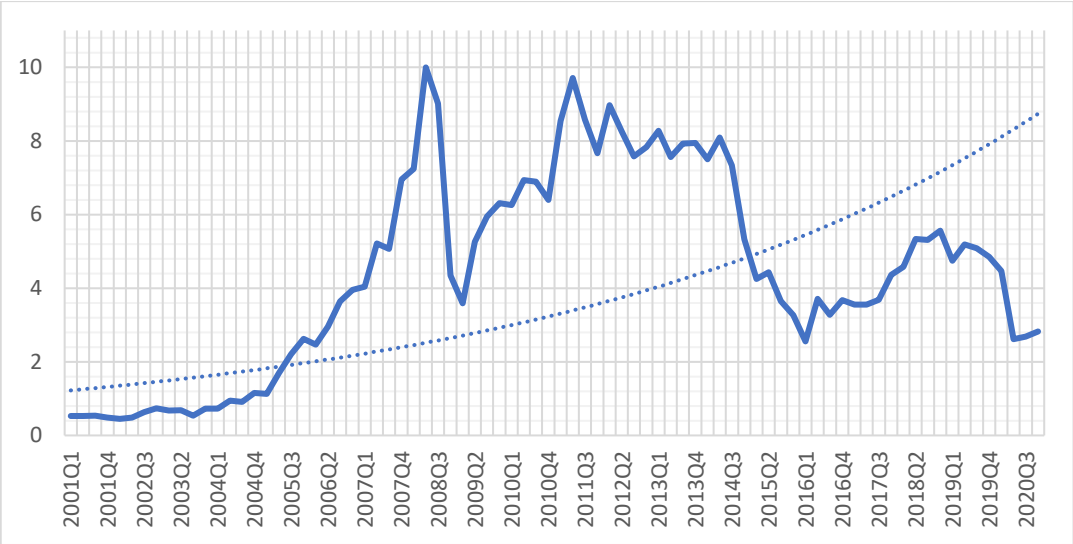


Figure 3.7 Azerbaijan's Exports in US Dollars (Billions) in the Quarterly Period 2001-2020

Source: AZSTAT

Figure 3.7 reveals that after 2001, exports increased gradually, reaching its peak quarterly value in 2008 Q2. However, due to the global crisis, there is a sharp decline following three quarters. Moreover, because of the decline in oil prices and devaluation, there is a drop in the value of exports from 2014-2015. Afterward, the export value changed its direction to a positive way until the first quarter of 2020, when there was a decline again, which could explain by the global pandemic disease.

Resource dependence also expresses the degree to which a country has access to alternative sources of income other than resource extraction. Figure 3.8 presents the structure of merchandise export in Azerbaijan. According to data, Azerbaijan's exports have received the largest share of the fuel sector in the last 20 years. This sector is well developed and keeps its dominance as Azerbaijan's traditional foreign trade sector. If fuel exports accounted for 91% of total merchandise exports in 2001, this measure for 2008 was about 97%. These results make it possible to say that Azerbaijan's exports are relatively weak in all other sectors except the fuel sector.

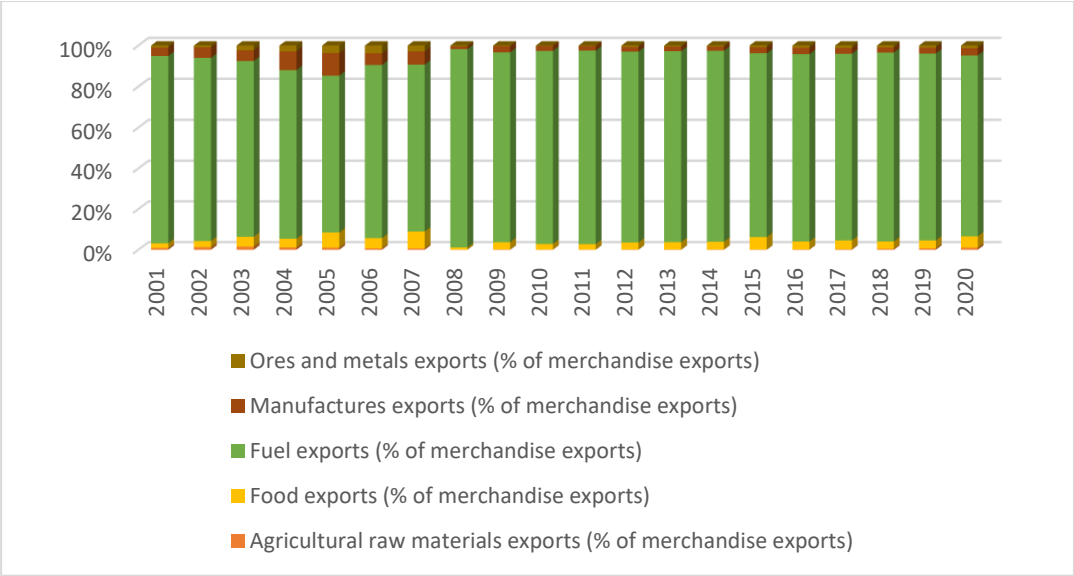


Figure 3.8 Sectoral Structure of Merchandise Exports in Azerbaijan in the Period 2001-2020

Source: World Bank WDI

Fuels export constitutes a large portion of the whole merchandise export in Azerbaijan. The average 2001-2020 fuels export as a share of the total merchandise export ratio was equal to 89.5%. In Azerbaijan, ores and metals, and manufacturing exports accounted for, on average, around 1.3% and 4% of total merchandise export, respectively. Furthermore, the export of food and agricultural raw materials accounted for around 4.2% and 0.5% of total merchandise export. Taking into account the fuels to merchandise export ratio, Azerbaijan should be considered a highly oil-dependent country.

The value of non-oil exports has increased from around US$ 969 million in 2001 to almost US$ 1.8 billion in 2020, an increase of 85%. In particular, the value of non-oil exports remained around US$ 200-300 million per quarter during 2001-2002, while during the period 2003-2013, the value of non-oil exports increased dramatically, with an average annual growth rate of 22.8%, reaching a total of US$ 1.75 billion in 2013. From 2013 to 2016, there was a decline in the value of non-oil exports due to several factors, such as increased uncertainty in the world economy, instability in financial markets, fall in oil prices, and devaluation of Manat. However, after 2016, the value of non-oil exports increased rapidly and reached its highest point in all years.

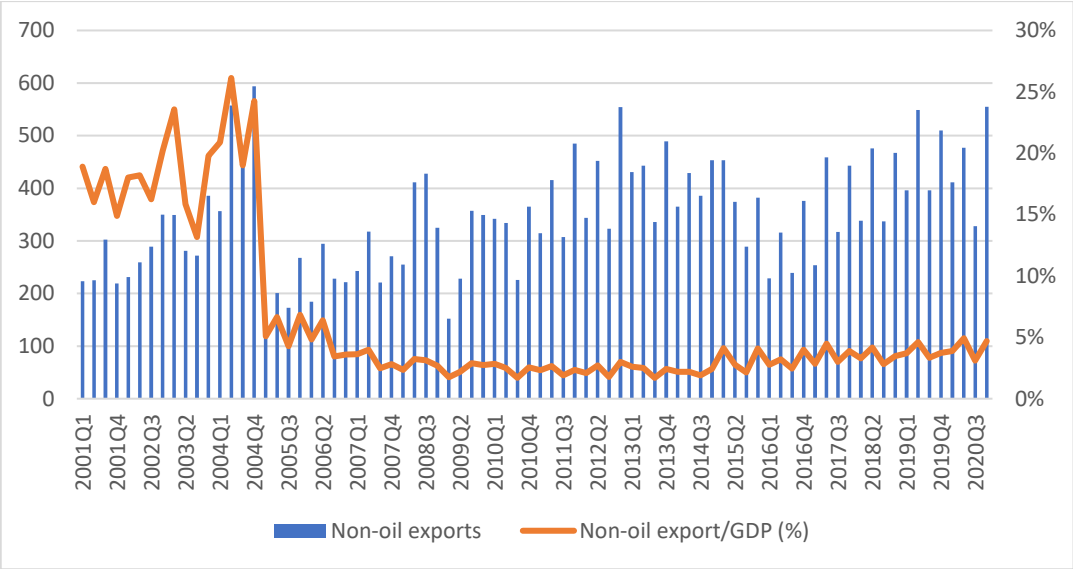


Figure 3.9 Non-oil Exports of Azerbaijan in the US Dollars (Millions) and Its Share of GDP over the Quarterly Period 2001-2020

Source: AZSTAT

As it is seen in Figure 3.9, although the value of non-oil exports increased for this period, the share of non-oil exports in GDP represents a declining trend. While the share of non-oil exports in GDP was 26% in the second quarter of 2004, this proportion decreased to approximately 4.7% in the last quarter of 2020. During 2009-2014, the share of non-oil exports in GDP showed its lowest point at 1.7%-2.5%.

Low- and middle-income economies are an increasingly important part of the global trading system. At the regional level, most exports from low- and middle-income economies are to high-income economies. Also, geographic patterns of trade vary widely by country and commodity. As Figure 3.10 reveals, the share of high-income economies dominates over low and middle-income economies almost for all years. Only in 2007, the share of merchandise exports to low and middle-income economies together within and outside the region exceeded the share of merchandise exports to high economies with 55.3% and 44.7%, respectively. Generally, it is seen that larger shares of exports from oil- and resource-rich economies are to high-income economies, which is appropriate for our economy.

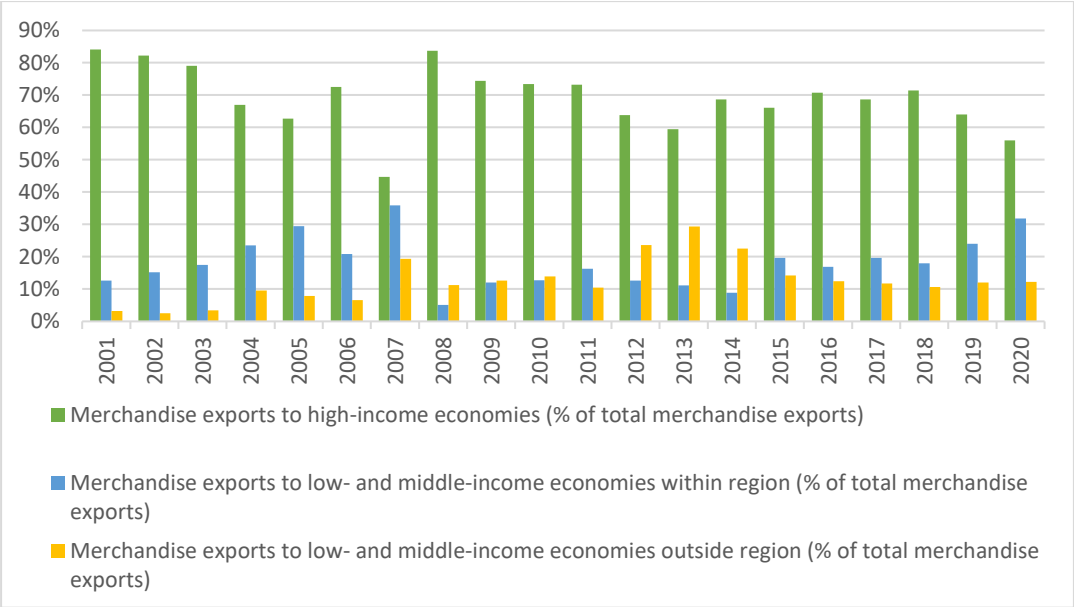


Figure 3.10 Azerbaijan's Merchandise Exports to Low, Middle, and High-Income Economies (% of Total Merchandise Exports) in the Period 2001-2020

Source: World Bank WDI

It is feasible to see from Figure 3.11 below that Europe is in the first place as the main direction of total exports of Azerbaijan for most of the years.

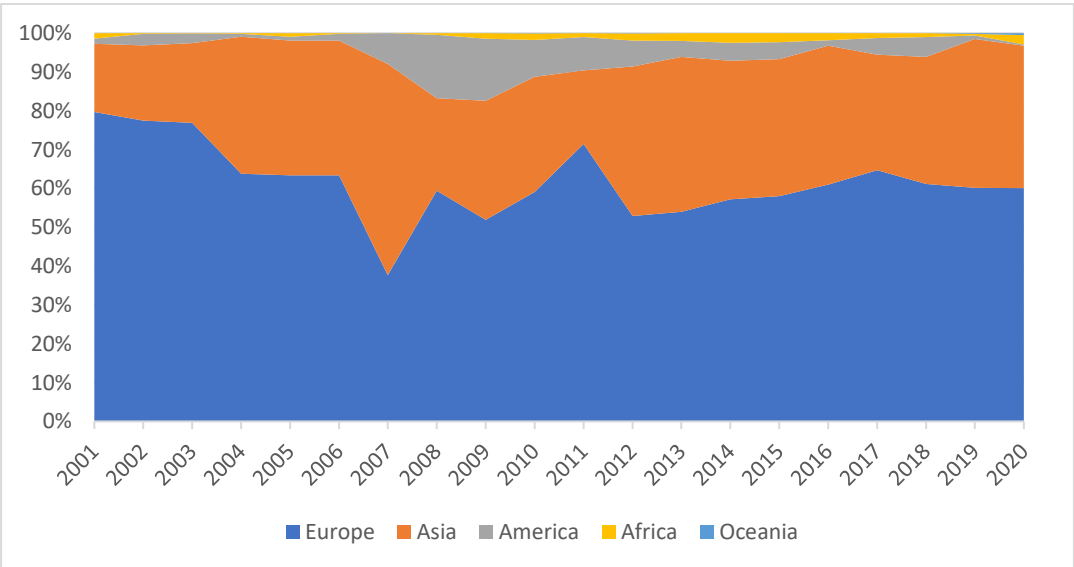


Figure 3.11 Azerbaijan's Geographical Structure of Exports (% of Total Exports) in the Period 2001-2020

Source: AZSTAT

Azerbaijan has established trade relations with more than 150 countries. According to Table 3.1, almost 97% of total exports were made with Russian Federation, Germany, USA, Indonesia, France, India, Israel, Italy, Turkey, and Georgia during 2001-2020. These countries are the main destination points for Azerbaijan's export. In the last 5 years (2016-2020), 31% of total exports were made with Italy, 12% with Turkey, 5% with Israel, 4% with India, 3.8% with Russian Federation, 3.6% with Germany, 3% with Georgia, and 2.6% with France.

Table 3.1 Top 10 Countries that Azerbaijan Exported the most in the US Dollars (Millions) in the Period 2001-2020

Years	Russian Fed.	Germany	USA	Indonesia	France
2001	77.5	12.9	13.6	0	66.5
2002	95.7	28.8	52	-	166.3
2003	147.9	7.3	63.9	0	209.7
2004	209.8	37.6	26	129.4	66.9
2005	285.4	34.8	43.2	-	406.7
2006	344.3	9	91.9	0	347.5
2007	527.1	19.7	228.2	390.3	258.8
2008	582.9	205.5	6014.3	1411.1	2322.7
2009	746.4	86.7	1746.8	660.7	1326.1
2010	773.6	9.9	1628	782.2	1856.5
2011	1187.4	523.4	1804.6	913.2	4036.7
2012	959.8	964.8	1600.8	1757.3	1775.6
2013	1077.8	1356.7	990.3	2771.8	1131.1
2014	640.3	1925.6	745.8	2012.3	1523.5
2015	417.8	1224	337.7	477.8	864.1
2016	409.3	610.8	80.7	77.5	626.4
2017	587	450.5	61.2	465.1	460
2018	665	787.8	331.5	597.5	441.6
2019	731.8	931.8	24.1	0.4	536.6
2020	709.4	234.1	24.9	0.5	110.6
Total	**11176.2**	**9461.7**	**15909.5**	**12447.1**	**18533.9**

Source: AZSTAT

Table 3.1 (Continued)

Years	India	Israel	Italy	Turkey	Georgia
2001	0.8	164.1	1324.1	67.4	103.2
2002	2.2	154.1	1082.7	83.4	80.8
2003	1.3	138.1	1345.9	107	110.1
2004	5.4	323.7	1614.9	182.6	188.9
2005	1.6	195.1	1315.7	276	208.4
2006	1	684.8	2845.4	388.1	285.3
2007	144.9	369.8	940.9	1056.3	343.8
2008	2432.5	3605.8	19220	626.2	490.7
2009	266.9	1236.2	3788.4	107.6	395
2010	299.6	1744.8	7044.2	170.9	411
2011	366.8	817.6	9341	455.8	535.3
2012	1890.7	1666.6	5548	600	570.7
2013	1098.4	1260.7	5989.7	526	519.2
2014	778.3	1766.9	4805.6	502.5	529.5
2015	270.2	801.5	2254.3	1477.3	496.2
2016	552	664.1	4333.7	1185.7	416.6
2017	404.1	638.9	5352.5	1393.8	487.8
2018	819.5	1310.8	5879.8	1826	498.3
2019	955.9	1331.6	5638.6	2862.7	586.9
2020	456.8	437.5	4172.3	2597.7	461.9
Total	**10748.9**	**19312.7**	**93837.7**	**16493**	**7719.6**

Source: AZSTAT

As it is seen in Figure 3.12, Italy ranked first as a major export direction for Azerbaijan due to oil transportation from the Trieste terminal, with 31% of total exports over the period 2001-2020. The value of exports to this country reached 19.2 billion US$ in 2008, forming 40.2% of total exports in that year. Israel and France ranked second and third as the leading export directions, according for 6.4% and 6.2% of total exports over the period 2001-2020, respectively.

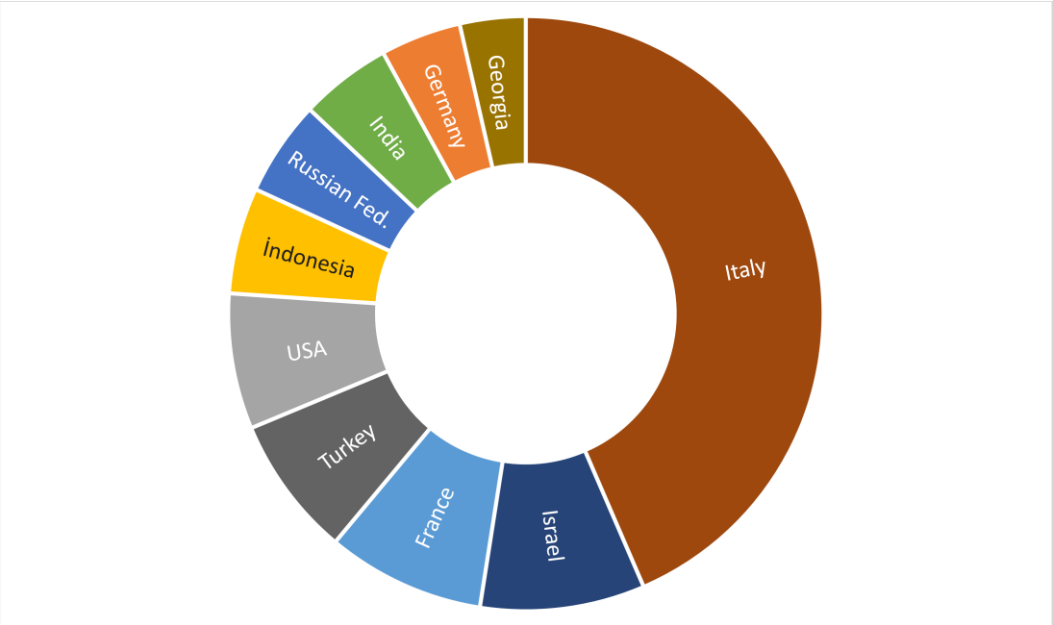


Figure 3.12 The Share of Top 10 Countries that Azerbaijan Exported the most in the Period 2001-2020

Source: AZSTAT

When we look at Table 3.1, we see that Azerbaijan's export directions have changed over the years, moving away from trade with the countries of the former USSR toward Western markets. For instance, until 2004, the 2nd and 3rd leading export destination points were Russian Federation and Georgia. However, this direction changed towards Western markets after 2004. With this change, Azerbaijan has generated trade relations with more developed and developing countries.

Table 3.2 provides data on Azerbaijan's export classified by nine major groups of commodities based on the sections of the SITC. According to data on AZSTAT, 92% of total exports over 2001-2020 belong to a group of "Mineral fuels, lubricants, and related materials". In this section of SITC, the main exported commodities are "mineral oils, mineral fuels, and products of their distillation; mineral waxes". The second place belongs to the "Food and live animals" section, with 3% of total exports from 2001 to 2020. The main exported products in this group are "edible fruit and nuts; peel of citrus fruit or melons; dairy products". According to other sections, with jointly 5% of total exports over the period 2001-2020, the major exported products are "sugars and sugar confectionery; organic and inorganic chemicals; plastic and articles

thereof; cotton; aluminum and articles thereof; iron and steel; pearls, precious metals and stones, etc".

Table 3.2 Azerbaijan's Structure of Exports on Standard International Trade Classification (SITC) in the US Dollars (Millions) over the Period 2001-2020

Years	Food and live animals	Beverages and tobacco	Crude materials except fuels	Mineral fuels, lubricants and etc.	Animal and vegetable oils, fats
2001	22.5	27.8	38.2	2113.6	2.9
2002	39.5	22.1	44.9	1927.4	3.8
2003	78.4	12.8	72.8	2227.7	34.1
2004	96.2	16.7	93.4	2972.5	40.8
2005	237.2	35.2	146.4	3337	52.3
2006	228	38.9	204	5390.3	52.8
2007	407.6	28.4	107.1	4931.2	67
2008	408.5	22.8	83.4	46362.9	98.8
2009	404.4	16.6	31.6	13639.5	103.7
2010	415.1	22	22.9	20110.1	154.9
2011	547.7	25	38	25089.3	140.7
2012	617.6	29.7	83.1	22259.2	180.8
2013	647.8	41.7	47	22229.8	182.8
2014	648.3	44.6	33.9	20177.2	138.5
2015	625.1	35.2	25.7	11187.1	105.5
2016	478.2	27.6	45.2	12270.2	14.2
2017	601.4	37.2	79	13867.1	14.5
2018	650.4	29.8	125.2	17878.6	14
2019	709.6	39	171.6	17800.2	14.8
2020	704.3	26.7	178.3	11981.3	20.5
Total	**8567.8**	**579.8**	**1671.7**	**277752.2**	**1437.4**

Source: AZSTAT

Table 3.2 (Continued)

Years	Chemicals and related products	Manufactured goods classified by material	Machinery and transport equipment	Miscellaneous manufactured articles
2001	26.4	17.2	41.7	23.8
2002	40.9	26.2	34	28.6
2003	50.6	64.1	36.8	13
2004	91.5	111.7	163.5	29.1
2005	99.8	124.2	297.1	18
2006	134.5	175.5	121.8	26.4
2007	98.1	221	147.4	50.4
2008	174.4	408.5	174.2	22.7
2009	90.2	171.3	201	32.2
2010	130.2	170.8	217.8	34.6
2011	242.4	303.7	56.6	36.7
2012	239.6	284.4	92.5	40.2
2013	175.5	265.1	163.5	149.3
2014	231.1	200.9	87.2	190.1
2015	190.2	179.8	208.7	88.9
2016	153.2	273.7	103.3	15.3
2017	178.8	323.4	60	19.3
2018	194.7	338.2	83.1	29.6
2019	279.5	324.8	90.3	33.4
2020	246.2	283.9	71.9	21.6
Total	**3067.8**	**4268.4**	**2452.4**	**903.2**

Source: AZSTAT

As it is clearly seen from Table 3.3, Italy is classified in the first place with approximately 31% of total export over ten countries which are the main export destinations of commodities from Azerbaijan in 2020. The value of total export made in 2020 was around 13.7 billion US$, and 68.1% of total export belonged to crude petroleum as a commodity. The second leading exported commodity in 2020 was natural gas, with 16% of total export. The other commodities jointly constituted 9% of total exports.

Table 3.3 Azerbaijan's Top 10 Export Destinations and Top 10 Exported Commodities in 2020

Countries	**Million US$**	**% of Total Export**
Italy	4,172.2	30.4%
Turkey	2,597.8	18.9%
Russian Federation	709.4	5.2%
Greece	523.3	3.8%
Croatia	470.8	3.4%
Georgia	461.9	3.4%
India	456.8	3.3%
Israel	437.5	3.2%
China	432.7	3.1%
Ukraine	353.1	2.6%
Commodities	**Million US$**	**% of Total Export**
Crude petroleum	9,363.6	68.1%
Natural gas	2,190.5	15.9%
Fresh fruits	349.9	2.5%
Fresh vegetables	219.9	1.6%
Heavy distillates or gas oils for other purposes	213.4	1.6%
Cottons fiber	131.9	1.0%
Polymers of ethylene, in primary forms	77.7	0.6%
Rough aluminum	63.7	0.5%
Electric energy	59.8	0.4%
Kerosene fuel for jet engine	53.6	0.4%

Source: IMF, AZSTAT

3.4 Import

As the country's economy develops, the structure of imports also becomes richer. In recent years, the list of essential types of products imported from abroad has increased. As in other developing countries, Azerbaijan has foreign exchange reserves for the import of goods and services and constantly increases these reserves. Despite the country's ongoing structural reforms, industrialization, and weak exports in the non-oil sectors, it can offset the balance of payments deficits with oil revenues. However, this situation is not a good thing for the country's economy, it is even an economic disease. Given both the recovery from the disease and the fact that oil exports will

decline in 15-20 years, it is inevitable that rapid industrialization and the production of import-substituting products will be necessary to maintain the external balance.

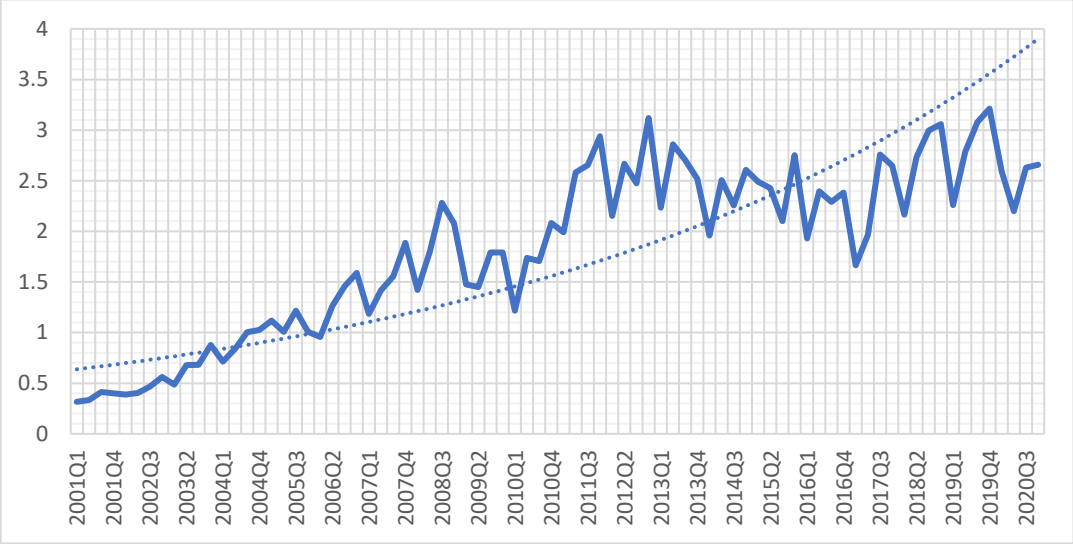


Figure 3.13 Azerbaijan's Imports in the US Dollars (Billions) in the Quarterly Period 2001-2020

Source: AZSTAT

It is possible to see from Figure 3.13, Azerbaijan's imports represent a positive trend over the period 2001-2020. The value of Azerbaijan's imports in 2001 was estimated at around US$ 1.4 billion, rising to US$ 10.1 billion in 2020, with an average annual growth of around 11.6%. Virtually, there was a dramatic increase after 2001 in the value of imports, reaching around US$ 10.4 billion in 2012, except for declining in 2008 due to the financial crisis. Because of economic instability around the world, a fall in oil prices, and devaluation of the Manat against the Dollar, there was a necessary reduction in the value of imports over 2014-2016. For the last three years, the volume of imports has shown a growing tendency despite fluctuations in quarters.

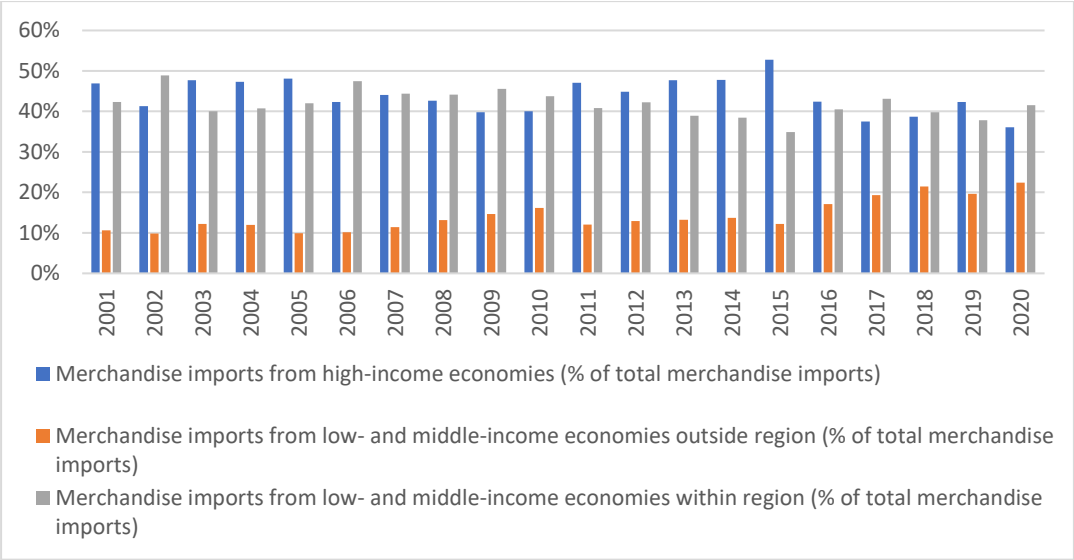


Figure 3.14 Azerbaijan's Merchandise Imports from Low, Middle and High-Income Economies (% of Total Merchandise Imports) in the Period 2001-2020

Source: World Bank WDI

As Figure 3.14 reveals, the share of merchandise imports from low and middle-income economies dominated the share of merchandise imports from high-income economies for almost all years during 2001-2020. Only in 2015, the share of merchandise imports from high-income economies was 53%. Inside low and middle-income economies, the demand for imports from within the region was higher than the demand for imports from the outside region for all years over the examined period.

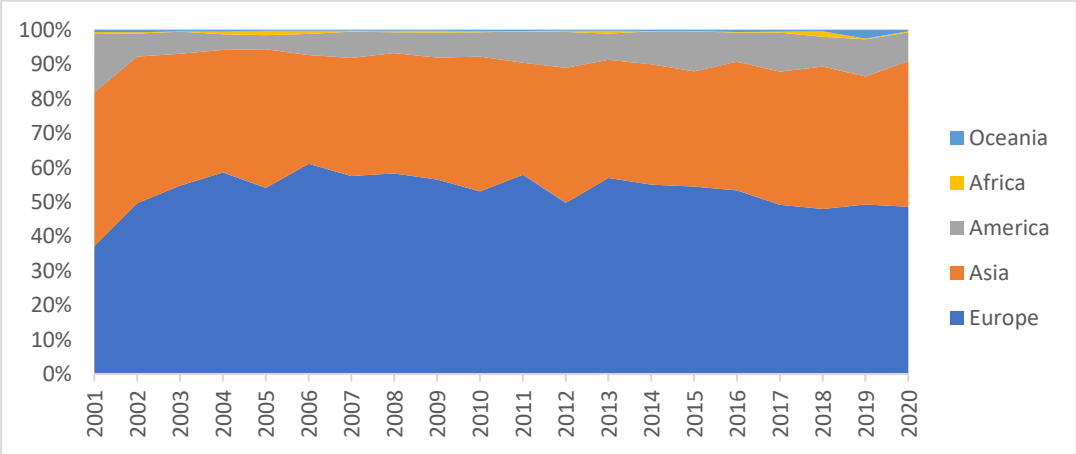


Figure 3.15 Azerbaijan's Geographical Structure of Imports (% of Total Imports) in the Period 2001-2020

Source: AZSTAT

Generally, the share of imports from Europe dominates over other regions for most of the years during the period 2001-2020. According to Figure 3.15, as one of the main regions where the imports came from, Asia holds dominance with 45% of total imports over other regions for Azerbaijan only for 2001. Asia was classified as the second leading region in other years. America as a continent is in third place.

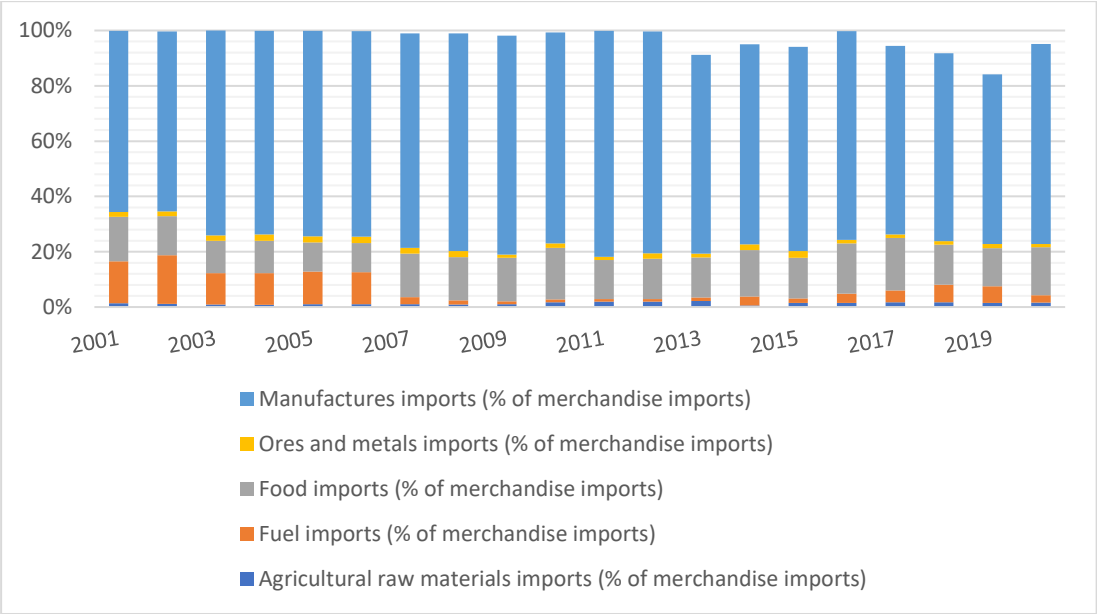


Figure 3.16 Sectoral Structure of Merchandise Imports in Azerbaijan for the period 2001-2020

Source: World Bank WDI

According to Figure 3.16, the share of manufactures imports was bigger than the share of other sectors' imports for all years. If manufactures imports accounted for 65% of total merchandise imports in 2001, this measure for 2011 was around 82% at its highest point. The second higher share belongs to food imports. In 2001, the share of food imports at total merchandise imports was 16%, but this measure decreased to approximately 10% in 2006, but then for the following years, the share increased to 15-18%. Although Azerbaijan exports fuel and related products to other countries, fuel imports have the third leading share over Azerbaijan's total imports, and this share was 15% in 2001. However, due to the implications and novelties in the oil sector, fuel imports decreased to a 2.6% level in 2020.

Table 3.4 Top 10 Countries that Azerbaijan Imported from the most in the US Dollars (Millions) in the Period 2001-2020

Years	Russian Fed.	Turkey	Ukraine	Germany	USA
2001	153	148.2	39.3	72.8	230.9
2002	280.9	156.2	80	83.5	98.7
2003	383.9	195.3	118.8	169.9	132.6
2004	569.4	225	170.4	198.5	131.9
2005	717.2	313	226.3	256.3	141.3
2006	1181.6	385	317.5	403.8	197.9
2007	1004.2	624.6	465.6	472.1	269
2008	1350.4	807.2	567.2	598.7	267.4
2009	1072.1	907	511.7	554.2	260.6
2010	1145	771.4	465.6	607.1	206.3
2011	1641.1	1302.4	557.8	845.3	630.5
2012	1378.4	1520.4	539.1	780	715.7
2013	1505.2	1463.8	589.1	823	376.5
2014	1314.5	1286.6	419.6	703.6	563.4
2015	1437.9	1171.4	309.7	690	847.4
2016	1641.7	1181.6	286.8	390.5	471.6
2017	1554.1	1273.8	460.4	443.7	720.6
2018	1885.2	1576.8	469.8	659.9	527
2019	2290.2	1646.8	467.1	710.4	767.8
2020	1962.2	1563.1	418.5	583.5	635.9
Total	**24468.2**	**18519.6**	**7480.3**	**10046.8**	**8193**

Source: AZSTAT

Table 3.4 (Continued)

Years	UK	China	Italy	Japan	France
2001	54	42	24.7	66.7	26.1
2002	85.2	51	26.4	48.4	118.1
2003	286.1	92.4	74	101.5	155.6
2004	421.8	145.5	106.7	127.1	120.1
2005	384.9	173.8	94.6	70.6	121.8
2006	453.8	222.5	124.6	188.3	55.8
2007	411.2	278.8	140.9	295.1	103.8
2008	386	478.8	190.6	241.6	132.8
2009	274.7	485.2	127.7	146.3	142.2
2010	302.8	587.6	118.3	146.3	136.1
2011	485.7	628.3	254.6	174.9	608.9
2012	496.2	631.9	261.6	243.1	185.8
2013	1334	566.3	249.3	288.4	425.4
2014	978.3	697.1	272.6	240.5	157.4
2015	553.3	511.9	587.8	558.1	212.3
2016	495.2	703.8	332.4	282.7	150.2
2017	239.9	854.5	318.8	170.8	154.8
2018	263.7	1196.6	340.1	383.9	183.5
2019	232.6	1432	369.9	221.6	250.7
2020	296.9	1413.8	396.2	195.1	448.2
Total	**8436.3**	**11193.8**	**4411.8**	**4191**	**3889.6**

Source: AZSTAT

According to Table 3.4, 69% of total imports were made by Russian Federation, Turkey, Ukraine, Germany, USA, UK, China, Italy, Japan, and France during 2001-2020. These countries are the main importing places for Azerbaijan. In the last five years (2016-2020), 17.6% of total imports were made with the Russian Federation, 13.6% with Turkey, 10.5% with China, 5.9% with the USA, 5.2% with Germany, 4% with Ukraine, 3.6% with Switzerland, 3.3% with Italy, 3% with the Islamic Republic of Iran, 2.9% with the UK and 30.4% with other 200 countries in the world.

Looking at Table 3.4, it is obvious that Azerbaijan preferred neighboring countries in import directions. So, in 2020, the total value of imports from neighboring countries

such as the Russian Federation, Turkey, Iran, and Georgia constituted approximately 36.3% of the total imports volume.

As it is seen in Figure 3.17, the value of imported products from the Russian Federation ranked in first place for Azerbaijan with 16.8% of total imports due to the sustainable development of trade relations between these two countries over the period 2001-2020. Moreover, the value of imports from the Russian Federation constituted the highest share among these most imported countries for all years. Turkey and Germany ranked second and third as the leading imported directions, according to 12.7% and 6.9% of total imports over the period 2001-2020, respectively.

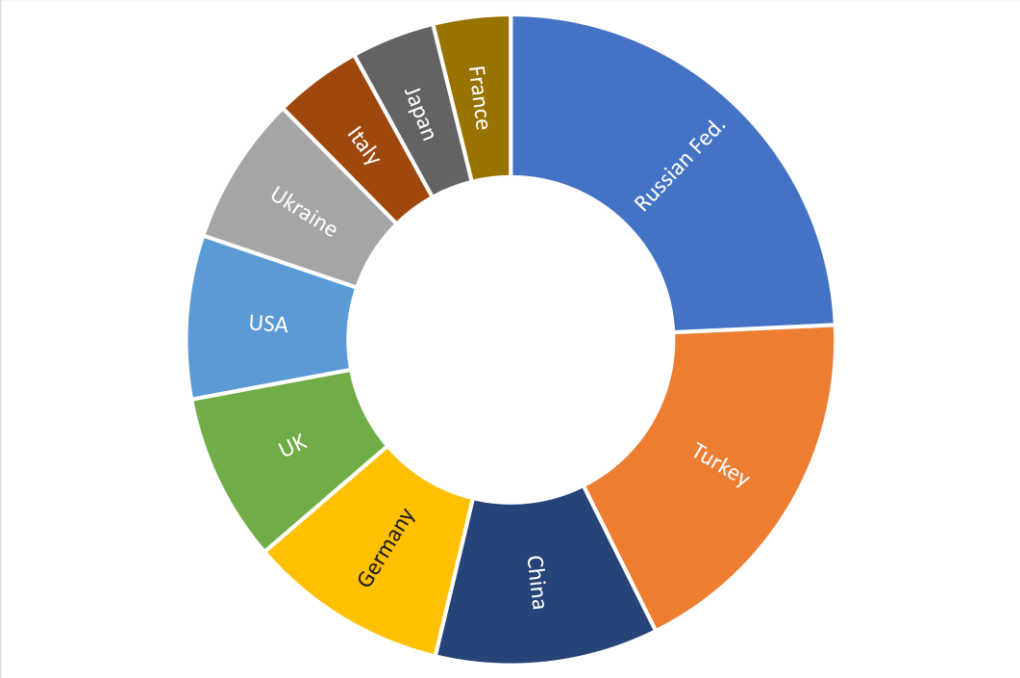


Figure 3.17 The Share of Top 10 Countries that Azerbaijan Imported from the most over the Period 2001-2020

Source: AZSTAT

Table 3.5 provides us with the data about Azerbaijan's imports classified by seven major groups of commodities based on the sections of SITC. According to data on AZSTAT, 42.7% of the total value of imports over the period 2001-2020 belongs to a group of "Machinery and transport equipment". In this section of SITC, the main imported commodities are "nuclear reactors, boilers, machinery, mechanical appliance and parts; machinery and electrical apparatus parts".

Table 3.5 Azerbaijan's Structure of Imports on Standard International Trade Classification (SITC) in the US Dollars (Millions) over the period 2001-2020

Years	Food and live animals	Chemicals and related products	Manufactured goods classified by material	Machinery and transport equipment
2001	194	78.7	214.3	552.5
2002	198.4	97.6	370.2	518.2
2003	259.5	145.9	622.4	1016.7
2004	349.5	173	789.7	1328.6
2005	307.1	225.7	740.6	1831.7
2006	398.7	305.5	905.2	2433.8
2007	655.6	425	1078.3	2611.6
2008	819.7	595.2	1211.7	3404.4
2009	639.6	499.2	1062.9	2901.2
2010	864.1	586.4	1425.1	2680.5
2011	988.3	862.1	1920.8	4723
2012	958.5	969.6	2073.3	4023.6
2013	1064	933.9	1933.7	4173.3
2014	982.3	875	1778.5	3454.9
2015	910.5	838.3	2362.3	3677.6
2016	1189.8	895.5	1864.2	2805.3
2017	1282.7	1040.1	1684.7	2933.3
2018	1270.9	1192.8	2173.8	3481.5
2019	1558	1313.3	2140.7	3876.4
2020	1553.7	1347.7	2002.7	4032.1
Total	**16444.9**	**13400.5**	**28355.1**	**56460.2**

Source: AZSTAT

Table 3.5 (Continued)

Years	Miscellaneous manufactured articles	Mineral fuels, lubricants and etc.	Beverages and tobacco
2001	98	215.9	24.6
2002	110.1	292.6	23
2003	168.8	295.9	23.7
2004	309.9	401.7	31
2005	343.1	499.6	96.1
2006	304.7	612.7	113.7
2007	404.5	143.1	199
2008	517.3	114	229.6
2009	528.2	64.6	248.6
2010	434	73.6	264.8
2011	514	83.8	294.8
2012	748.1	84.7	353.2
2013	749.1	141.6	400.2
2014	692.1	297.1	469.3
2015	631.3	150.1	360
2016	909.8	282.7	210
2017	860	378.8	231.8
2018	1124.7	723.7	250.3
2019	1161.3	827.3	182.6
2020	959.6	280.2	143.6
Total	**11568.6**	**5963.7**	**4149.9**

Source: AZSTAT

In the 2nd place, the "Manufactured goods classified chiefly by material" section came up with 21.4% of total imports from 2001 to 2020. The main imported products in this group are "plastic, rubber and their articles; iron, steel and their articles". The "Food and live animals" section also has a indispensable role in the value of imported commodities as 12.4% of total imports for the examined period. The products that are most demanded in this section are "edible fruit and nuts, citrus fruit; dairy products; cereals". According to other sections, which constitute jointly 33.8% of the value of total imports over the period 2001-2020, the major imported products are "tobacco and manufactured tobacco substitutes; sugars and sugar confectionery; mineral fuels,

mineral oils, and products of their, bituminous substances; pharmaceuticals products; wood and articles of wood, wood charcoal; pearls, precious stones, precious metals".

Table 3.6 Top 10 Countries that Azerbaijan Imported and Top 10 Imported Products in 2020

Countries	**Million US$**	**% of Total Import**
Russian Federation	1962.2	18.3%
Turkey	1563.1	14.6%
China	1413.8	13.2%
USA	635.9	5.9%
Germany	583.5	5.4%
France	448.2	4.2%
Ukraine	418.5	3.9%
Italy	396.2	3.7%
Islamic Republic of Iran	300.6	2.8%
UK	296.9	2.8%
Commodities	**Million US$**	**% of Total Import**
Passenger cars	542.4	5.1%
Medicaments	327.2	3.0%
Wheat	296.9	2.8%
Transmission apparatus for radio-telephony, radio-telegraphy, radio-broadcasting or television; television cameras; digital cameras and etc.	207.7	1.9%
Railway locomotives and wagons	131.6	1.2%
Petroleum oils and oils obtained from bituminous minerals, crude.	203.1	1.9%
Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like	155.8	1.5%
Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media and etc.	144.3	1.3%
Tubes, pipes and hollow profiles, seamless, of iron or steel.	127.2	1.2%
Wood sawn or chipped lengthwise, sliced or peeled	116.5	1.1%

Source: AZSTAT

As we see from Table 3.6, both Russian Federation and Turkey kept their leading roles in the share of total imported products in 2020 over the period 2001-2020. In contrast to the countries which had a higher share of the value of total imported products during the examined period, there is a new country in 2020 that achieved to get inside the Top 10 imported countries. This new country is the Islamic Republic of Iran, with approximately 3% share of total imported products in 2020.

In the commodities section, passenger cars lead to the list of Top 10 imported commodities with around US$ 0.5 billion, which constitutes 5.1% of total imported products in 2020, although Azerbaijan has achieved necessary progress over the production of passenger cars in the last five years. The commodities such as medicaments and wheat constituted together almost 6% share of total imports in 2020.

3.5 Inflation

In order to better understand the economic situation in the country, it is necessary to examine the inflation rates of Azerbaijan. Two reasons make inflation important. First, inflation is an indicator of macroeconomic stability. Second, inflation can also be thought of as an indicator of social welfare. Therefore, it is necessary policy aims to keep inflation at the desired government level. The same is true for the Azerbaijani economy.

In the early 1990s, Azerbaijan became acquainted with the concept of inflation. Until 1994, the lack of an indicator to be taken into account in the money supply and the regular use of money to meet budget deficits led the manat to enter a period of hyperinflation, regularly depreciating. Besides, the closure of the northern railway line due to the Russian-Chechen war during the period of inflation and the decline in imports played a key role in the depreciation process.

As a consequence of the implementation of the stability program, inflation from 2001 until 2004 was at a low level. In the following years, as a result of the softening of the hard-monetary policy implemented, prices started to increase again. Inflation in 2007 and 2008, which was 16.6% and 20.8% respectively, was caused by an increase in the selling price of oil, the rise of the euro in the region, and the rise in world market prices for some food products imported by Azerbaijan.

Table 3.7 The Average Inflation Rate in Azerbaijan in the Period 2001-2020

(Consumer Prices, Annual %)

Years	Inflation (annual %)		Years	Inflation (annual %)
2001	1.55		2011	7.85
2002	2.77		2012	1.07
2003	2.23		2013	2.42
2004	6.71		2014	1.39
2005	9.68		2015	4.01
2006	8.33		2016	12.45
2007	16.66		2017	12.94
2008	20.84		2018	2.26
2009	1.46		2019	2.61
2010	5.73		2020	2.75

Source: World Bank WDI

In 2009, the average annual inflation rate decreased to 1.5%, and inflation was maintained at a single-digit level until 2016. Like other oil-exporting countries, Azerbaijan's economy was also affected by the sharp drop in oil prices in 2014. In general, prices of consumer goods and services sector increased by roughly 8% in 2015 compared to the previous year. As a result, the inflation rate, which reached 4% in 2015, became 12.5% in 2016 and 12.9% in 2017.

3.6 Exchange Rate

The exchange rate policy implemented in Azerbaijan has close relationship with foreign trade. Studies show that the exchange rate in developing countries plays a role in both foreign trade indicators, real sector opportunities, and anti-inflationary regulations. Fixing exchange rates in order to protect the value of foreign debt in line with the IMF's expectations will negatively impact on domestic production and exports. This also affected the difference between imports and exports in favor of imports.

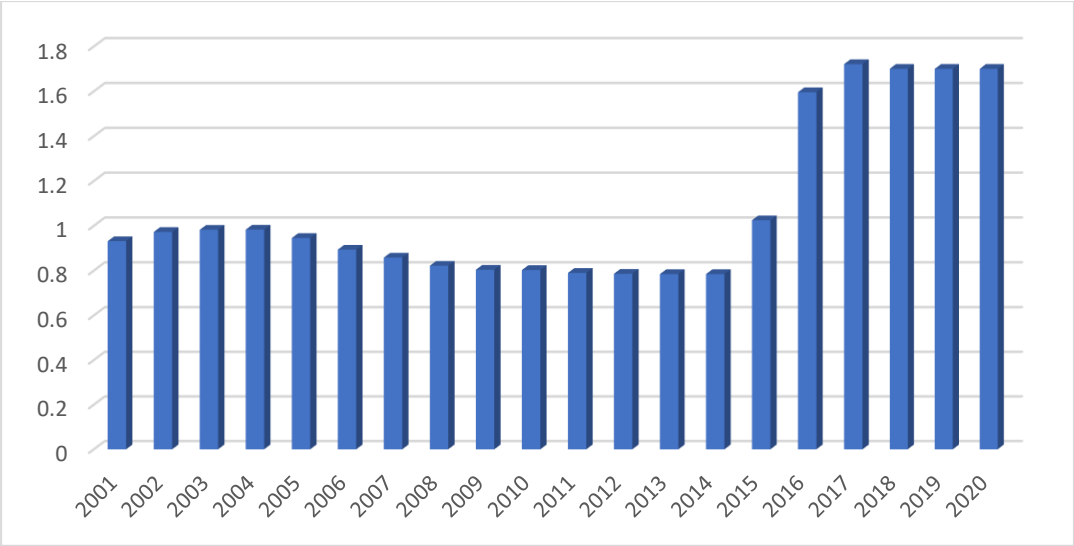


Figure 3.18 The Exchange Rate of Azerbaijan as Period Average over the Period 2001-2020

Source: World Bank WDI

It is possible to see from Figure 3.18 that the manat, which underwent a soft devaluation between 2000 and 2003, gained some value in the following years. The reasons for the appreciation of the manat were the inflow of large amounts of currency into the country as a result of increased oil and natural gas production. At the same time, since January 1, 2006 denomination was implemented in Azerbaijan, the nominal value of the money was reduced 5,000 times, and the New Azerbaijan Manat was put into circulation. Within the exchange rate policy framework, there was no significant change in the value of the manat between 2008 and 2014.

The manat was devalued in 2015 due to the sharp decline in world oil prices and increased interest rate by US Federal Reserve. The Central Bank went into devaluation twice a year, from 0.78 AZN to 1.05 AZN in February, with a second devaluation at the end of December to 1.55 AZN. The depreciation process continued until 2017 and reached 1.70 AZN.

3.7 External Debt

As Figure 3.19 reveals, the amount of Azerbaijan's external debt and the share of external debt in GDP has been growing steadily over the years. Here, according to World Bank, "total external debt is the sum of public, publicly guaranteed, private

non-guaranteed long-term debt, short-term debt, and use of IMF credit". Data are in current US dollars.

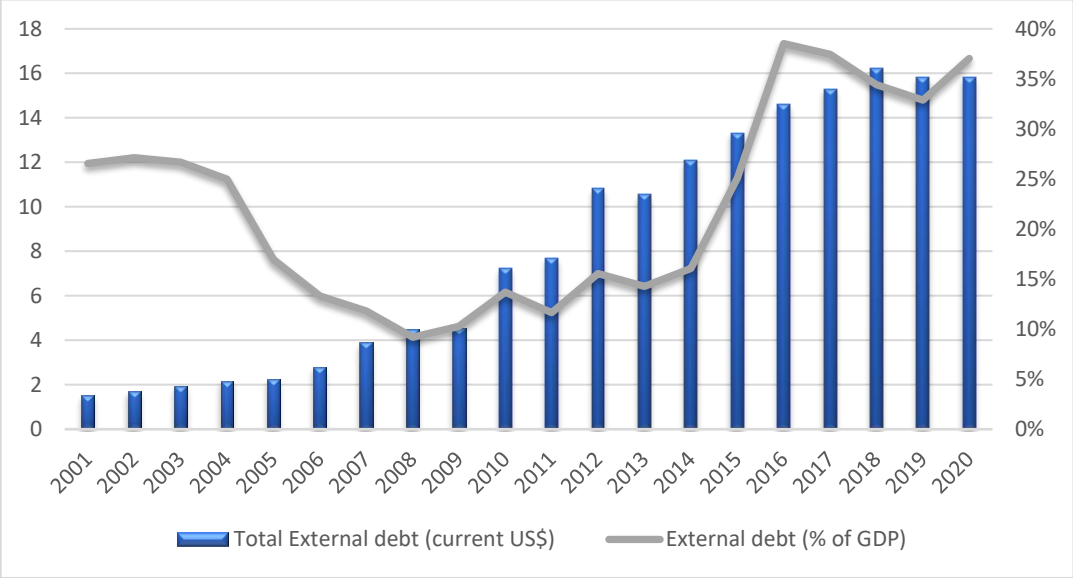


Figure 3.19 Azerbaijan's Total External Debt in the US Dollars (Millions) and External Debt as a % of GDP over the Period 2001-2020

Source: World Bank WDI

The value of total external debt was US$ 1.5 billion in 2001, and there was an increasing trend until 2019. The average annual growth rate of total external debt was 14.1% and reached US$ 15.8 billion in 2020. The growth rate of the export revenues,

which is the most important asset in the repaymants of external debt, is lower than the growth rate of external debt, and this situation led to an increase in the external debt/export ratio. This ratio was 27.6% in 2005, 25.6% in 2010, 66.5% in 2015, and 104% in 2020.

If we look at the external debt ratio to GDP, this ratio decreased from 26.5% in 2001 to 9% in 2008. During 2008-2020, although there were certain ups and downs, the share of external debt in GDP reached 38.5% in 2016, which was the highest percentage over the period 2001-2020.

It is understandable that without integration into the world market and also foreign debts, no country can be developed. Thus, all countries in the world have foreign debts. It is clear that rapid integration into the world market formed mutual responsibilities

and debts among countries. Even highly developed countries receive long-term external debts in order to realize big projects. When the foreign debt as a percentage of GDP passes 30%, this can be dangerous for the development of the country. For developing countries, this percentage constitutes 40-60% of their GDPs. In Azerbaijan, this number was 37% in 2020.

3.8 Foreign Direct Investment

The inflow of Foreign Dırect Investment (FDI) into the Azerbaijan economy began in 1994 as a result of oil contracts. The signing of the Azeri-Chirag-Gunashli project in September 1994, which was the country's first international oil contract, laid the groundwork for FDI. In 1994, the inflow of FDI to Azerbaijan was US$ 22 million and increased until 1998 and reached US$ 1.1 billion. However, due to tight monetary policy, economic stagnation, delayed privatization, and the lack of expected economic reforms, the inflow of FDI into the Azerbaijan economy declined between 1998-2001.

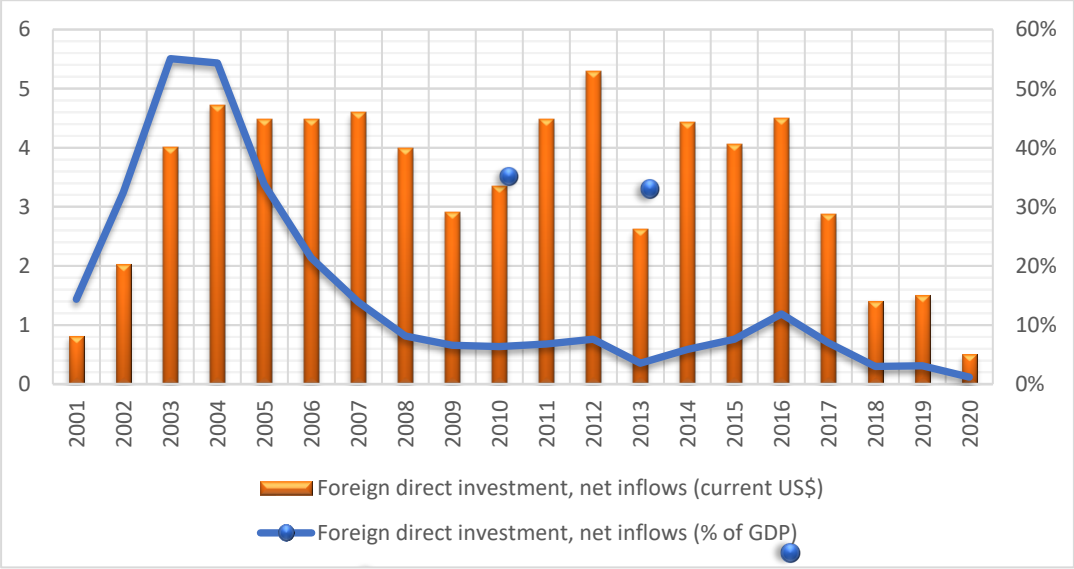


Figure 3.20 Net Inflows of FDI of Azerbaijan in the US Dollars (Billions) and Its Share as a Percentage of GDP over the Period 2001-2020

Source: World Bank WDI

FDI has increased since the last months of 2000, thanks to some changes in the law, a partial reduction in customs and tax rates, and measures to protect foreign investment. Between 2003-2008, FDI exceeded US$ 4 billion annually. Due to the financial crisis,

there was a reduction in the value of FDI in 2009. FDI reached its peak in 2012 with US$ 5.2 billion over the period 2001-2020. There has been a sharp decline in the last four years (2017-2020): the value of such investments decreased by 36.3% in 2017 compared to the previous year, decreased again by 51.1% in 2018 (reached US$ 1.4 billion), in 2019 increased by 7.2% per year (reached US$ 1.5 billion) and lastly in 2020 the value sharply decreased by 66% reaching half billions.

According to data from AZSTAT, between 2000-2017, 85.9% of FDI in the Azerbaijan economy was made in the oil sector and the remaining 14.1% in the non-oil sectors.

The average growth rate of the amounts of FDI was 8.5% from 2001-2020. The highest growth rate over 2001-2020 was 147% in 2002, while the lowest growth rate was -66.3% in 2020.

As Figure 3.20 reveals, the inflow of FDI as a percentage of GDP represented a growth trend between 2001-2003 and reached approximately 55% of GDP in 2003. Starting from 2004, there was a reduction in the share of FDI in GDP. This decline continued until 2013 and reached 3.5% of GDP. However, after 2013, there was a little increase in the share of FDI in GDP, and it reached 11% in 2016 over the period 2001-2020. As it is seen from the figure above, a gradual reduction in the share of FDI is observed between 2016-2020, reaching a 1.2% share of GDP in 2020.

Foreign direct investment inflows in Azerbaijan in the last ten years have largely financed Azerbaijan's current account deficits and have been the driving force of economic growth.

3.9 State Budget

As a result of increased defense expenditures due to the Karabakh War, Azerbaijan's budget balance began to deteriorate from 1993. The reforms made during the transition to the free-market economy caused the state budget revenues to increase, and the budget deficit, which was high in the early 1990s, started to decrease since 1995. The budget deficit, which was 9.4% of GDP in 1994, was 2.4% in 1999 and 1% in 2000. The budget deficit started to decrease in 2001, and surplus emerged in the 2006-2008.

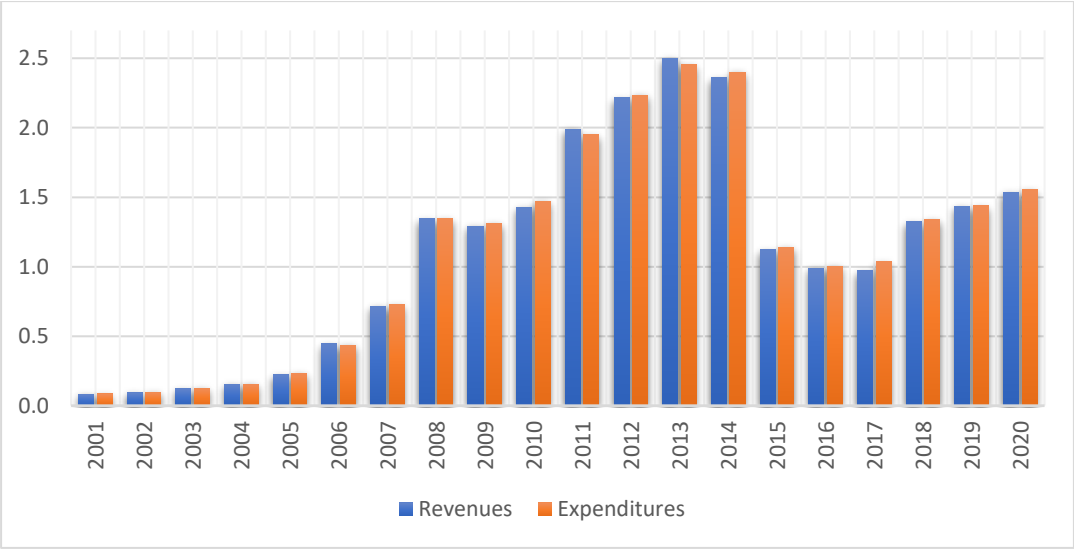


Figure 3.21 State Budget Revenues and Expenditures over the Period 2001-2020
Source: AZSTAT

In recent years, oil-related budget revenues have also increased. The share of oil export revenues in budget revenues has increased since 2010. In 2012, according to the data from the AZSTAT, the State Oil Fund of Azerbaijan's (SOFAZ) transfer rate was 54%, and the transfer volume for the next two years accounted for approximately half of the budget revenues. As a result of decreasing oil prices in the world market and two times devaluation in Azerbaijan, there was a sharp decline in 2015, which influenced the budget negatively.

In addition to budget revenues, budget expenditures are increasing every year. In Azerbaijan, the share of public expenditures in GDP continues to increase. Moreover, over the years, the share of security expenditures in budget expenditures has been increasing.

The budget for 2020 mainly focused on salaries, economic activity, and defense expenditures. Generally, the budget for 2019 was US$ 14.3 billion, and the budget for 2020 was US$ 15.3 billion, respectively. According to the data from the AZSTAT, the share of the SOFAZ transfers in the state budgetary revenues was 49.4% which constitutes US$ 7.5 billion.

CHAPTER 4

MODELLING THE VOLATILITIES OF THE RATES OF CHANGES IN OIL PRICES AND AZERBAIJAN'S REAL EFFECTIVE EXCHANGE RATE

4.1 Introduction

Since 1994, agreements related to oil production, which were signed between Azerbaijan and certain international companies, have allowed the re-establishment of the infrastructure required for the country and stimulated economic growth rapidly. Thus, Azerbaijan as one of the most crucial source, reached the transmission lines allowing the export of energy sources with integration to world economies.

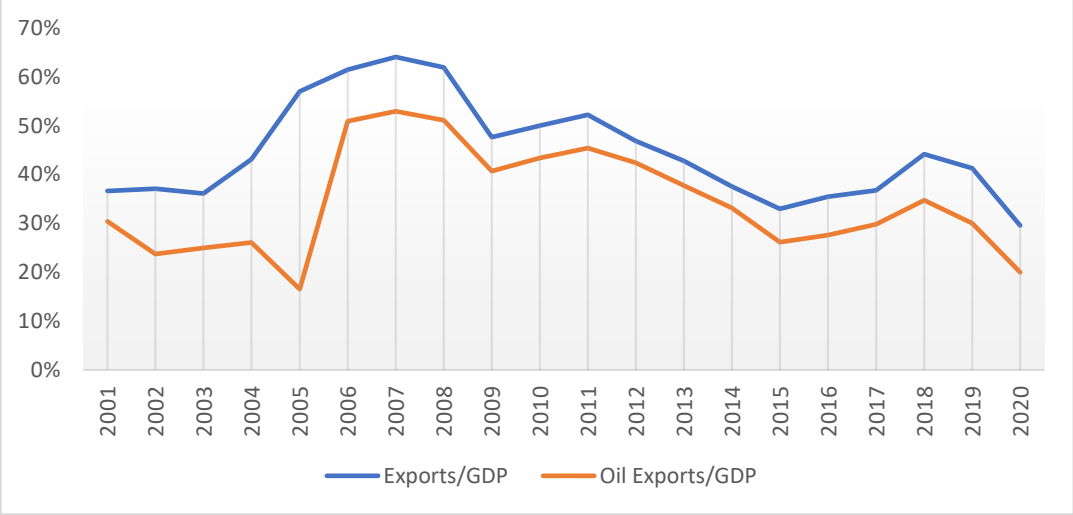


Figure 4.1 Ratio of Exports to GDP and Oil Exports to GDP in Azerbaijan for 2001-2020

Source: AZSTAT, CBAR

It is seen from Figure 4.1 that export has played an important role since 2000 when oil exportations started to increase. Although the share of exports on GDP was 37% in 2001, the export numbers increased to 64% in 2007. Because of the decline in world oil prices, the tendency for the following years is in a negative way. The share of Export on GDP constitutes roundly 30% in 2020.

According to Figure 4.2, Azerbaijan got most of its export revenues from oil and oil products. The development in the foreign trade balance is related to the country's oil exports as a consequence of oil production and exports within the framework of international agreements in relation to the Caspian energy source. The share of oil and oil products in export fluctuates mainly near 80% of exports for most of the years in examined period, and despite some ups and downs, primarily we see increasing trend. The increase is chiefly due to the export of crude oil. For one reason, the price of crude oil is increased; on the other hand the volume of export increased. Thus, it is possible to say that Azerbaijan's economy has become dependent on energy prices since crude oil and oil products are the main exports of Azerbaijan. This situation reveals an important problem for Azerbaijan's economy because of dependence on only one sector. It is feasible to see from the figure below that the share increased to approximately 91% in 2012.

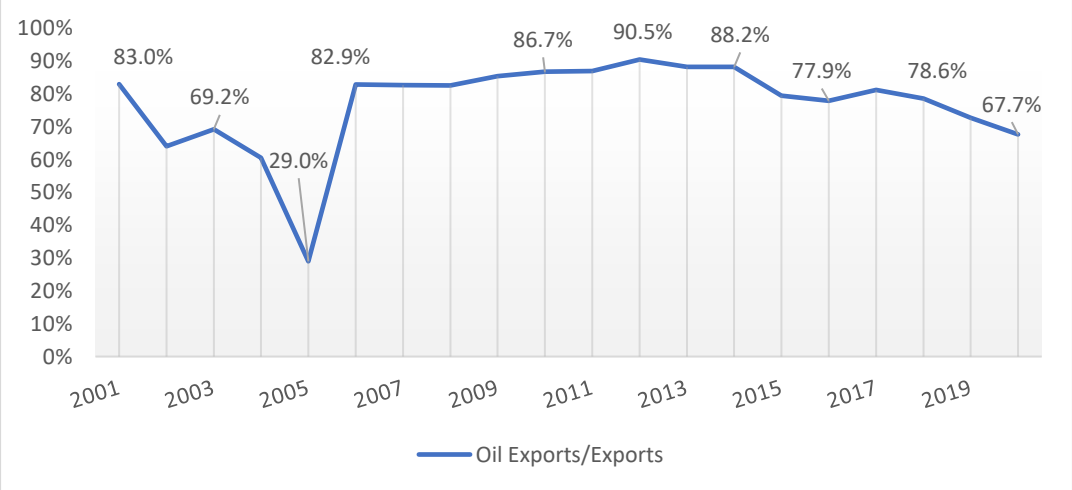


Figure 4.2 Ratio of Oil Exports to Exports in Azerbaijan for 2001-2020

Source: AZSTAT, CBAR

As the demand for crude oil has been increasing daily worldwide, the impact of oil prices on exchange rates and exchange rate volatility will become more evident. In the case of Azerbaijan, the oil price is the crucial variable determining the real exchange rate of Azerbaijan. Fluctuations in oil prices cause massive inflow or outflow of oil revenues in Azerbaijan. This directly affects the appreciation and depreciation of the exchange rate, which undermines the competitiveness of the non-oil sector of the economy.

Variables such as oil prices and exchange rates are among the macroeconomic variables that are highly volatile. Moreover, these two variables constitute the main components in both the practice and implementation of monetary policy, especially in countries such as Azerbaijan, which is highly dependent on oil for revenues. It is known that oil price and exchange rate fluctuations have often been the main obstacles to macroeconomic management in the country. According to Beckman and Czudaj (2012), since the 1970s, both oil prices and the exchange rates have presented uncommon fluctuations as a consequence of the first oil price shock and the accidental breakdown of the Bretton-Woods system of fixed exchange rates. These fluctuations in oil price and exchange rate have a necessary impacts on trade, growth, and economic management.

Overall, since the oil price and exchange rate variables are volatile and have a high impact on the economic performance of Azerbaijan, it is necessary to model the volatilities of rates of changes in oil prices and exchange rate.

In the time series used in modern economic theory, it is common to use conditional variance models to analyze time-dependent variability in high-frequence data. This is possible with the help of ARCH and GARCH models. The Autoregressive Conditional Heteroscedasticity (ARCH) model was first introduced by Engle (1982) which has time varying conditional variance. Although the ARCH model is simple, many parameters are often needed to explain the volatility process of an asset return. Bollerslev (1986) extended the ARCH model and proposed the Generalized ARCH (Generalized Autoregressive Conditional Heteroscedasticity, GARCH) model, which is more historical and has a more flexible delay structure. This model mainly reduces the high order of estimated parameters to just a few parameters. Thus, the GARCH

model is useful for predicting time-varying time series variance. Also, there is another model, such as the Exponential GARCH (E-GARCH), which is known as the model that allows the leverage effect to be decomposed.

In this chapter, conditional variance models will be modeled using the real effective exchange rate and the real "Brent" oil prices data published on the website of the Bruegel and the U.S. Energy Information Administration (EIA), respectively. The rest of the article, which aims to analyze conditional variance models, consists of four main sections: Section 2 presents data and the research methodology, Sections 3 and 4 is about modeling the volatility of the rates of changes in real effective exchange rate and real "Brent" crude oil prices, respectively. Inside Sections 3 and 4, we present the time series properties of variables, their stationarity status, mean equation of variables with ARMA methods, investigation of the ARCH effect, conditional variance equations and their comparisons, estimating best-predicted model for appropriate series and diagnostics. Finally, Section 5 concludes.

4.2 Data & Methodology

This study uses the real effective exchange rate (REER) and the "Brent" oil prices as variables to model conditional variance models. The sample covers the period 1995 Q1 – 2021 Q4. The REER and the "Brent" oil prices are sourced from the Bruegel datasets and the U.S. Energy Information Administration (EIA), respectively. The total observations for each variable are 108. All data used is in logarithmic returns. The "Brent" oil prices data is not in real terms; therefore, GDP Deflator is employed to convert them to real terms. 2010 Q4 is taken as the base year while converting to real terms, and this is also acceptable for the REER variable. The models were estimated with the Student Lite version of the Eviews 12 program. Firstly, we check the stationarity and then employ three different ARCH/GARCH models for forecasting purposes.

The stationarity is essential for ARCH/GARCH type modeling. Hence, unit root properties of the return series employed as the first part of the analysis. There are several tests available to determine whether unit roots exist, however the findings are occasionally inconsistent. The series' stationarity must be ensured in order to proceed

with the analysis safely. A time series is regarded as stable in principle if it fluctuates around a fixed mean, suggesting that the series has a finite variance.

On the other hand, the process is non-stationary if a time series has a unit root. I particular, the series do not exhibit continuos variance to retrace their steps. The commonly used methods in the literature to test for the presence of unit roots are "the Augmented Dickey-Fuller (ADF) test belongs to, as the name implies, Dickey and Fuller (1979), Philips-Perron (PP) developed by Philips and Perron (1988)". In order to get reliable results, these tests were conducted.

The ARCH model is used to check for the presence of heteroscedasticity after identifying the order of the variable's integration. The ARCH (q) model is stated in its generic form as follows:

$$r_t = \mu + \varepsilon_t,\ t = 1, \ldots\ldots, T \tag{4.1}$$

where *T* is the total number of observations, ε_t denotes residuals and μ stands for the time series' mean (r_t). However, the ARCH model's residual procedure shows that the following assumptions are made about the residuals:

$$\varepsilon_t = \sigma_t z_t;\ \ Z_t \mathrm{N}\ (0, 1) \tag{4.2}$$

The series of σ_t^2 is then modeled as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-p}^2 \tag{4.3}$$

where $\alpha_i \geq 0$; $i > 0$ and $\alpha_0 > 0$. "The model assumption is that ε_t are assumed to follow a standard normal (Gaussian), Student's t-test, or Generalized Error Distribution (GED) methods" (Tsay, 2005).

The symmetric GARCH model suggested by Bollerslev (1986) and Taylor (1986) was utilized to account for the volatility in the series presented in the paper. Bollerslev and Taylor believe that "the symmetric GARCH model better captures the volatility in a return series than the ARCH model".

The definition and formulation of the GARCH (p, q) model are:

$$\sigma_t^2 = c + \varepsilon_{t-i}^2 + \sigma_{t-j}^2 \quad (4.4)$$

where σ_{t-1}^2 indicates the variance, ε_{t-i}^2 is the squared error for the period *t-i*, ε_i is the residual coefficient, *t* denotes time, while *j* denotes the number of lags, *c* is the intercept, ε_{t-i}^2 represents the ARCH terms, and σ_{t-j}^2 is the GARCH terms. However, "the residual coefficient and the intercept in the equation above have to be more than zero in order to ensure a positive variance" (Reider, 2009).

To capture the asymmetric response of volatility in the series, the E-GARCH (p, q) model was introduced by Nelson (1991). This model is a discrete-time estimate of a continuous-time stochastic volatility process that is expressed in the form of logarithms and conditional volatility that is certain to be positive without any limitations on the parameters (Nelson, 1991). The exponential GARCH (p, q) model is computed using the following equation:

$$log(\sigma_t^2) = \alpha_0 + \sum_{j=1}^{q} \beta_j \, log\left(\sigma_{t-j}^2\right) + \sum_{i=1}^{p} a_i \left|\frac{e_{t-i}}{\sigma_{t-i}}\right| + \sum_{k=1}^{r} \gamma_k \frac{e_{t-k}}{\sigma_{t-k}} \quad (4.5)$$

In the equation, α_0 is the constant term. The term σ_{t-j}^2 represents past volatility estimates, e_{t-i} represents the error term in past periods, and σ_{t-i} represents the conditional standard deviation in past periods. On the other hand, γ_k indicates the asymmetry parameter. If the asymmetry parameter is "0", the established E-GARCH model is symmetrical. However, this condition should not be met in volatility models. If δ is negative, it is concluded that "negative shocks are more effective than positive shocks". On the contrary, positive shocks are much more effective than negative shocks (Aktaş, Kavaklıdere, Elçiçek, 2018).

When the literature is examined, it is generally seen that ARCH group models are successful in prediction and when comparing models, Mean Error (ME), Mean Squared Error (MSE), Mean Absolute Error (MAE), Root of Mean Error Square (RMSE) and Mean Absolute Proportional Error (MAPE) values are used. A comparison is made by considering one of these values, and it is assumed that the model that minimizes the value is successful in the estimation. For example, according

to West and Cho (1995), who studied the performance measurement of models, the RMSE criterion was used, and it was revealed that the GARCH model was the model with the best performance in estimation. Static or dynamic estimations can be made while performing data analysis using the RMSE criterion. Of these, the static model estimation assumes that the variance remains constant. On the other hand, dynamic models make predictions by assuming that the variance and, in addition, the correlation between the variables change (Çelik, 2014). In both ways, estimations can be made, and it is assumed that the model that minimizes the RMSE value makes the best estimation.

4.3 Modelling Estimation of the Volatility of the Real Effective Exchange Rate (REER)

In this section, conditional variance models will be modeled by applying them to the REER data. The real effective exchange rate values published on the website of the Bruegel, which constitutes the data set used in the application of this study. Student Lite version of the EViews 12 package program was used to perform the analyzes and get the volatility of DLREER.

4.3.1 Univariate Time Series Properties of the REER

Before working with the data set, logarithmic values of the REER data set were taken to eliminate various unit roots and other negativities. It is possible to see the graph of logarithms of the REER (LREER) in Figure 4.3.

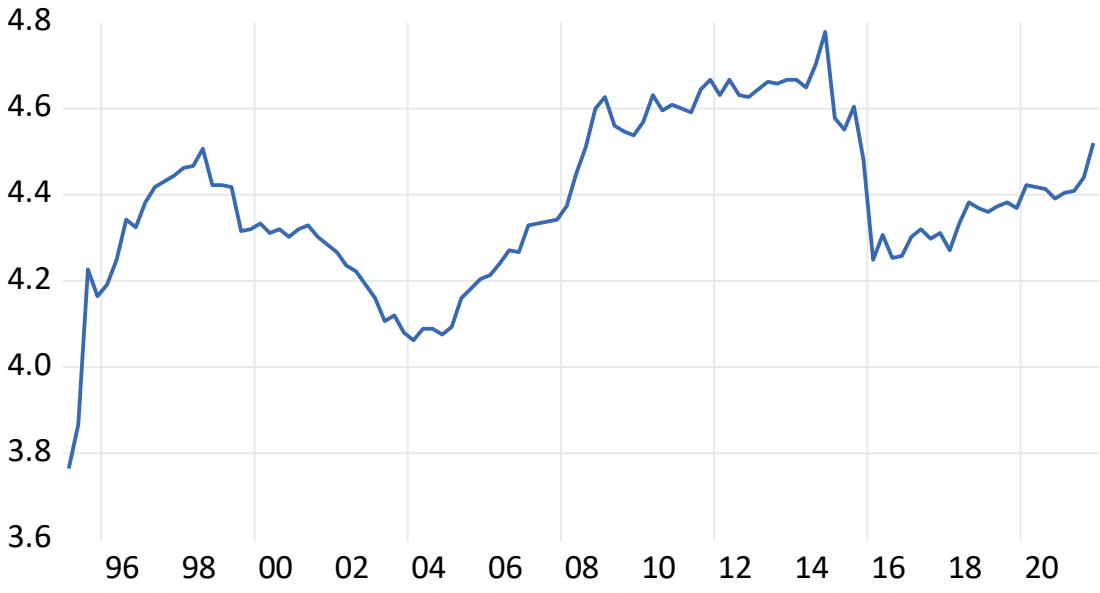


Figure 4.3 Logarithmic Series of the REER

The observations of the statistical features of the LREER series presented in Figure 4.4 can be listed as follows; the kurtosis value is 3.174; the skewness value was found to be -0.281 roundly for the specified period, and it was determined that the distribution had a left-skewed structure. The statistical probability value of the "Jarque-Bera" criterion cannot reject the H_0 hypothesis, which is the "normal distribution" hypothesis.

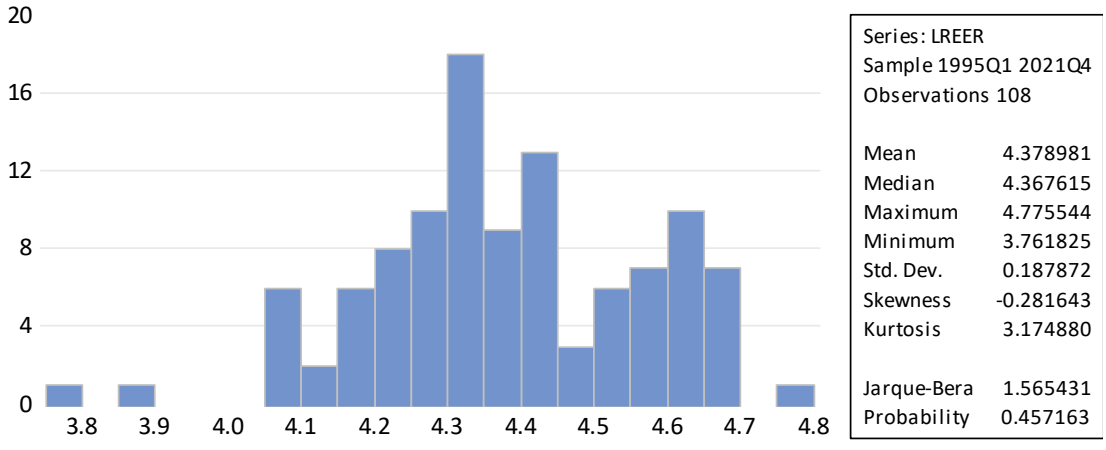


Figure 4.4 Descriptive Statistics of the LREER Series

4.3.2 Stationarity

Since stationarity is an indispensable prerequisite for time series, unit root tests, "Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests" were performed. It is possible to see the results of the unit-roots test from Table 4.1.

Table 4.1 Unit Root Test

	ADF test			
LREER	Levels		First Difference	
	Constant	Constant + trend	Constant	Constant + trend
	0.2145	0.1262	0.0001	0.0010
	PP test			
LREER	Levels		First difference	
	Constant	Constant + trend	Constant	Constant + trend
	0.3113	0.1711	0.0000	0.0000

As can be easily seen from the table above, the LREER series is not stationary at the original level. According to the ADF and PP test statistics, the probability is greater than 5% levels. Thus the null hypothesis is accepted, so it is decided that the LREER series is not stationary at the original level. The stationarity of the series is retested by taking the first difference of the LREER series. According to ADF and PP test statistics, the probability is less than 1% levels, and the null hypothesis is rejected, that is, when the first difference of the LREER series is taken, it is decided that the LREER series is stationary.

It is possible to see from Figure 4.5 and Figure 4.6 that the first differenced LREER (DLREER) series is stationary.

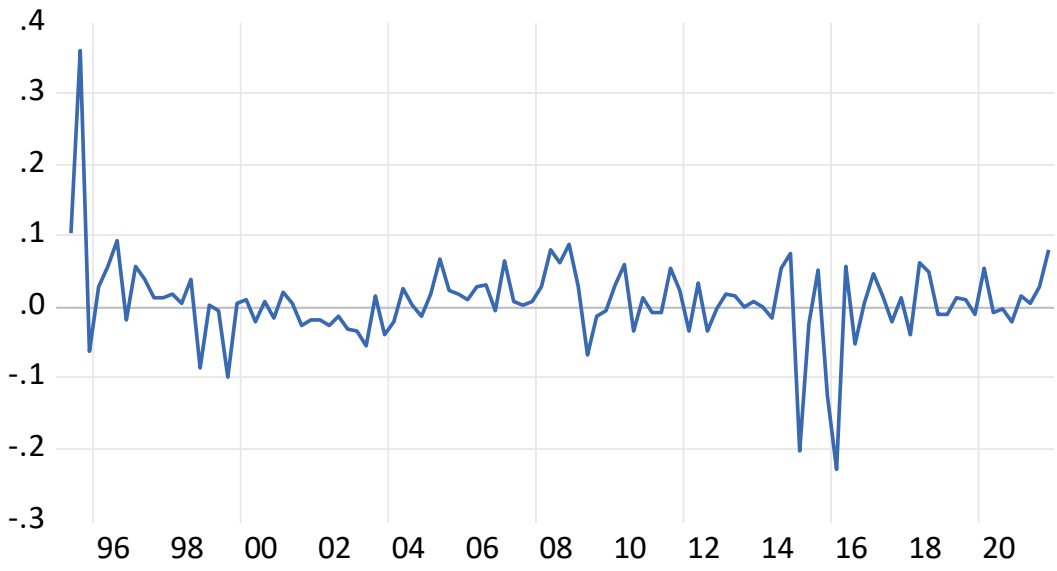


Figure 4.5 The Graph of DLREER

The observations of the statistical features of the DLREER series presented in Figure 4.6 can be listed as follows; the kurtosis value is 15.477; the skewness value was found to be 0.883 roundly for the specified period. The statistical probability value of the "Jarque-Bera" criterion rejects the H_0 hypothesis, which is the "normal distribution" hypothesis.

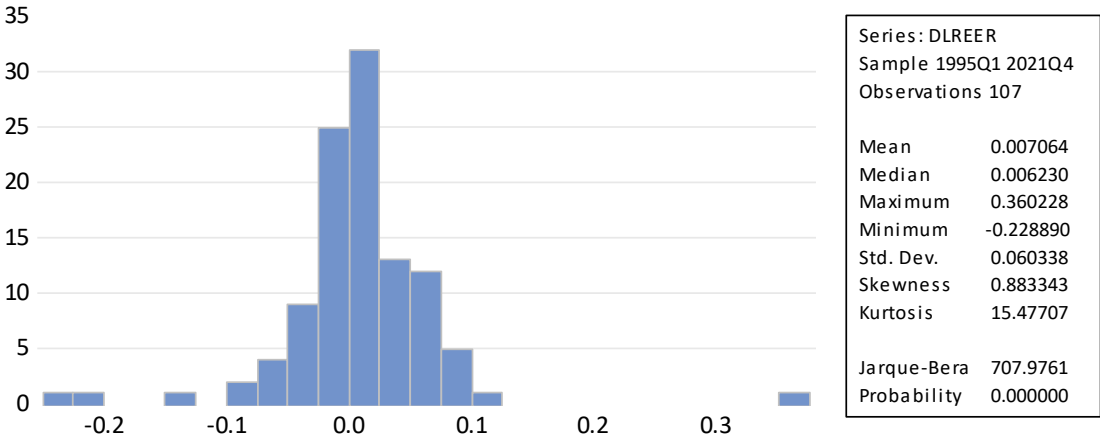
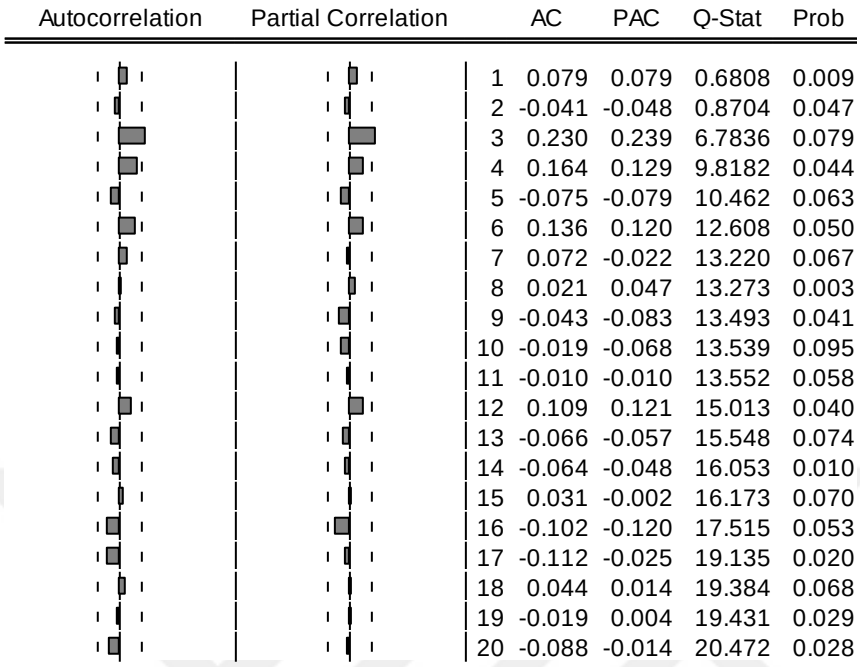


Figure 4.6 Descriptive Statistics of the DLREER

In Figure 4.7, it is seen that the autocorrelation (ACF) coefficients do not take very high values and do not show continuous reduction with the increase in the number of delays, while the partial autocorrelation (PACF) coefficients rapidly approach zero

after the first delay and represent approximately same direction with ACF coefficients. In this case, the series shows a stationary structure.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.079	0.079	0.6808	0.009
		2	-0.041	-0.048	0.8704	0.047
		3	0.230	0.239	6.7836	0.079
		4	0.164	0.129	9.8182	0.044
		5	-0.075	-0.079	10.462	0.063
		6	0.136	0.120	12.608	0.050
		7	0.072	-0.022	13.220	0.067
		8	0.021	0.047	13.273	0.003
		9	-0.043	-0.083	13.493	0.041
		10	-0.019	-0.068	13.539	0.095
		11	-0.010	-0.010	13.552	0.058
		12	0.109	0.121	15.013	0.040
		13	-0.066	-0.057	15.548	0.074
		14	-0.064	-0.048	16.053	0.010
		15	0.031	-0.002	16.173	0.070
		16	-0.102	-0.120	17.515	0.053
		17	-0.112	-0.025	19.135	0.020
		18	0.044	0.014	19.384	0.068
		19	-0.019	0.004	19.431	0.029
		20	-0.088	-0.014	20.472	0.028

Figure 4.7 The Correlogram of the DLREER Series

4.3.3 Estimation of the Volatility Models for DLREER

After making variables stationary, it is necessary to determine the most suitable model for the structure of the series by using the DLREER series as the next step. Moreover, the prediction method with specific diagnostics will help to reveal the best-predicted model in terms of conditional variance. Finally, after comparisons, we predict the values of the variable for the next four quarters.

4.3.3.1 Estimation of the Mean Equation for DLREER

The most suitable model for the series structure will be determined by trying different degrees of ARMA models.

By looking at the correlogram of the time series from Figure 4.7, it is possible to determine which of the MA (q), AR (p), or ARMA (p, q) processes fit the DLREER series. “The order of the AR part is determined by the significant partial autocorrelation coefficients, and the number of significant autocorrelation coefficients

determines the order of the MA part. The peaks in these functions show the order of the models of this process" (Göktaş, 2005).

Table 4.2 Appropriate Model Selection Results for the DLREER Series

Models	R^2	AIC	SIC	Log likelihood	SigmaSQ
ARMA (1,1)	0.0148	-2.7270	-2.6271	149.89	0.0035
ARMA (1,3)	0.0619	-2.7746	-2.6746	152.44	0.0033
ARMA (1,4)	0.0466	-2.7575	-2.6576	151.53	0.0034
ARMA (3,1)	0.0863	-2.7990	-2.6991	153.75	0.0032
ARMA (3,3)	0.0896	-2.8021	-2.7021	153.91	0.0032
ARMA (3,4)	0.1128	-2.8271	-2.7272	155.25	0.0032
ARMA (4,1)	0.0457	-2.7569	-2.6570	151.49	0.0034
ARMA (4,3)	0.0917	-2.8051	-2.7052	154.07	0.0032
ARMA (4,4)	0.0515	-2.7615	-2.6616	151.74	0.0034

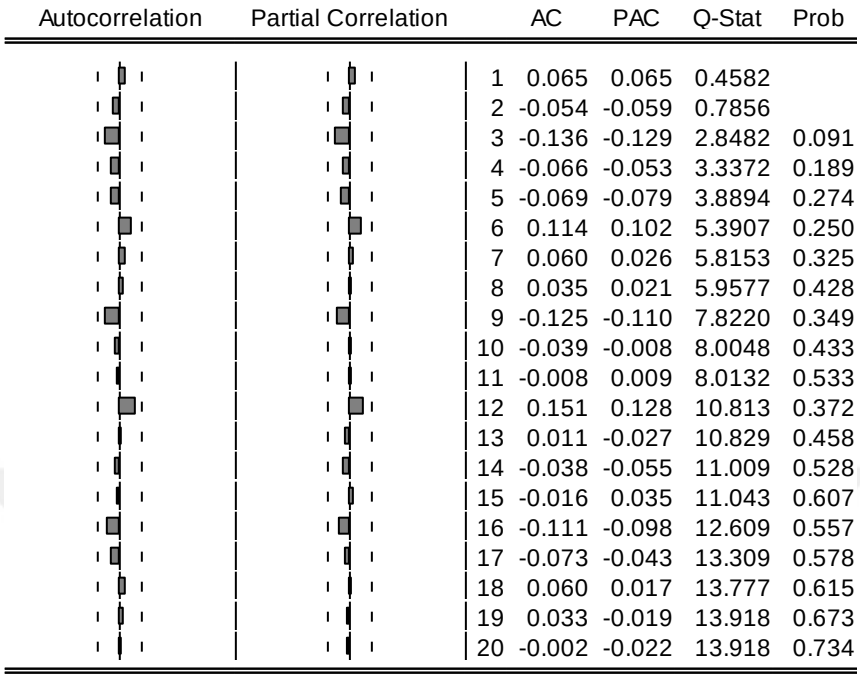
Therefore, when the correlogram created using the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the DLREER series is examined, the peaks in the 3rd and 4th lags in the autocorrelation and partial autocorrelation functions are remarkable. Accordingly, it would be healthier to decide by examining the alternative model estimates from the table given above.

The results of the alternative models estimated for the DLREER series given in Table 4.2 are evaluated according to the criteria below:

- **(i)** The parameters are significant;
- **(ii)** The coefficient of determination is high;
- **(iii)** The AIC and SIC information criteria are as low as possible;
- **(iv)** The log-likelihood ratio is as high as possible;
- **(v)** The volatility (SigmaSQ) is as low as possible;
- **(vi)** The F statistic of the model is significant.

After considering these criteria, ARMA (3, 4) model was determined as a suitable model. In order to test the suitability of the model, whether the residuals produced by

the model have white noise characteristics should be checked with the figure given below.



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.065	0.065	0.4582	
		2	-0.054	-0.059	0.7856	
		3	-0.136	-0.129	2.8482	0.091
		4	-0.066	-0.053	3.3372	0.189
		5	-0.069	-0.079	3.8894	0.274
		6	0.114	0.102	5.3907	0.250
		7	0.060	0.026	5.8153	0.325
		8	0.035	0.021	5.9577	0.428
		9	-0.125	-0.110	7.8220	0.349
		10	-0.039	-0.008	8.0048	0.433
		11	-0.008	0.009	8.0132	0.533
		12	0.151	0.128	10.813	0.372
		13	0.011	-0.027	10.829	0.458
		14	-0.038	-0.055	11.009	0.528
		15	-0.016	0.035	11.043	0.607
		16	-0.111	-0.098	12.609	0.557
		17	-0.073	-0.043	13.309	0.578
		18	0.060	0.017	13.777	0.615
		19	0.033	-0.019	13.918	0.673
		20	-0.002	-0.022	13.918	0.734

Figure 4.8 Correlogram of the Residuals of the DLREER ARMA (3, 4) Model

When the correlogram of the error terms is examined, it is seen that the majority of the autocorrelation and partial autocorrelation coefficients are within the 95% confidence interval. This result confirms our knowledge that the model is suitable.

Table 4.3 Estimation Results of the DLREER ARMA (3, 4) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010377	0.009239	1.123084	0.2640
AR(3)	0.323123	0.077572	4.165469	0.0001
MA(4)	0.215876	0.078425	2.752647	0.0070
SIGMASQ	0.003200	0.000272	11.76650	0.0000

R-squared	0.112813	Mean dependent var	0.007064
Adjusted R-squared	0.086973	S.D. dependent var	0.060338
S.E. of regression	0.057654	Akaike info criterion	-2.827157
Sum squared resid	0.342375	Schwarz criterion	-2.727239
Log likelihood	155.2529	Hannan-Quinn criter.	-2.786652
F-statistic	4.365767	Durbin-Watson stat	1.828188
Prob(F-statistic)	0.006165		

The model estimated according to the least-squares results in Table 4.3 for the DLREER series is successful in terms of certain evaluation criteria and the significance of the parameters other than the constant.

In order to determine whether the established ARMA model is stable, it is necessary to make some tests. One of them shows whether the AR polynomial's inverse roots are located inside the unit circle. None of the inverse roots of the AR Polynomial are outside the unit circle, as can be shown in Figure 4.9.

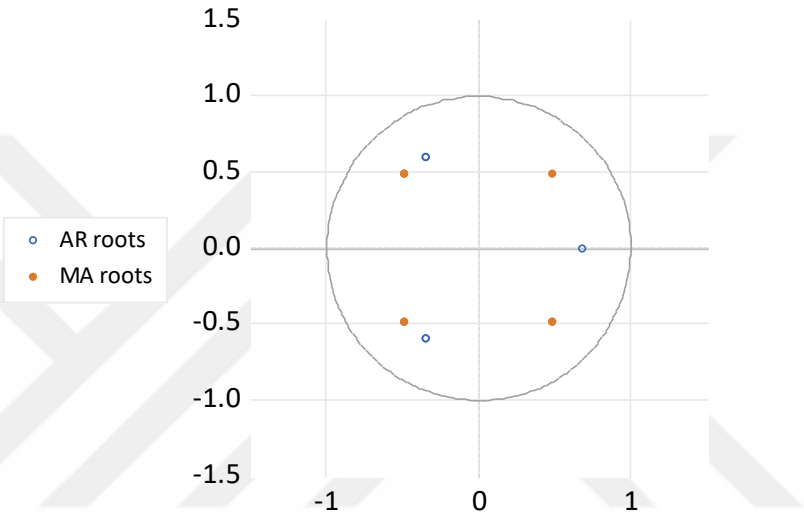


Figure 4.9 Inverse Roots of AR/MA Polynomial of the DLREER ARMA (3, 4) Model

4.3.3.2 Investigation of the ARCH Effect for the Mean Equation of DLREER

After the tests, the ARCH-LM test was also applied in order to determine whether the DLREER series has an ARCH effect. The optimum lag number for the ARCH-LM test was found using the Akaike information criterion (AIC) with the lag length minimizing the numerical value.

According to Table 4.4, the minimum value was given by the 1st lag length. When compared according to the Akaike information criterion, the optimal length is one. Since the values tend to decrease after the 1st delay length until the 5th, the AIC values after the 5th delay were not examined.

Table 4.4 Lag Length for the DLREER Series with ARCH-LM AIC Values

Lag length	AIC
1	-7.560
2	-7.547
3	-7.552
4	-7.556
5	-7.538

The ARCH-LM test for the DLREER series is performed for the 1st lag length. Probability values showed that the series exhibited conditional variable variance, which is less than the 5% level. According to the results of the ARCH-LM test conducted to determine the volatility in the DLREER index, it has serial volatility. For this, volatility will be tried to be modeled with suitable ARCH/GARCH models.

Table 4.5 ARCH-LM Test Result for the DLREER ARMA (3, 4) Model (With Optimal Lag Length of 1)

Heteroskedasticity Test: ARCH

F-statistic	1.097172	Prob. F(1,104)	0.0252
Obs*R-squared	1.106597	Prob. Chi-Square(1)	0.0291

4.3.3.3 Autoregressive Conditional Variance Equations of DLREER

The tests for the DLREER series are ARCH (1), GARCH (1.1), and E-GARCH (1.1), respectively. All tests were compared according to Gaussian (normal), Student's-t, and GED distribution methods to find the best distribution using the Akaike information criterion and other important indicators. According to the comparison results, GED distribution method in each estimation model is suitable.

The results of the ARCH (1) estimation model (Table 4.6) with the GED distribution method is better than other methods. There is no autocorrelation in the model, which makes this model's results better. Therefore, it would be better to consider the GED distribution method as a reliable model among them. According to the table below, the results for GARCH (1.1) model with the GED distribution method are more attractive than others.

Table 4.6 Results of Models for the DLREER Series

	Methods	AIC	SIC	Log likelihood	Heteros-cedasticity	Auto-correlation
ARCH (1)	*Gaussian*	-3.333	-3.206	178.33	No	No
	Student's-t	-3.341	-3.188	179.74	No	No
	GED	-3.547	-3.395	190.48	No	No
GARCH (1.1)	*Gaussian*	-3.337	-3.185	179.55	No	No
	Student's-t	-2.796	-2.618	152.43	No	No
	GED	-3.526	-3.348	190.37	No	No
E-GARCH (1.1)	*Gaussian*	-3.419	-3.241	184.83	No	No
	Student's-t	-3.500	-3.296	190.01	No	No
	GED	-3.507	-3.304	190.40	No	No

The results of the E-GARCH (1.1) model require choosing the better model between the results obtained with the GED distribution method and the Student's-t method, which have approximately the same conclusions. Nevertheless, because of the presence of fewer information criteria results in the GED distribution method, it would be quite clear to choose the results obtained with the GED distribution method.

4.3.3.4 Comparisons of the Variance Equations for DLREER

According to the results, the ARCH (1) model, which is modeled and reported for the DLREER series with volatility, it is seen that there is no ARCH effect in the newly established model, and Akaike values also other indicators show the suitability of this model. From this point of view, it is seen that the ARCH (1) model interprets the existing volatility most appropriately.

Table 4.7 Necessary Indicators of Models

	ARCH (1) GED	GARCH (1.1) GED	E-GARCH (1.1) GED
AIC	-3.547	-3.526	-3.507
SIC	-3.395	-3.348	-3.304
Log likelihood	190.48	190.37	190.40

Table 4.8 Estimation Results of DLREER ARCH (1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004798	0.003028	1.584523	0.1131
AR(3)	0.147172	0.057023	2.580935	0.0099
MA(4)	-0.023817	0.064376	-0.369957	0.0114
Variance Equation				
C	0.001080	0.000392	2.756358	0.0058
RESID(-1)^2	0.640928	0.314395	2.038607	0.0415
GED PARAMETER	0.996426	0.208859	4.770801	0.0000
R-squared	0.067103	Mean dependent var		0.003417
Adjusted R-squared	0.048630	S.D. dependent var		0.048824
S.E. of regression	0.047622	Akaike info criterion		-3.547868
Sum squared resid	0.229052	Schwarz criterion		-3.395307
Log likelihood	190.4891	Hannan-Quinn criter.		-3.486061
Durbin-Watson stat	1.853117			

Required constraints for the ARCH (1) model (Equation 4.3) $0 < \alpha_0$ and $0 \leq \alpha_1 < 1$ are provided as α_0 = 0.001080 and α_1 = 0.640928 in Table 4.8. The obtained model is like below:

$$DLREER_t = 0.004798 + 0.147172 \times DLREER_{t-1} - 0.023817 \times \varepsilon_{t-1} + \varepsilon_t \quad (4.7)$$

$$\sigma_t^2 = 0.001080 + 0.640928 \times \varepsilon_{t-1}^2 \quad (4.8)$$

After all this process, according to Table 4.9, to measure the success of the ARCH (1) model, the ARCH-LM test was performed, resulting in no ARCH effect. In other words, the established ARCH (1) model was very successful in estimating the return of the REER.

Table 4.9 ARCH-LM Test Result for ARCH (1) Model

Heteroskedasticity Test: ARCH			
F-statistic	0.005023	Prob. F(1,101)	0.9436
Obs*R-squared	0.005122	Prob. Chi-Square(1)	0.9429

4.3.4 Estimating Model for the DLREER Series with Prediction Method and Diagnostics

In terms of predicting the unexpected volatility of the DLREER, the examinations on which model makes the best estimation were made by estimating the remaining observations by excluding the last four observation values. For this, "the Root Mean Squared Error (RMSE), the Mean Absolute Error (MAE), the Mean Absolute Percent Error (MAPE), and the Theil Inequality Coefficient values" were compared. Values with dynamic criteria were examined.

From the literature, the data from that volatility model was used with the following to produce the best model:

- lowest Schwarts Information Criterion;
- lowest Root Mean Squared Error (RMSE);
- lowest Mean Absolute Error (MAE);
- lowest Mean Absolute Percent Error (MAPE);
- highest Theil's Inequality Coefficient.

Table 4.10 Necessary Indicators of Models with Prediction Method

DYNAMIC Forecast	RMSE	MAE	MAPE	Theil inequality	SIC
ARCH (1)	0.0410	0.0297	76.00	0.8881	-3.300352
GARCH (1.1)	0.0411	0.0299	77.84	0.8873	-3.220348
E-GARCH (1.1)	0.0413	0.0301	79.19	0.8979	-3.182045

According to the values in Table 4.10, the ARCH (1) model was found to be the model that best predicted the DLREER series since it was found to be smaller than other models for SIC values. Finally, the standard deviation and variance graphs of the ARCH (1) model were drawn below.

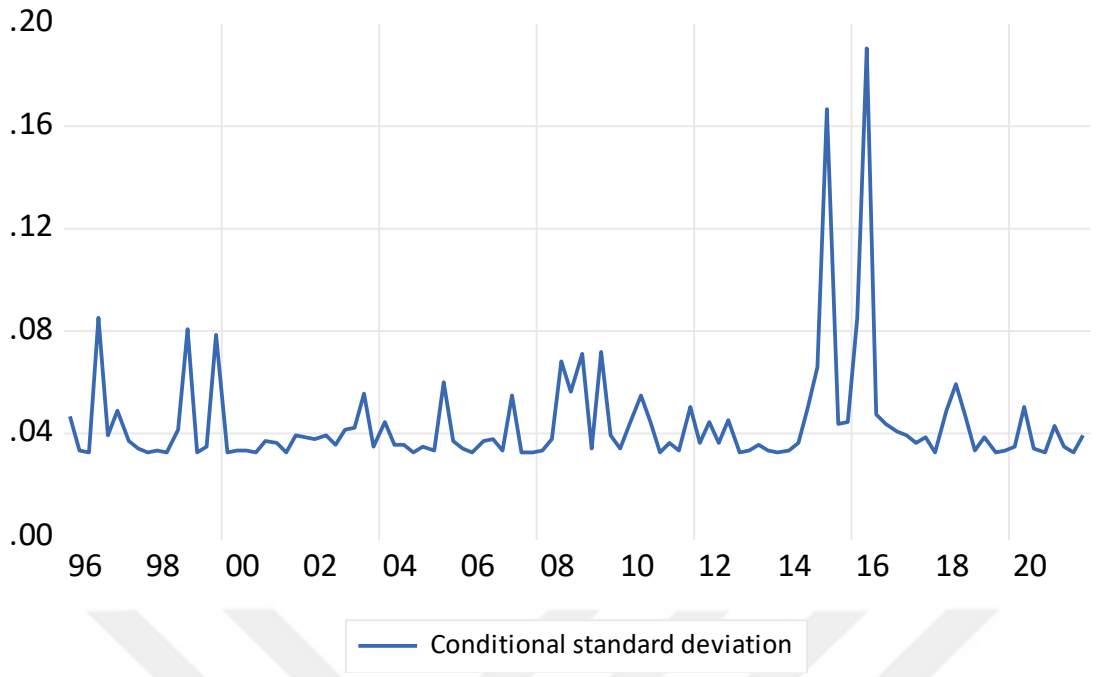


Figure 4.10 The Conditional Standard Deviation Graph for the DLREER Series ARCH (1) Model

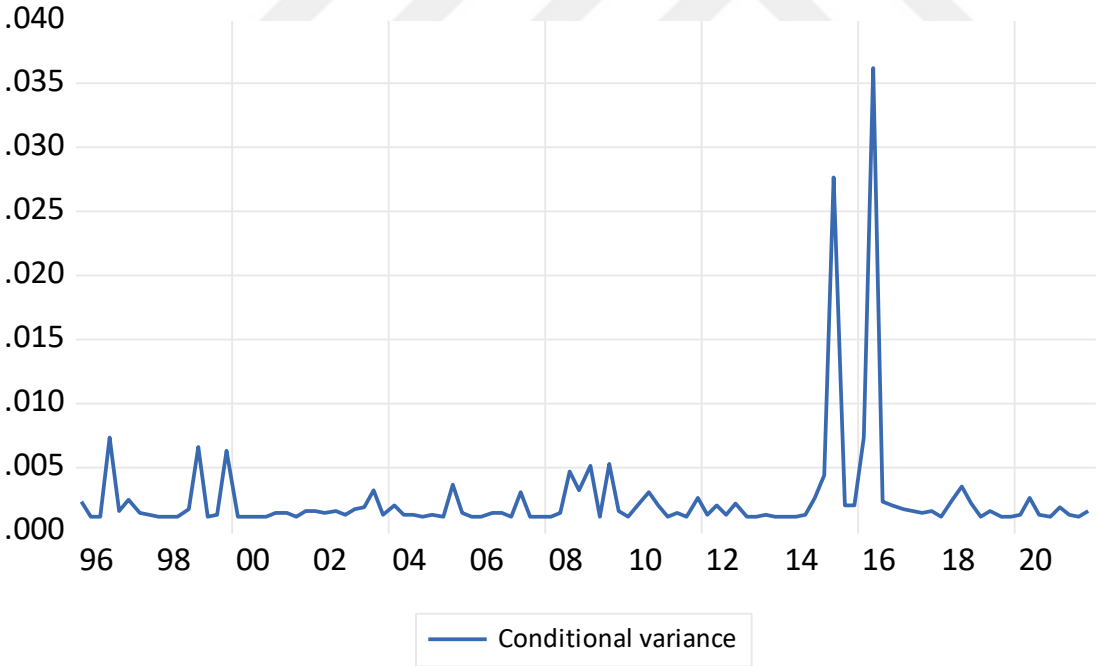


Figure 4.11 Conditional Variance Graph for the DLREER Series ARCH (1) Model

The variance prediction and conditional standard deviation of the ARCH (1) model from the figures given above are very close to each other. It is seen that the volatility of the DLREER series had peak fluctuations between 2008-2010 which were known

as crisis periods, and between 2014-2016 which corresponds with two devaluations in the Azerbaijan currency.

4.3.5 Predicting the DLREER Series for Next 4 Quarters

Finding the best model for the DLREER series makes it possible to forecast the DLREER series for future quarters. According to Figure 4.12, the blue line shows 2022Q1 – 2022Q4 values for the DLREER series, representing a growing trend and approaching zero.

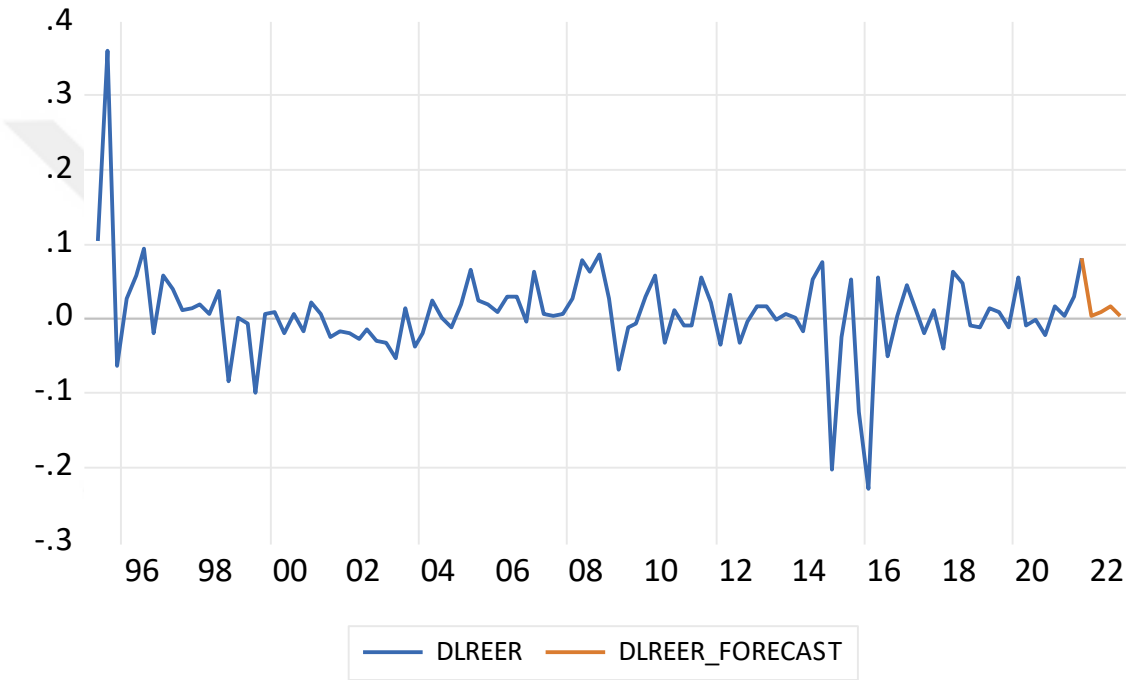


Figure 4.12 2022Q1 – 2022Q4 Forecasting Graph with ARCH (1) Model

4.4 Modelling Estimation of the Volatility of the Changes in the Rates of Real "Brent" Oil Prices (POIL)

In this section, conditional variance models will be modeled by applying them to the POIL data. The real "Brent" oil prices values published on the U.S. Energy Information Administration website constitute the data set used in the application of this study. Student Lite version of the EViews 12 package program was used to perform the analyzes and get volatility values.

4.4.1 Univariate Time Series Properties of POIL

The logarithmic values of the real "Brent" oil prices data set were also taken to eliminate various unit roots and other negativities. It is feasible to see the graph of logarithms of the real "Brent" oil prices (LPOIL) from Figure 4.13.

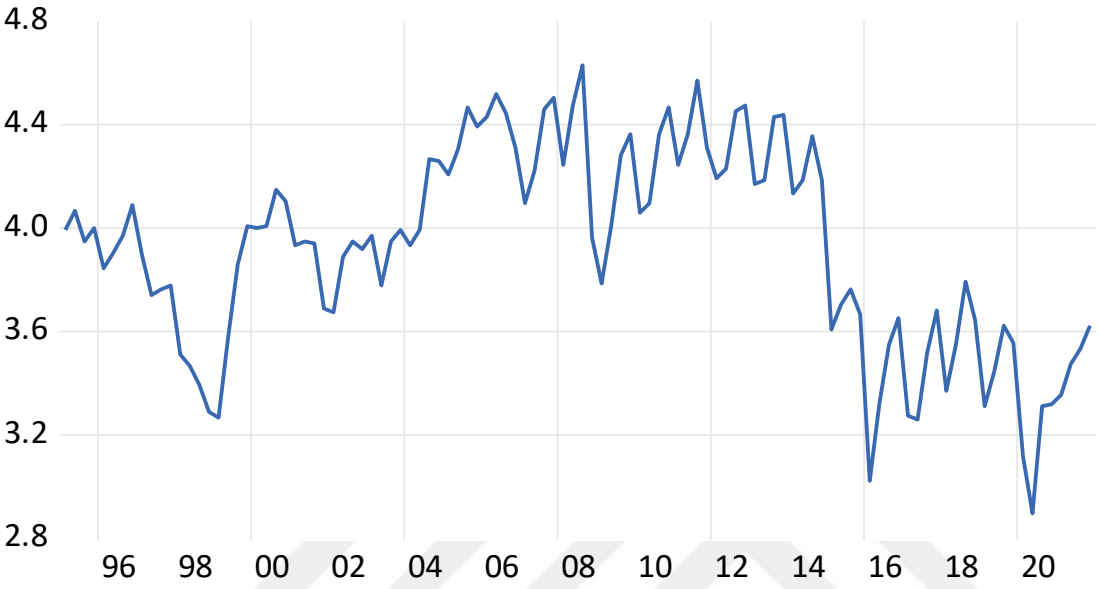


Figure 4.13 Logarithmic Series of the Real "Brent" Oil Prices

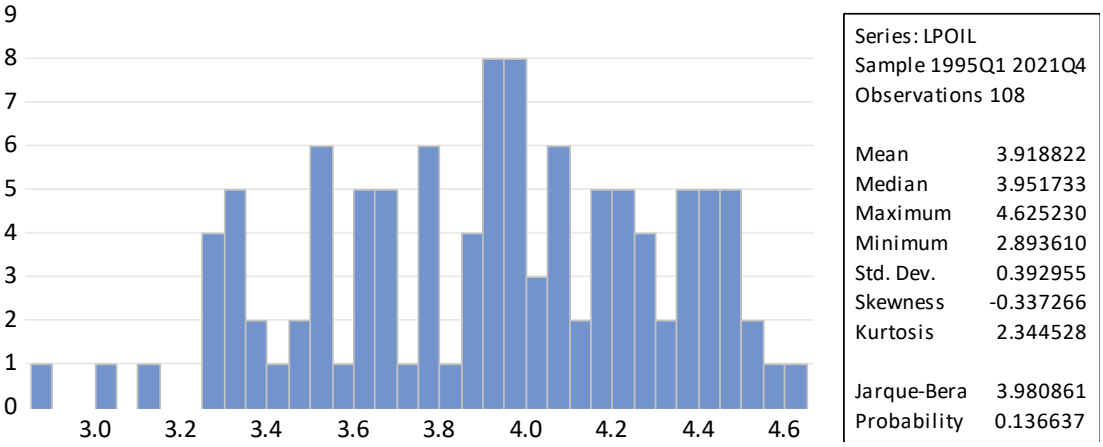


Figure 4.14 Descriptive Statistics of the LPOIL Series

The observations of the statistical features of the LPOIL series presented in Figure 4.14 can be listed as follows; the kurtosis value is 2.344; the skewness value was found

to be -0.337 roundly for the specified period. The statistical probability value of the "Jarque-Bera" criterion cannot reject the H_0 hypothesis, which is the "normal distribution" hypothesis.

4.4.2 Stationarity

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were used to investigate whether the quarterly logarithmic series of the LPOIL is stationary. ADF and PP test statistics obtained for the series whose stationarity was investigated are given in Table 4.11.

Table 4.11 Unit Root Test

	ADF test			
LPOIL	Levels		First Difference	
	Constant	Constant + trend	Constant	Constant + trend
	0.2053	0.3949	0.0006	0.0040
	PP test			
LPOIL	Levels		First difference	
	Constant	Constant + trend	Constant	Constant + trend
	0.1010	0.2280	0.0000	0.0000

As can be easily seen from the table above, the LPOIL series is not stationary at the original level. According to the ADF and PP test statistics, the probability is greater than the 5% levels. Thus the null hypothesis is accepted, so it is decided that the LPOIL series is not stationary at the original level. The stationarity of the series is retested by taking the first difference of the LPOIL series. According to ADF and PP test statistics, the probability is less than 1% levels, the null hypothesis is rejected. That is, when the first difference of the LPOIL series is taken, it is decided that the LPOIL series is stationary.

We can see from Figure 4.15 and Figure 4.16 that the first differenced LPOIL (DLPOIL) series is stationary.

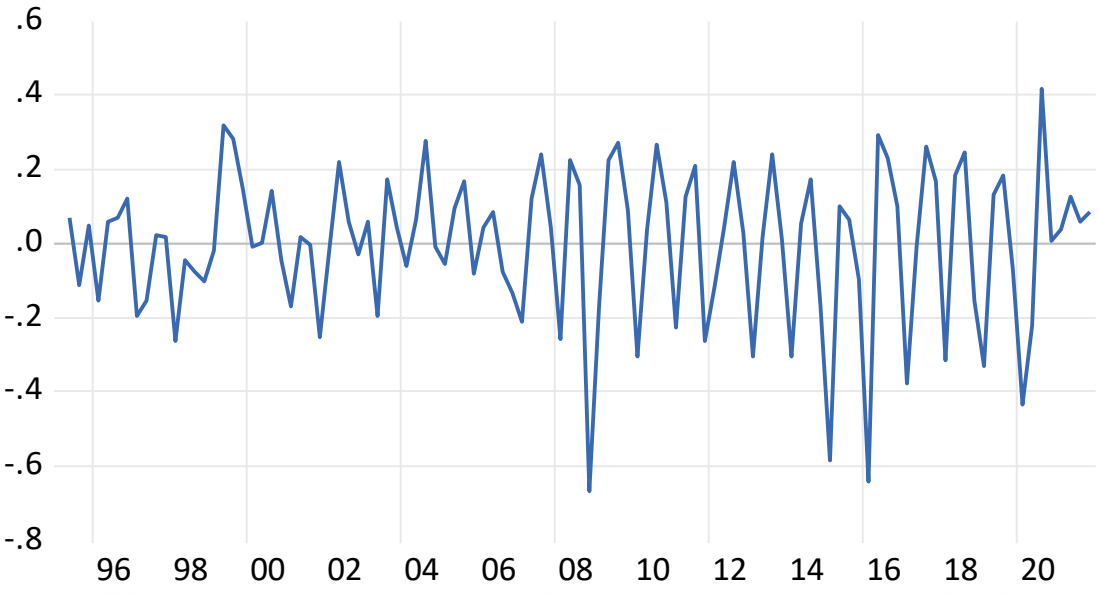


Figure 4.15 The Graph of DLPOIL Series

The observations of the statistical features of the DLPOIL series presented in Figure 4.16 can be listed as follows; the kurtosis value is 3.990; the skewness value found to be -0.863 roundly for the specified value of the "Jarque-Bera" criterion rejects the H_0 hypothesis, which is the "normal distribution" hypothesis.

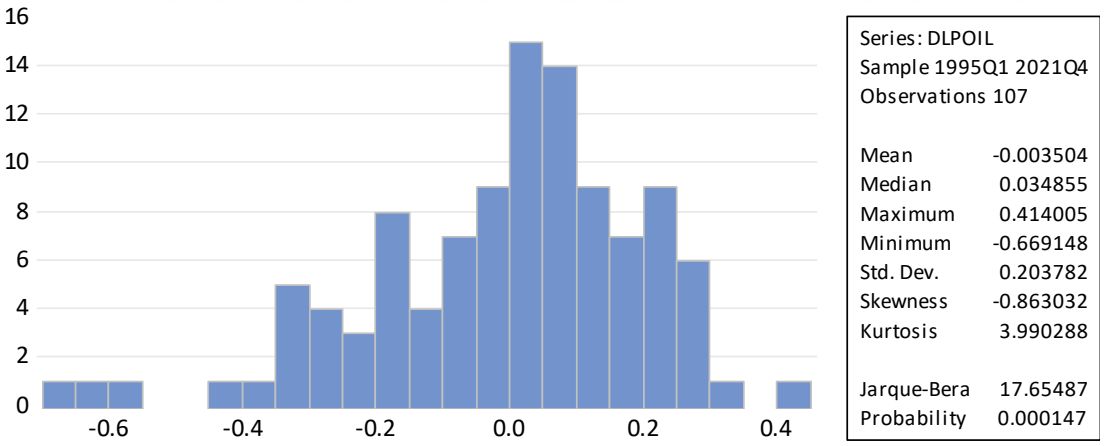
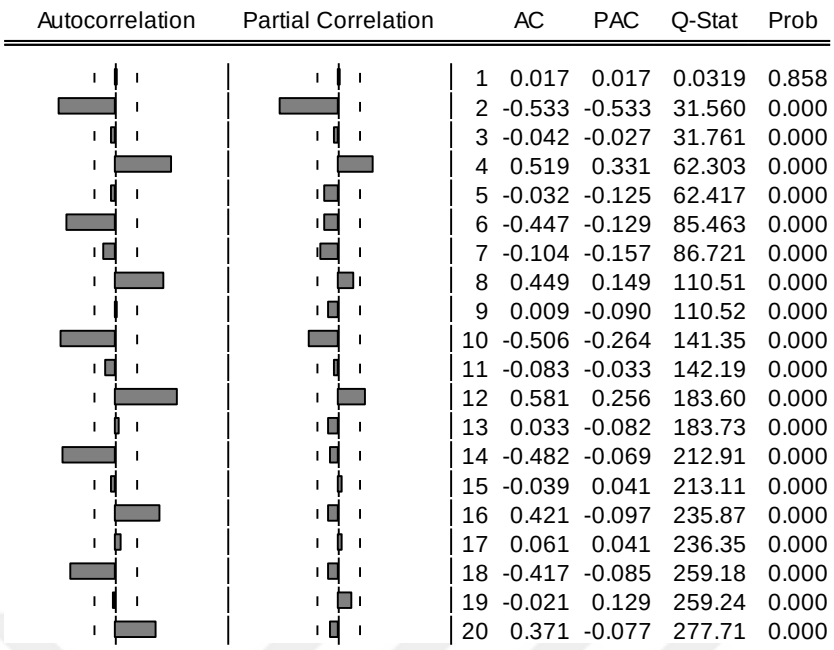


Figure 4.16 Descriptive Statistics of DLPOIL Series

Figure 4.17 represents that the autocorrelation (ACF) coefficients do not take very high values and do not show continuous reduction with the increase in the number of delays, also the partial autocorrelation (PACF) coefficients represent approximately the same direction as ACF coefficients. In this case, the series shows a stationary structure.



	AC	PAC	Q-Stat	Prob
1	0.017	0.017	0.0319	0.858
2	-0.533	-0.533	31.560	0.000
3	-0.042	-0.027	31.761	0.000
4	0.519	0.331	62.303	0.000
5	-0.032	-0.125	62.417	0.000
6	-0.447	-0.129	85.463	0.000
7	-0.104	-0.157	86.721	0.000
8	0.449	0.149	110.51	0.000
9	0.009	-0.090	110.52	0.000
10	-0.506	-0.264	141.35	0.000
11	-0.083	-0.033	142.19	0.000
12	0.581	0.256	183.60	0.000
13	0.033	-0.082	183.73	0.000
14	-0.482	-0.069	212.91	0.000
15	-0.039	0.041	213.11	0.000
16	0.421	-0.097	235.87	0.000
17	0.061	0.041	236.35	0.000
18	-0.417	-0.085	259.18	0.000
19	-0.021	0.129	259.24	0.000
20	0.371	-0.077	277.71	0.000

Figure 4.17 The Correlogram of the DLPOIL Series

4.4.3 Estimation of the Volatility Models for DLPOIL

After making variables stationary, it is necessary to determine the most suitable model for the structure of the series by using the DLPOIL series as the next step. Moreover, the prediction method with specific diagnostics will help to reveal the best-predicted model in terms of conditional variance. Finally, after comparisons, we forecast the variable's values for the upcoming four quarters.

4.4.3.1 Estimation of the Mean Equation for DLPOIL

The most suitable model for the series structure will be determined by trying different degrees of ARMA models.

By looking at the correlogram of the time series from Figure 4.17, we determine which of the MA (q), AR (p), or ARMA (p, q) processes fit the DLPOIL series.

Thus, when the correlogram created using the autocorrelation function (ACF) and partial correlation function (PACF) of the DLPOIL series examined, the peaks in the 1st and 2nd lags in the autocorrelation and partial autocorrelation functions are remarkable. Accordingly, it would be healthier to decide by examining the alternative model estimates from the table below.

Table 4.12 Appropriate Model Selection Results for DLPOIL Series

Models	R^2	AIC	SIC	Log likelihood	SigmaSQ
ARMA (1,1)	0.0461	-0.3247	-0.2248	21.37	0.0392
ARMA (1,2)	0.1749	-0.4681	-0.3681	29.04	0.0339
ARMA (2,1)	0.2857	-0.6085	-0.5086	36.55	0.0293
ARMA (2,2)	0.4544	-0.8604	-0.7605	50.03	0.0224

The results of the tested models estimated for the DLPOIL series given in Table 4.12 were evaluated according to the criteria which were used in model estimation for the DLREER. In order to test the suitability of the model, whether the residuals produced by the model have white noise characteristics should be checked with the figure given below.

When the correlogram of the error terms in Figure 4.18 is examined, it is seen that most of the autocorrelation and partial autocorrelation coefficients are within the 95% confidence interval. This result confirms our knowledge that the model is suitable.

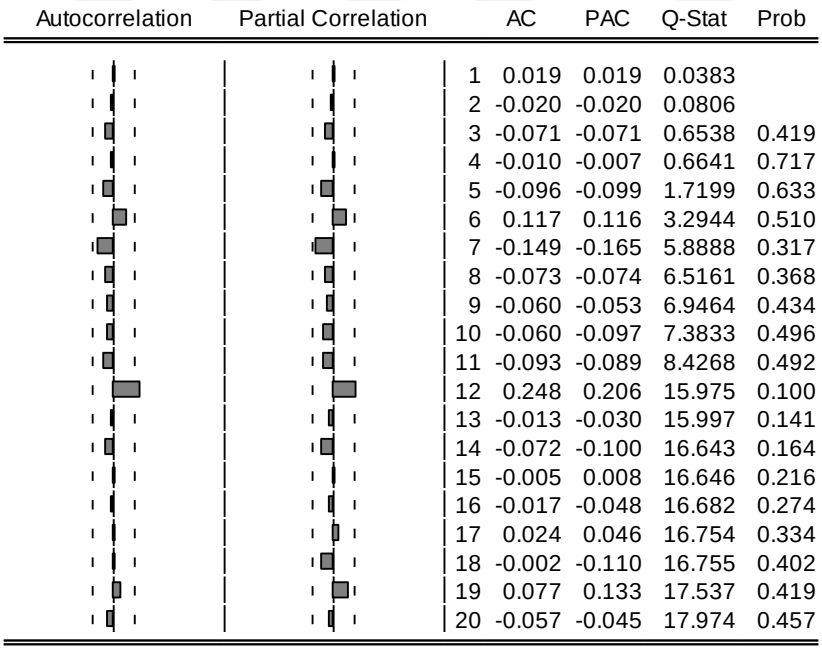


Figure 4.18 Correlogram of the Residuals of the DLPOIL ARMA (2, 2) Model

The model estimated according to the least-squares results in Table 4.13 is successful in terms of certain evaluation criteria and the relevance of the parameters other than the constant.

Table 4.13 Estimation Results of the DLPOIL ARMA (2, 2) Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004796	0.015389	-0.311656	0.7559
AR(2)	-0.987127	0.026750	-36.90165	0.0000
MA(2)	0.854873	0.098143	8.710474	0.0000
SIGMASQ	0.022444	0.002481	9.047869	0.0000

R-squared	0.454434	Mean dependent var	-0.003504
Adjusted R-squared	0.438544	S.D. dependent var	0.203782
S.E. of regression	0.152695	Akaike info criterion	-0.860454
Sum squared resid	2.401523	Schwarz criterion	-0.760535
Log likelihood	50.03427	Hannan-Quinn criter.	-0.819948
F-statistic	28.59824	Durbin-Watson stat	1.954386
Prob(F-statistic)	0.000000		

In order to determine whether the established ARMA model is stable, some tests, such as inverse roots of the AR polynomial and AR polynomial modulus, were used. None of the inverse roots of the AR Polynomial are outside the unit circle, as can be shown in Figure 4.19.

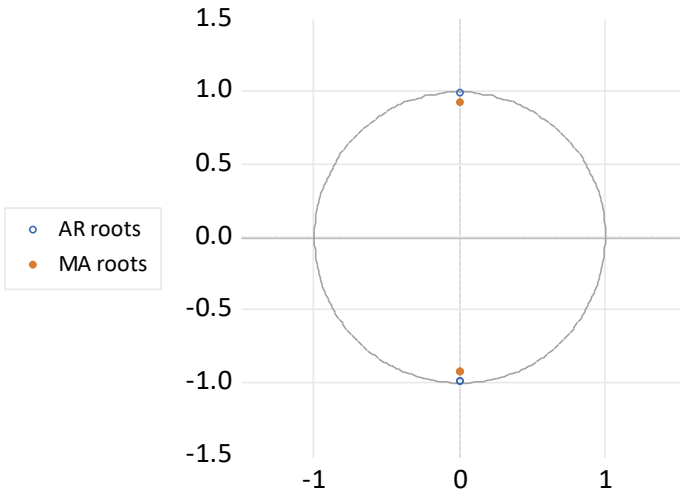


Figure 4.19 Inverse Roots of AR/MA Polynomial of the DLPOIL ARMA (2, 2) Model

4.4.3.2 Investigation of the ARCH Effect for the Mean Equation of DLPOIL

After the tests, the ARCH-LM test was also applied in order to determine whether the DLPOIL series has an ARCH effect. The optimum lag number for the ARCH-LM test was found using the Akaike information criterion (AIC) with the lag length minimizing the numerical value.

Table 4.14 Lag Length for the DLPOIL Series with ARCH-LM AIC Values

Lag length	AIC
1	-3.411
2	-3.384
3	-3.357
4	-3.351
5	-3.324

According to Table 4.14, the minimum value was given by the 1st lag length. When compared according to the Akaike information criterion, the optimal length is one. Since the values tend to decrease after the 1st delay length, the AIC values after the 5th delay were not examined.

Table 4.15 ARCH-LM Test Result for the DLPOIL ARMA (2, 2) Model

Heteroskedasticity Test: ARCH

F-statistic	0.530380	Prob. F(1,104)	0.0480
Obs*R-squared	0.537837	Prob. Chi-Square(1)	0.0433

The ARCH-LM test for the DLPOIL series is performed for the 1st lag length. Probability values showed that the series exhibited conditional variable variance, which is less than the 5% level. According to the results of the ARCH-LM test conducted to determine the volatility in the DLPOIL index, it has serial volatility. For this, volatility will be tried to be modeled with suitable ARCH/GARCH models.

4.4.3.3 Autoregressive Conditional Variance Equations of DLPOIL

The tests for the DLPOIL series are ARCH (1), GARCH (1.1), and E-GARCH (1.1), respectively. All tests were compared according to Gaussian (normal), Student's-t, and GED distribution methods to find the best distribution using the Akaike information criterion and other important indicators.

The results of the ARCH (1) estimation model (Table 4.16) with the GED distribution method is better than other methods. Therefore, it would be better to consider this method as a reliable model among them.

Table 4.16 Results of Models for the DLPOIL Series

	Methods	**AIC**	**SIC**	**Log likelihood**	**Heteros-cedasticity**	**Auto-correlation**
ARCH (1)	*Gaussian*	-0.830	-0.704	48.60	No	No
	Student's-t	-0.858	-0.706	51.04	No	No
	GED	-0.920	-0.760	54.33	No	No
GARCH (1.1)	*Gaussian*	-0.352	-0.200	24.48	No	No
	Student's-t	0.028	0.205	5.48	No	Yes
	GED	-0.901	-0.724	54.32	No	No
E-GARCH (1.1)	*Gaussian*	-0.937	-0.769	56.71	No	No
	Student's-t	-0.927	-0.725	56.69	No	No
	GED	-0.927	-0.724	56.67	No	No

According to the table above, the results for GARCH (1.1) model with the GED distribution method are more attractive than others. However, due to the unmatched required constraints of the GARCH value, it would be better to use the Gaussian method in considering the model.

The results of the E-GARCH (1.1) model represent that because of the high Log-likelihood and information criteria values in results with the Gaussian method, it would be quite clear to choose results with Gaussian method.

According to the comparison results, Gaussian (normal) method in the GARCH and E-GARCH estimation models and the GED distribution method in ARCH, the E-GARCH estimation models are suitable.

4.4.3.4 Comparisons of the Variance Equations for DLPOIL

According to the results, E-GARCH (1.1) model, which is modeled and reported for the DLPOIL series with volatility, it is seen that there is no ARCH effect in the newly established model, and Akaike values also, other indicators show the suitability of this model. From this point of view, it is seen that the E-GARCH (1.1) model interprets the existing volatility most appropriately.

Table 4.17 Necessary Indicators of Models

	ARCH (1) **GED**	**GARCH (1.1)** **Gaussian**	**E-GARCH (1.1)** **Gaussian**
AIC	-0.920	-0.352	-0.937
SIC	-0.760	-0.200	-0.769
Log likelihood	54.33	24.48	56.71

Table 4.18 Estimation Results of DLPOIL E-GARCH (1.1) Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.012061	0.010997	1.096671	0.2728
AR(2)	-1.027737	0.006234	-164.8662	0.0000
MA(2)	0.947652	0.031325	30.25239	0.0000
Variance Equation				
C(4)	-3.939090	1.146179	-3.436714	0.0006
C(5)	-0.942317	0.228495	-4.124009	0.0000
C(6)	0.113688	0.163495	0.695364	0.0068
C(7)	-0.195772	0.288411	-0.678796	0.0172
R-squared	0.455434	Mean dependent var		-0.003165
Adjusted R-squared	0.444757	S.D. dependent var		0.205330
S.E. of regression	0.153001	Akaike info criterion		-0.937372
Sum squared resid	2.387748	Schwarz criterion		-0.769441
Log likelihood	56.71203	Hannan-Quinn criter.		-0.865676
Durbin-Watson stat	1.919968			

The E-GARCH model, which is the constrained version of ARMA (p, q) models and obtained to show the effect of shocks on volatility asymmetrically, is as follows:

$$DLPOIL_t = 0.012061 - 1.027737 \times DLPOIL_{t-1} + 0.947652 \times \varepsilon_{t-1} \qquad (4.9)$$

$$Ln\,\sigma_t = -3.939090 - 0.942317 \times ln\,\sigma_{t-1} + 0.113688 \times \left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - 0.195772 \times \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (4.10)$$

Since the coefficient of γ, which shows the negative relationship between volatility and return, is different from zero with a value of 0.113, the existence of the asymmetric effect has been proven.

Table 4.19 ARCH-LM Test Result for E-GARCH (1.1) Model

Heteroskedasticity Test: ARCH

F-statistic	0.248757	Prob. F(1,102)	0.6190
Obs*R-squared	0.253018	Prob. Chi-Square(1)	0.6150

After all this process, according to Table 4.19, to measure the success of the E-GARCH (1.1) model, the ARCH-LM test was performed, and the result was that there was no ARCH effect. In other words, the established GARCH (1.1) model was found to be very successful in estimating the volatility of the rate of change in the real "Brent" oil prices.

4.4.4 Estimating Model for the DLPOIL Series with Prediction Method and Diagnostics

In terms of predicting the unexpected volatility of the DLPOIL, the examinations on which model makes the best estimation were made by estimating the remaining observations by excluding the last four observation values. For this, "the Root Mean Squared Error (RMSE), the Mean Absolute Error (MAE), and the Mean Absolute Percent Error (MAPE), the Theil Inequality Coefficient values" were compared. Values with dynamic criteria were examined.

Table 4.20 Necessary Indicators of Models with Prediction Method

DYNAMIC Forecast	RMSE	MAE	MAPE	Theil inequality	SIC
ARCH (1)	0.2885	0.2447	512.32	0.7788	-0.815
GARCH (1.1)	0.2733	0.2360	489.35	0.7756	-0.550
E-GARCH (1.1)	0.2658	0.2309	477.14	0.7726	-1.021

From the literature, we use the statistics from that volatility model to ahcieve best model with the following measures:

- lowest Schwarz Information Criterion;
- lowest Root Mean Squared Error (RMSE);
- lowest Mean Absolute Error (MAE);
- lowest Mean Absolute Percent Error (MAPE);
- highest Theil's Inequality Coefficient.

According to the values in Table 4.20, the E-GARCH (1.1) model was found to be the model that best predicted the DLPOIL series since it was found to be smaller than other models for SIC values. Finally, the standard deviation and variance graphs of the E-GARCH (1.1) model were drawn below.

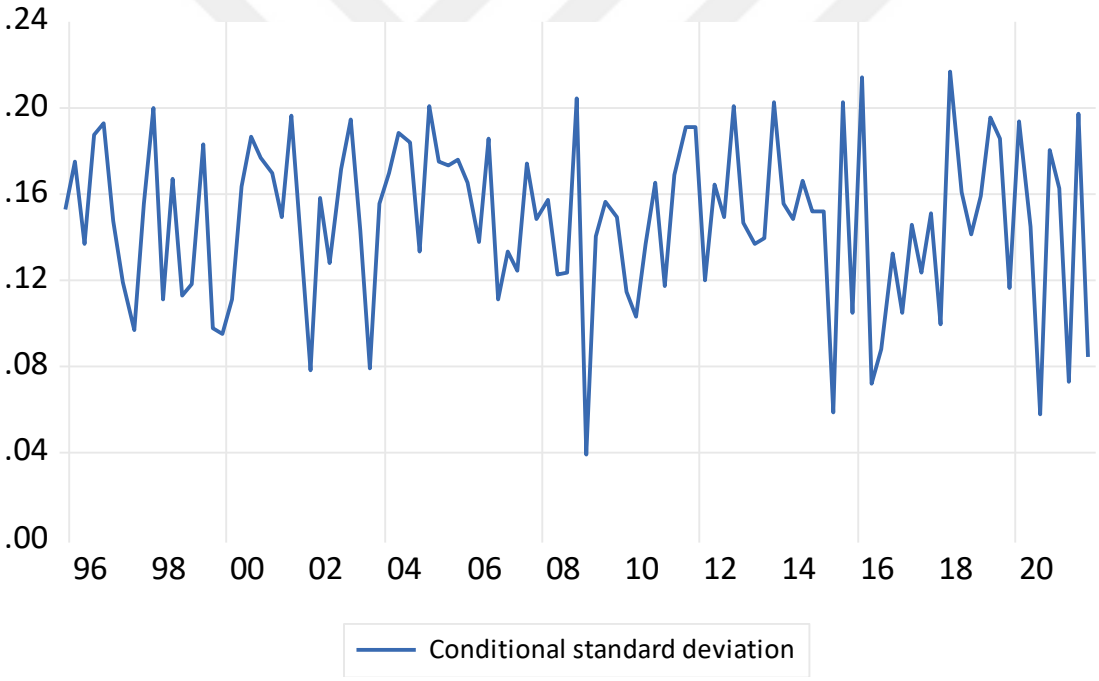


Figure 4.20 Conditional Standard Deviation Graph for the DLPOIL Series E-GARCH (1.1) Model

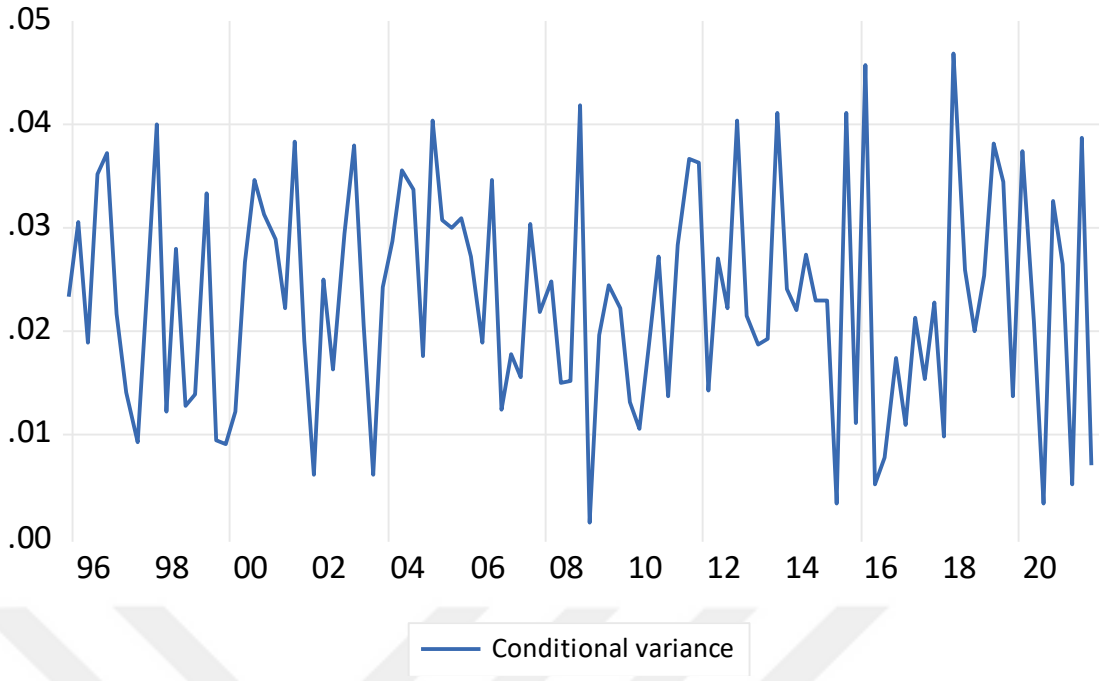


Figure 4.21 Conditional Variance Graph for the DLPOIL Series E-GARCH (1.1) Model

The variance prediction and conditional standard deviation of the E-GARCH (1.1) model from the figures given above are very close to each other. It is seen that the volatility of the DLPOIL series represents high fluctuations because of constantly volatile oil prices.

4.4.5 Predicting the DLPOIL Series for Next 4 Quarters

By finding the best model, it is possible to forecast the DLPOIL series for future quarters. According to Figure 4.22, the blue line shows 2022Q1 – 2022Q4 values for the DLPOIL series, which stands stable along the zero line.

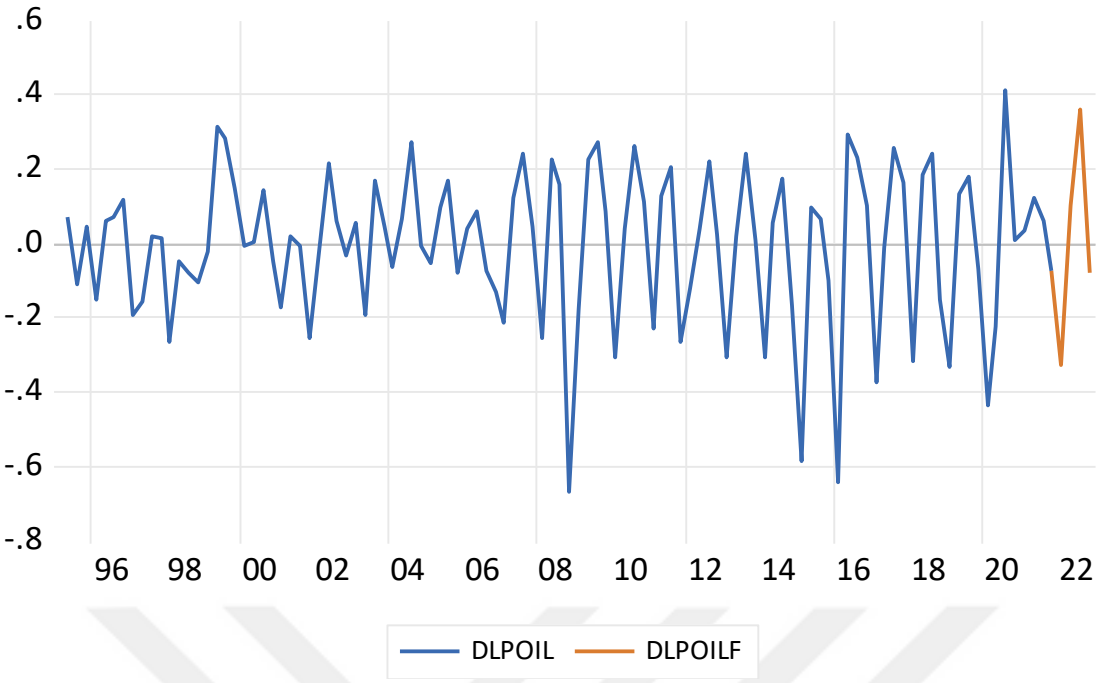


Figure 4.22 2022Q1 – 2022Q4 Forecasting Graph with E-GARCH (1.1) Model

4.5 Conclusion

In this chapter, employing the real effective exchange rate and the real "Brent" oil price variables, conditional variance models are modeled by the support of the student lite version of the EViews 12 program.

First, the stationarity of the series, time path graphs, and correlograms were examined and tested with ADF and PP unit root tests. For non-stationary series, stationarity was obtained by taking first-order differences. By evaluating the autocorrelation and partial autocorrelation functions of the series together, the most suitable ARMA models for the series were determined. Whether there is an ARCH effect on the error terms of these determined models was tested with the ARCH-LM test, and ARCH-GARCH models were obtained for the data with the ARCH effect. After determining the most suitable ARCH-GARCH model, the ARCH-LM test was applied to the residuals, and it was investigated that the ARCH effect disappeared in the series. Also, estimating the best model with the prediction method was used for the variables separately. Finally, the volatility graphs of the series were evaluated, and the graph of prediction for the next four quarters was represented.

The ARMA (3, 4) and ARMA (2, 2) models, which were found to be statistically significant, were determined as the most suitable model for the DLREER and DLPOIL series, which became stationary after the first difference was taken. As a result of the ARCH-LM test applied for the error terms of this model, it was revealed that there is an ARCH effect on the errors. In order to eliminate this effect, ARCH-GARCH models with different values have been tried. The most suitable ARCH-GARCH model to eliminate this effect is the ARCH (1) model and E-GARCH (1.1) model for the DLREER and the DLPOIL variables, respectively. The suitability of these models was again tested with the ARCH-LM test, and it was found that the ARCH effect disappeared in the series of errors. Moreover, choosing the best models for the series of the DLREER and the DLPOIL tries an alternative method: the prediction method. This method, furthermore, gave the same results got from Autoregressive conditional variance equations. It has been observed that the conditional standard deviation and variance prediction graphs examined with the ARCH and E-GARCH models are similar.

Overall, as a result of these implementations, we got the volatility values of the DLREER and the DLPOIL series in order to use them in VAR econometric analysis in the next chapter.

CHAPTER 5

VAR MODELLING OF AZERBAIJAN'S FOREIGN TRADE INTEGRATING OIL PRICES AND EXCHANGE RATES

5.1 Introduction

In this chapter, we want to find out the relationship between GDP growth, export growth, import growth, and the impact of growth rates of real effective exchange rates and oil prices on them. In order to interpret the results, I employed the VAR model to show the direct effect of variables on another, the Impulse Response Functions constructed. The results of this analysis cleared some situations for Azerbaijan's economy and are mainly similar to the condition of the economy nowadays.

It is known from previous chapters that oil prices have a huge impact on the economy of Azerbaijan since crude oil and oil products are the main exports of Azerbaijan, such as on total exports, the oil exports' share is over 80% for most of the years. This kind of dependency on economy makes us analyze the impact of oil price variable separately over other variables. However, as oil prices are mainly not dependent on Azerbaijan's crude oil production and there are some countries where their huge oil production to world markets directs the prices, we used oil prices as an exogenous variable in the analysis. Therefore, oil price is considered an exogenous variable, but others as an endogenous variables in the constructed VAR model. In order to detect the graphs that represent the positive and negative relationships with oil price growth and other variables, the Dynamic Multiplier functions wereused in this chapter because of including oil price as an exogenous variable in the VAR model. Moreover, to determine the relationship between endogenous variables, IRFs were employed in Stata 12 program.

The rest of the chapter is organized as follows: Sections 2 and 3 explain the data and methodology used in this article. Section 4 is the main part of this article and gives information about empirical analysis and findings from VAR model. This section includes determining optimal lag length for the VAR model, stability checking for the VAR model, Granger causality WALD test, Impulse Response functions of endogenous variables, Dynamic multiplier functions of oil price growth, and Forecast error variance decompositions of endogenous variables. Section 5 concludes the chapter.

5.2 Data

In the study, the relationship between imports, exports, REER, oil prices, and GDP were analyzed by considering quarterly data in the period 2001Q1 – 2020Q4. Since the number of observations must be at least 30 to perform a time series analysis, the results were obtained by performing an econometric analysis with quarterly data between these periods. Moreover, the other reason I choose this time frame is the availability of the quarterly data.

The data on GDP is real and in millions of U.S. dollars. I downloaded it from the State Statistical Committee of the Republic of Azerbaijan (AZSTAT). The export and import also are real and in millions of U.S. dollars. I collected this data from the Central Bank of Azerbaijan Republic (CBAR) Balance of Payments publications. The REER is a weighted average of the value of the Azerbaijani manat in relation to the U.S. Dollar, with inflation impacts taken into account. It is an indicator of trade competitiveness, such as an increase in the nation's REER makes exports valuable and imports cheaper. The data on REER loaded from the "Bruegel" database. Next, quarterly data for "Brent" crude oil prices are published on the U.S. Energy Information Administration (EIA) webiste in dollar terms. Because all variables are not in real terms, GDP Deflator is used to convert them to real terms. Data for the GDP deflator is also published on the CBAR website and is open source. 2010 Q4 is taken as the base year while converting to real terms. Since the series have substantial values in the analysis, all variables are expressed in logarithmic values. EViews 12 and Stata 12 package programs were used in the calculations.

5.2.1 Variables

All variables used in this chapter are included along with their descriptions in Table 5.1.

Table 5.1 Variables

Variables	Explanation
LGDP	Logarithm of real Gross Domestic Product (in US dollars)
DLGDP	First difference of LGDP: Growth rate of real GDP
LIMP	Logarithm of real imports (in US dollars)
DLIMP	First difference of LIMP: Growth rate of real imports
LEXP	Logarithm of real exports (in US dollars)
DLEXP	First difference of LEXP: Growth rate of real exports
LREER	Logarithm of real effective exchange rate (Manat/Dollar)
DLREER	First difference of LREER: Growth rate of real effective exchange rate
LPOIL	Logarithm of real "Brent" oil prices (in US dollars)
DLPOIL	First difference of LPOIL: Growth rate of real "Brent" oil prices

5.3 Methodology

I will go over my approach in this part, which entails the subsequent actions:

- Test unit root of five-time series;
- Construct a five-variable VAR model;
- VAR diagnostics;
- Granger causality WALD test;
- Dynamic simulation (impulse response function, dynamic multipliers, and variance decomposition).

As it is known, when a variable's mean, variance, and autocovariance remain constant across time, this is known as stationary. The stationarity is essential in time series following a stochastic process. Potential shocks in stationary series will only last a short while. "The shock effect will gradually decrease, and the series will return to its long-term average level. In non-stationary series, on the other hand, there will be no

long-term means to which the series can return after the shock." The stationarity of the series is determined by the unit root test (Sevüstekin, 2010). The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests were used to test whether the series is stationary. After checking stationarity, we will be used to construct a five-variable VAR.

The five-variable standard VAR model of order p comes next (unstructured form). "VAR models allow us to analyze the interdependencies between these variables by employing multiple time series in one model" (Lütkepohl, 2005). My empirical strategy is based on a linear VAR model (Sims, 1980) of order p in conjunction with various endogenous variables, which can be written in its reduced form as follows:

$$y_t = \delta + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + u_t \quad (5.1)$$

where $y_t = (y_{1t}, y_{2t}, \ldots, y_{kt})$ is a K dimensional vector of endogenous variable, while y_{t-i} is the relative lag values of order i. δ stands for the K dimensional constant terms, A_i are the i^{th} $(K * K)$ coefficient matrices of vector y_{t-i} for $i = 1, 2, \ldots, p$, u_t $(u_{1t}, u_{2t}, \ldots, u_{nt})$ is the K dimensional white noise process which is the vector of unobservable i.i.d. (identically and independently distributed) zero mean error term.

According to Shin and Pesaran (1998), the model has to satisfy the conditions such as:

- The roots of the characteristic polynomial have to be inside in the unit circle;
- The modulus of the roots of the characteristic polynomial has to be less than 1.

To check whether the assumptions of our VAR model are met, the following tests should be implemented:

- Lag order selection;
- VAR residual serial correlation LM test;
- VAR residual normality.

According to Enders (2003), "the model will be misspecified when the lag length is too small. The more lags, the more parameters we need to estimate and the less bias in our results. The model will be overparameterized if the number of lags is too large". "There are two approaches: lag order selection based on the LR test; and lag order selection based on information criteria such as AIC (Akaike's Information Criteria),

FPE (Final Prediction Error), SC (Schwarz criterion), HQ (the Hannan & Quinn (1979) criterion)" (Lütkepohl, 2005).

However, "it is expected that different criteria give a different number of maximum lag lengths. The problem is which criteria we should choose. To overcome this problem, we should run VAR with different lag orders, chosen by different criteria, and then implement the VAR residual serial correlation LM test and the residual normality test" (Lütkepohl, 2005). The lag order must pass those conditions in order to be appropriate.

We should use the Granger causality (WALD) test to determine the causality between the time series. "This test detects whether the lags of one variable can granger-cause any other variables in the VAR system. The null hypothesis is that all lags of one variable can be excluded from each equation in the VAR system" (Enders, 2003).

Based on this test, we do not know whether or not export growth and import growth have a positive or negative effect on GDP growth. It also needs to be clarified whether or not the impact of export growth on GDP growth is stronger than that of import growth on GDP growth. To answer these questions, we analyze the impulse response functions (for endogenous variables), dynamic multipliers (for exogenous variable), and the variance decomposition.

Shin and Pesaran defined the impulse response function: "An impulse response function measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamic system". "Also, Cholesky decomposition is one of the frequently used methods for determining the impulse response functions, verticalizing the errors, and making the variance-covariance matrix cross (diagonal)" (Phillips, Tzavalis 2007).

As an impulse response function, the dynamic multipliers determine the effect of shocks on response variables at a given period. But the difference from IRF is that the dynamic multipliers make it possible to find out the response of endogenous variables to the shock on exogenous variables.

To determine the reasons of the changes in the variables, variance decomposition was performed, and the analysis was concluded. According to enders (2003), "variance decomposition tells how much a given variable changes under the impact of its shock and the shock of other variables. Therefore, the variance decomposition defines the relative importance of each random innovation with affecting the variables in the VAR".

5.4 Empirical Analysis and Findings of VAR Model (DLEXP, DLGDP, DLIMP, DLREER, DLPOIL)

In this section, the steps such as the determination of lag length, the modulus of roots of the autoregressive characteristic polynomial, the position of inverse roots of AR characteristic polynomial in the unit circle, VAR model, Granger Causality Wald test, Impulse Response Functions, Dynamic Multiplier Functions, and Forecast Error Variance Decomposition are examined in this analysis."

5.4.1 Stationarity

It will be determined whether the variables employed in the time series are stationary at the time in order to conduct statistical analysis. The series must be stationary since non-stationary data will lead to an incorrect regression issue and improper series estimation. By taking the first and second differences, non-stationary series should become stationary. The stationary of the series was evaluated using the ADF and PP unit root tests.

Table 5.2 below provides the results of the unit root testing. The tests used with both a constant and a constant with the trend, and reported the stationarity test in both levels and in the first difference. The fact that the test statistic value is higher than the MacKinnon critical value at 1%, 5%, and 10% significance levels indicates that the series becomes stationary when the 1st difference is taken, which is our H_1 hypothesis.

Table 5.2 Unit Root Test of the Variables

Variables	Levels		First difference		Decisions
	constant	constant + trend	constant	constant + trend	
ADF test					
LGDP	0.3485	0.9267	0.0869	0.0408	I (1)
LEXP	0.2759	0.8253	0.0271	0.0103	I (1)
LIMP	0.0107	0.1534	0.0000	0.0001	I (0)
LPOIL	0.7467	0.6715	0.0000	0.0000	I (1)
LREER	0.5872	0.6779	0.0012	0.0031	I (1)
PP test					
LGDP	0.0824	0.2325	0.0001	0.0001	I (1)
LEXP	0.4522	0.9163	0.0000	0.0001	I (1)
LIMP	0.0000	0.0000	0.0001	0.0001	I (0)
LPOIL	0.8382	0.8005	0.0000	0.0000	I (1)
LREER	0.4493	0.2486	0.0000	0.0000	I (1)

Conducted the ADF and PP tests represented that GDP, export, oil price, and the REER variables are only supported to be stationary in the first difference I (1). But the import variable is stationary in level I (0) and also in the first difference I (1). As a result, the series is stationary and does not contain a unit root.

5.4.2 Optimal Lag Length

It is important to determine the optimal lag length for the VAR model estimation to be healthy.

Table 5.3 Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	220.9741	NA	2.60e-08	-6.111947	-5.984472*	-6.061255
1	243.4064	41.70502	2.17e-08	-6.293137	-5.655763	-6.039674
2	263.2970	34.73857	1.96e-08	-6.402733	-5.255459	-5.946498
3	304.4011	67.15593	9.76e-09	-7.109889	-5.452715	-6.450884
4	347.0432	64.86408*	4.71e-09	-7.860372	-5.693298	-6.998595*
5	364.3265	24.34261	4.70e-09*	-7.896520	-5.219546	-6.831972
6	376.4610	15.72361	5.53e-09	-7.787633	-4.600760	-6.520315
7	396.5059	23.71509	5.33e-09	-7.901574*	-4.204801	-6.431484
8	411.6738	16.23611	6.06e-09	-7.878136	-3.671463	-6.205275

There is an accepted rule which indicates that if the data is monthly, it is feasible to use 12 as an optimal lag while the data frequency is quarterly and yearly; optimal lag is 4 and 1, respectively. As it is seen from the table above, the optimal lag length according to Schwarz Information Criterion (SIC) is 1, Hannan-Quinn Information Criterion (HQ) and the Likelihood Ratio (LR) test statistic is 4, the Final Prediction Error (FPE) is 5, but according to Akaike Information Criteria (AIC), the optimal lag length is 7. As a result of Table 5.3, based on the AIC criterion, I will employ seven lags when estimating the VAR system.

5.4.3 Stability of VAR Model and Autocorrelation

Here, I will run a few simple tests on the model to determine its level of specification. The inverse roots of the AR characteristic polynomial must first be verified in order to confirm that this model is one that has been adequately stated.

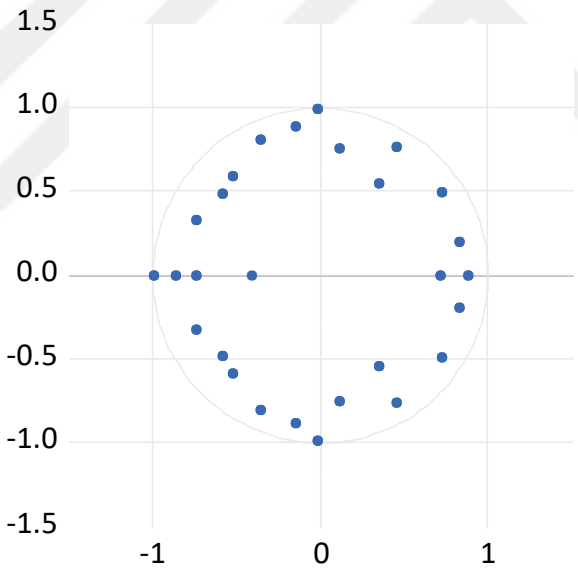


Figure 5.1 Inverse Roots of AR Characteristic Polynomial

The position of the inverse roots of the AR characteristic polynomial belonging to the supposed model within the unit circle reveals that there are no stability issues with this model.

Moreover, it is seen from Table 5.4 that the modulus of all roots is less than 1, which confirms the stability of the estimated VAR model.

Table 5.4 VAR Eigenvalue Stability Condition Test

Root	Modulus
-0.013081 - 0.990430i	0.990516
-0.013081 + 0.990430i	0.990516
-0.988142	0.988142
-0.145795 + 0.887237i	0.899136
-0.145795 - 0.887237i	0.899136
0.886209	0.886209
0.454988 - 0.760316i	0.886055
0.454988 + 0.760316i	0.886055
0.731953 + 0.496469i	0.884442
0.731953 - 0.496469i	0.884442
-0.353653 - 0.805435i	0.879657
-0.353653 + 0.805435i	0.879657
0.832797 + 0.198383i	0.856100
0.832797 - 0.198383i	0.856100
-0.854658	0.854658
-0.736186 + 0.325261i	0.804838
-0.736186 - 0.325261i	0.804838
-0.514838 + 0.585121i	0.779375
-0.514838 - 0.585121i	0.779375
0.120517 - 0.751229i	0.760835
0.120517 + 0.751229i	0.760835
-0.581195 + 0.487345i	0.758481
-0.581195 - 0.487345i	0.758481
-0.736238	0.736238
0.719152	0.719152
0.351004 - 0.542566i	0.646205
0.351004 + 0.542566i	0.646205
-0.407167	0.407167

The next step is to determine whether autocorrelation exists. An autocorrelation test should be carried out to determine whether the VAR model has a structural error. You may determine how much of an effect previous values of variables have on their future values by testing for autocorrelation. It is possible to determine whether the VAR model exhibits any autocorrelation by using the Lagrange Multiplier (LM) test.

The null hypothesis states no autocorrelation at lag order (h). Based on the p-values in Table 5.5, I cannot reject the null hypothesis at all lag orders because of more than 5% level.

Table 5.5 VAR Residual Serial Correlation LM Test

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	19.24380	16	0.2562	1.228952	(16, 110.6)	0.2577
2	19.57055	16	0.2401	1.251604	(16, 110.6)	0.2416
3	18.37387	16	0.3024	1.168950	(16, 110.6)	0.3040
4	12.26378	16	0.7256	0.759246	(16, 110.6)	0.7267
5	11.56206	16	0.7735	0.714148	(16, 110.6)	0.7744
6	13.08083	16	0.6668	0.813281	(16, 110.6)	0.6680
7	28.72330	16	0.0959	2.095664	(16, 110.6)	0.0961

The results of the White test, which tests whether the variance of the error term is constant in all variables, that is, the problem of varying variance, are given in the table below.

Table 5.6 VAR Residual White Heteroskedasticity Test

Chi-sq	df	Prob.
570.7482	580	0.6001

According to the White test results for the varying variance, the p-value of the test is greater than 5%, and the H_0 hypothesis, which has no varying variance, is accepted. As a result, each variable in the model does not have the problem of varying variance.

Another requirement for consistent results in the VAR model is the normal distribution of residuals. For this, the "Jarque-Bera" test is applied. The test results are given in the table below.

Table 5.7 VAR Residual Normality Test

Component	Jarque-Bera	df	Prob.
1	2.661941	2	0.1204
2	4.885177	2	0.0869
3	3.000239	2	0.2231
4	0.265389	2	0.8757
Joint	10.812746	8	0.3225

When Table 5.7 is examined, the "Jarque-Bera" test statistic shows that, according to "Cholesky verticalization", under 2 degrees of freedom, the error residuals of variables are normally distributed. The p-values of the "Jarque-Bera" test statistic are greater than the 5% significance level, and the H_0 hypothesis is accepted as the error terms have a normal distribution.

5.4.4 Granger Causality WALD Test

The Granger causality test was used to determine the causality relationship among variables employed in VAR analysis. The results obtained with the Granger causality tests are as follows:

H_0 : "*X* is not the Granger cause of *Y*".
H_1 : "*X* is the Granger cause of *Y*".

Table 5.8 Granger Causality Test (WALD)

Equation	***Excluded***	***Chi-sq***	***df***	***P-value***
DLEXP	DLGDP	10.664	7	0.154
DLEXP	DLIMP	5.5467	7	0.594
DLEXP	DLREER	7.9015	7	0.341
DLEXP	ALL	24.176	21	0.285
DLGDP	DLEXP	20.054	7	0.005
DLGDP	DLIMP	14.950	7	0.037
DLGDP	DLREER	11.227	7	0.029
DLGDP	ALL	71.614	21	0.000
DLIMP	DLEXP	18.166	7	0.011
DLIMP	DLGDP	19.309	7	0.007
DLIMP	DLREER	9.0758	7	0.247
DLIMP	ALL	65.941	21	0.000
DLREER	DLEXP	13.991	7	0.039
DLREER	DLGDP	13.648	7	0.045
DLREER	DLIMP	10.784	7	0.148
DLREER	ALL	61.443	21	0.000

According to Table 5.8, only the following hypotheses can be rejected in 5% significance level as a result of the Granger causality test:

- "Growth in exports" does not cause "growth in GDP";
- "Growth in imports" does not cause "growth in GDP";
- "Growth rate of the REER" does not cause "growth in GDP";
- "Growth in exports" does not cause "growth in imports";
- "Growth in GDP" does not cause "growth in imports";
- "Growth in exports" does not cause "growth rate of the REER";
- "Growth in GDP" does not cause "growth rate of the REER".

It is seen that there is a unidirectional causality running from export growth to GDP growth, from export growth to import growth, and from export growth to the growth rate of the REER. Moreover, bidirectional causality maintains its effect between GDP growth and import growth, between GDP growth and the growth rate of the REER. According to the table above, the H_0 hypothesis is rejected between these variables due to the less than 5% significance level.

5.4.5 Impulse Response and Dynamic Multiplier Functions

The purpose of this chapter is to find out the relationships between export growth, GDP growth, and import growth, moreover, the impact of the growth rate of real effective exchange rate and real oil price on export-import growth and GDP growth. It would be useful to determine the response of export-import growth and GDP growth when the shocks are introduced to themselves, DLREER and DLPOIL.

In order to identify the impulse responses, the "Cholesky decomposition method" suggested by Doan (1992) is employed here to introduce shocks to the variables. I assessed the confidence interval for the impulse reponse functions (IRFs) to be 95% as a measure of significance. The impulse responses' prediction period are 4 steps (1 year). "The middle line in the impulse response figure represents the impulse response function, and the dotted lines above and under represent the confidence interval" (Doan 1992).

Figure 5.2 depicts the Orthogonalized IRFs of GDP growth and import growth after the one-unit shock introduced in export growth. According to the figure below, the response of GDP growth to the one-unit shock in export growth shows an increasing direction in 1st quarter then we see a decrease in the response line in 2nd quarter. In the following quarters, the impulse line mainly maintains its effect in the positive section. It is clearly seen from the figure below that the response is significant at the end of 1st period and positive. This finding matches the result from Granger Causality test which mentions a causality running from export growth to the GDP growth with a 1% significance level.

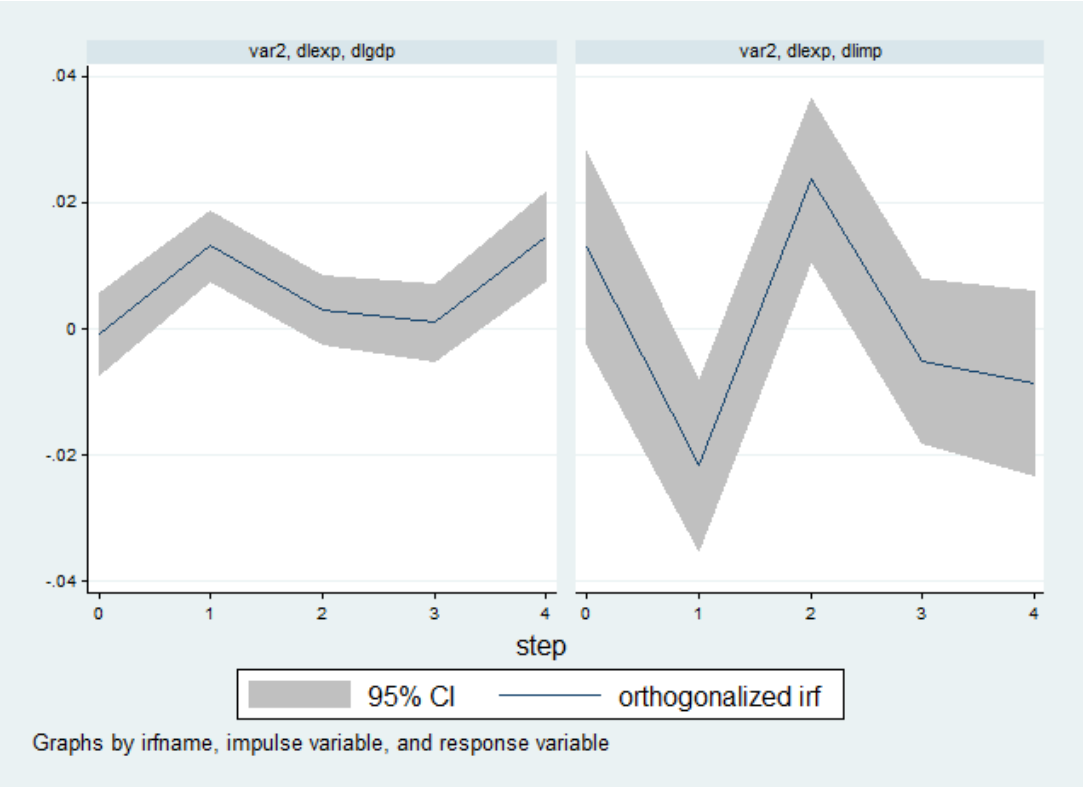


Figure 5.2 Orthogonalized IRFs of GDP Growth and Import Growth Against the Shock in Export Growth

When a one-unit shock is introduced to the export growth, the response of import growth represents a sharp decrease till the end of 1st quarter, then the direction of response changes in a positive way and increases. The following quarters show a reduction till the end of periods in response to import growth. This response is also significant at the end of 1st period and negative in the short term. This finding matches

the result from the Granger Causality test which mentions a causality running from export growth to the import growth with 5% significance level.

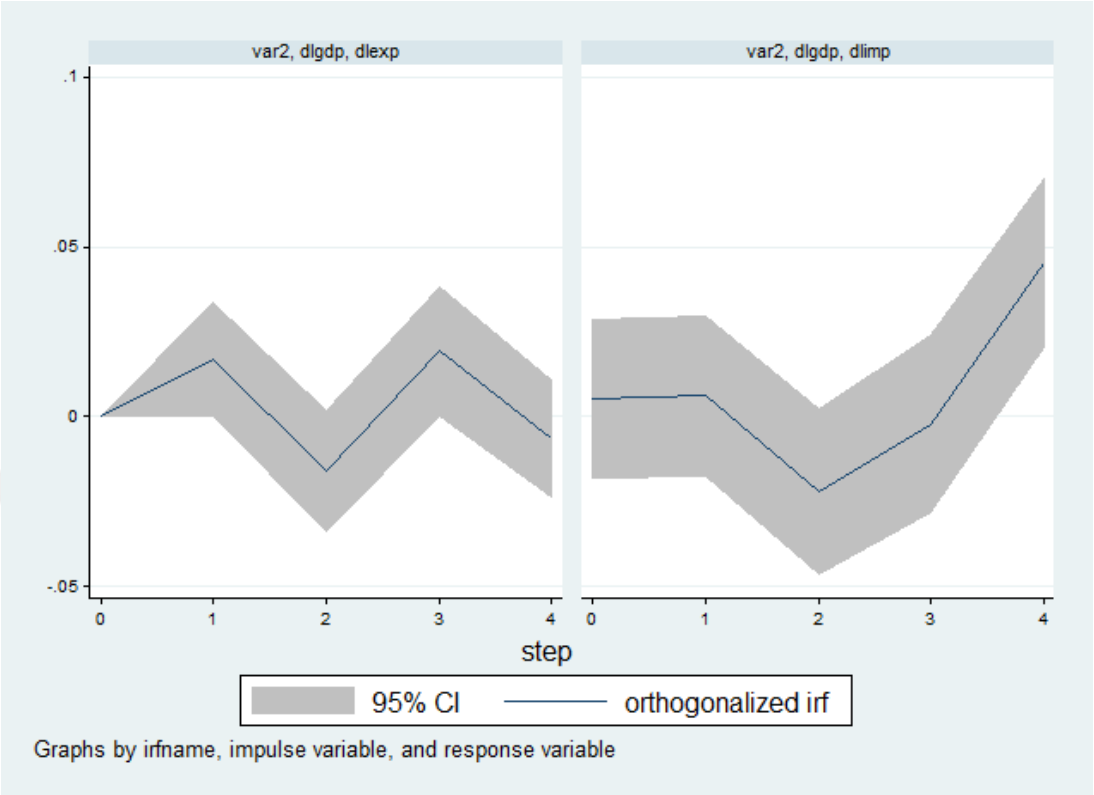


Figure 5.3 Orthogonalized IRFs of Export Growth and Import Growth Against the Shock in GDP Growth

Now we are looking for the graphs of the response of export growth and import growth to the one-unit shock in GDP growth. According to the GDP growth shock, the response of export growth represents instant increase in 1st quarter, and then a decrease follows this increase. For the next quarter, the response line fluctuates unclearly around the zero line. It is seen from the figure above that the response is insignificant. This finding matches with the result from the Granger Causality test, which mentions there is not causality running from GDP growth to export growth.

When there is a GDP growth shock, the response of import growth stays stable during 1st quarter and decreases slightly till 2nd quarter. But until 4th quarter, the response line shows positive growth and passes the zero line with reaching positive section till the end of the periods. This response, however, is significant at the end of 4th period and

positive. This finding matches the result from Granger Causality test which mentions a causality running from GDP growth to the import growth with 1% significance level.

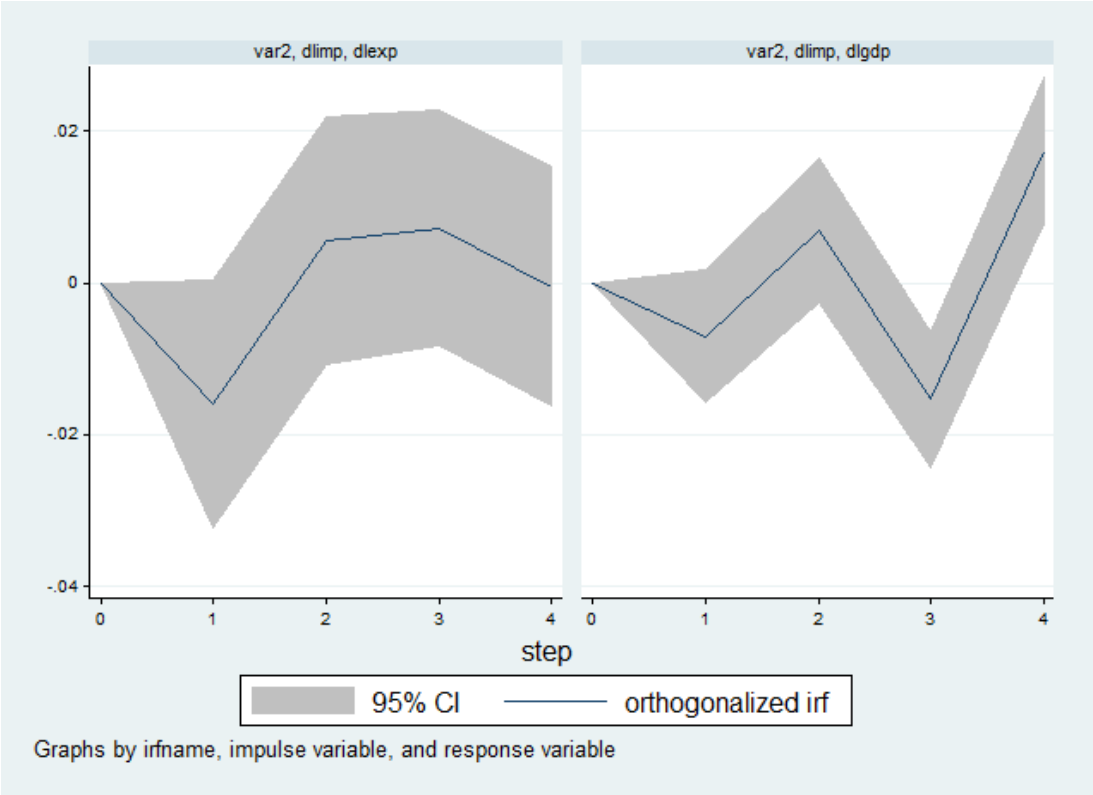


Figure 5.4 Orthogonalized IRFs of Export Growth and GDP Growth Against the Shock in Import Growth

The next IRFs are about the responses of export growth and GDP growth to the shock in import growth. According to the response of export growth, until the end of 1st quarter, we observe a decline in the response with its lowest level. Between the 1st and 3rd quarters, real export growth increases to the positive section, then the decreasing trend follows the increasing segment. The figure above represents that the response is insignificant. This finding matches the result from the Granger Causality test, which mentions there is no causality running from import growth to export growth.

The response of GDP growth to the shock in import growth shows the same direction in the impulse line during first 2 quarters. After 2nd quarter, we see a sharp decline in response towards negative section till the end of 3rd quarter. Then strong growing trend changes the direction of response to the positive section with passing zero line. As it is seen, this response is significant at the end of 3rd period and negative in the short

term. This finding matches the result from the Granger Causality test which mentions a causality running from GDP growth to import growth with 5% significance level.

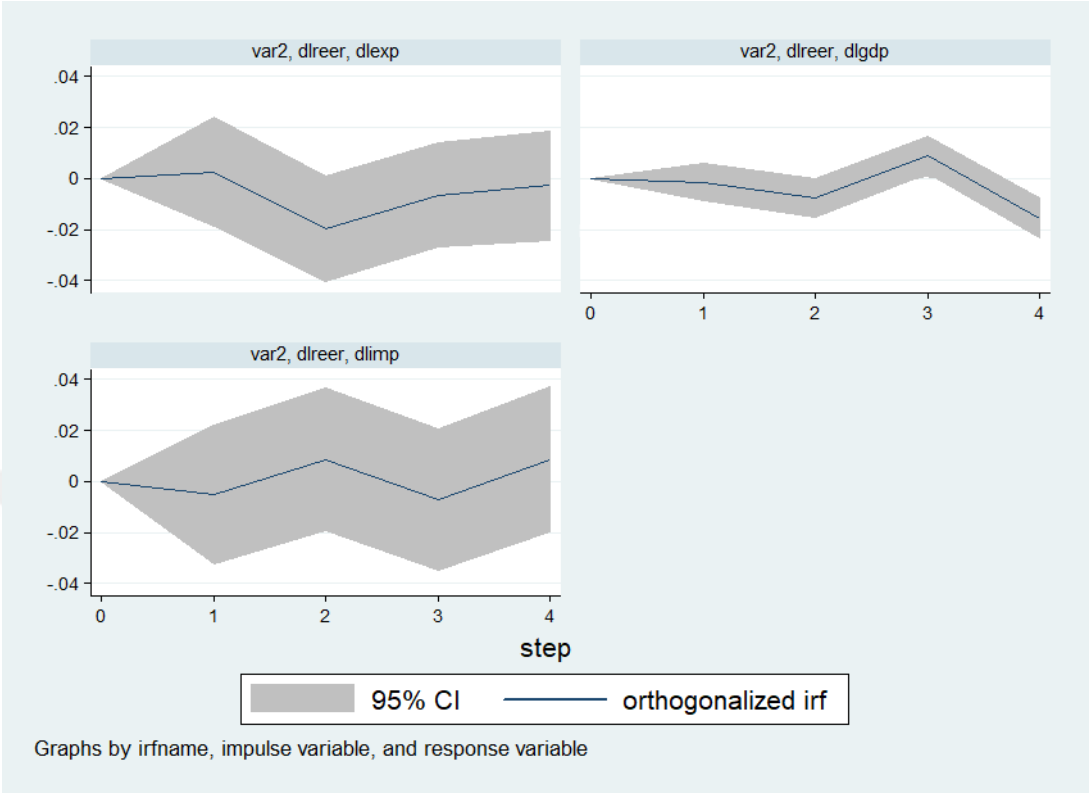


Figure 5.5 Orthogonalized IRFs of Export Growth, GDP Growth and Import Growth Against the Shock in Growth Rate of Real Effective Exchange Rate

After analyzing the relationships and the responses of import-export growth and GDP growth to each other, the next variable is the growth rate of real effective exchange rate (DLREER). In Figure 5.5, the IRFs was introduced in order to find out the impact of one standard deviation innovation in DLREER on export growth, GDP growth, and import growth together.

According to the figure above, the responses of export growth and import growth mainly represent the same results, such as the responses maintain stable till the end of 1st period, then fluctuates along the zero line till the end of 3rd period and show an increasing trend at last period. Both responses are insignificant and match with the results from the Granger Causality test, which mentions there is no causality running from DLREER to the export growth and running from DLREER to the import growth.

On the other hand, it is seen from Figure 5.5 that the response of GDP growth to the DLREER shock starts from the zero line and slightly decreases till the end of 2nd quarter. Then the increasing trend substitutes the previous declining trend. From 3rd quarter till the end, the sharp reduction maintains its effect on response by passing the zero line to the negative section. It is clearly seen from the figure above that the response is significant in the end of 4th period and negative. This finding matches with the result from the Granger Causality test, which mentions there is a causality running from DLREER to the GDP growth with 5% significance level.

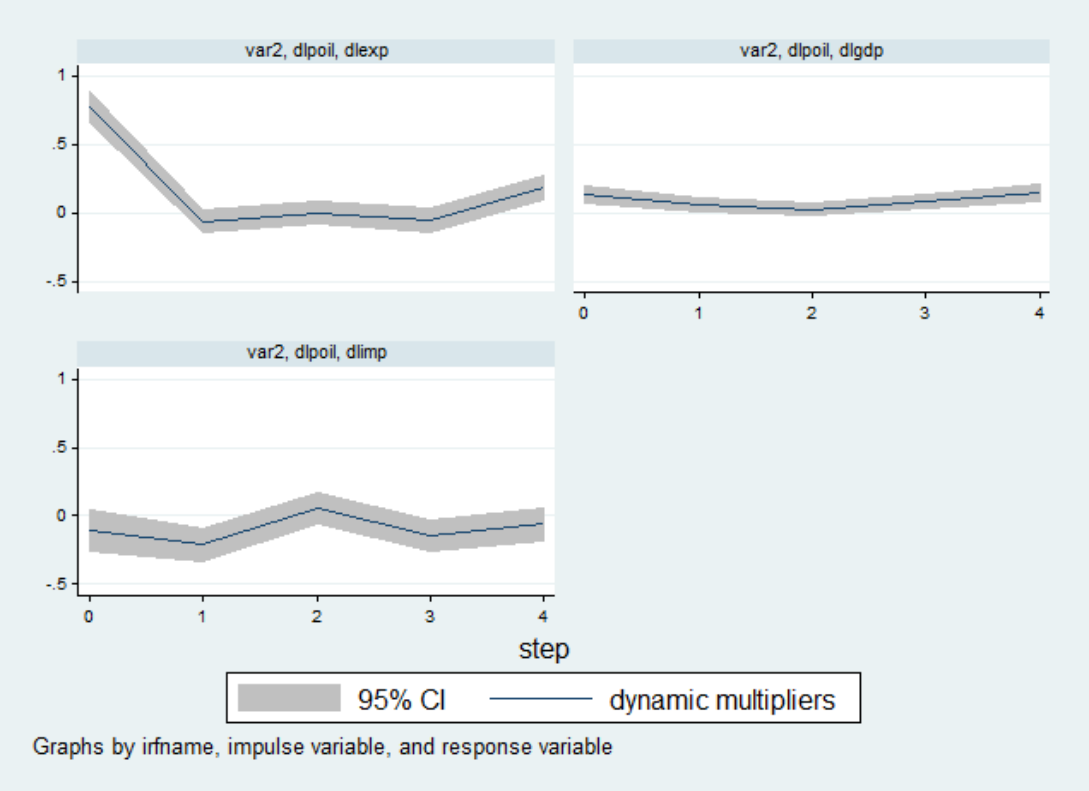


Figure 5.6 Dynamic Multipliers Functions of Export Growth, GDP Growth and Import Growth Against the Shock in Growth Rate of Real Oil Price

Because the oil price growth (DLPOIL) variable is the exogenous variable in our VAR model, it is feasible to determine its shock on other variables with the help of dynamic multiplier functions. The IRFs mainly present the relationships among endogenous variables.

Figure 5.6 depicts the dynamic multiplier functions of export growth, GDP growth, and import growth after one standard deviation innovation in DLPOIL variable. It is

seen that the responses of export growth and GDP growth to the shock in DLPOIL are significant and start from the positive section, and the positive sign continues till the end of 1st quarter. Later, the responses maintain stable and ended up with gradual increase starting from 3rd quarter.

When there is a one-unit shock in DLPOIL variable, the response of import growth represents a diminishing direction till the end of 1st quarter, reaching its lowest level. Starting from 2th quarter, we see gradual increasing for next quarter. Then the response fluctuates along the zero line. It is seen from the figure above that the response is significant at the end of 1st period and negative.

Overall, after the investigation of these figures, we say that determining the clear sign of the response of variables to the shock in other variables is possible in the short term. In order to find out the clear impact, we are looking for significant responses such as:

- one-unit shock in export growth resulted in a positively on the response of GDP growth and a negatively on the response of import growth;
- one-unit shock in GDP growth resulted in a positively on the response of import growth;
- one-unit shock in import growth resulted in a negatively on the response of GDP growth;
- one-unit shock in growth rate of the REER resulted in a negatively on the response of GDP growth;
- one-unit shock in oil price growth resulted in a positively on the responses of export growth and GDP growth and a negatively on the response of import growth.

Additionally, I have to contend that insignificant responses are not considered reliable impacts. It has to be informed that the results attained from these IRFs and dynamic multipliers functions match clearly with the results presented Granger Causality test.

5.4.6 Variance Decomposition Analysis

Variance decomposition is obtained from the VAR model and expresses the shocks that the endogenous variables cause on themselves and other endogenous variables as

a percentage. In other words, it expresses how many percent of changes in the variables are due to other variables. Variance decomposition analysis results are represented in Table 5.9 below. The prediction periods of variance decompositions are set to 8 periods.

Table 5.9 Cholesky Forecast Error Variance Decompositions for VAR Model

Response variables	Period	Impulse variables			
		DLEXP	DLGDP	DLIMP	DLREER
DLEXP	1	99.78	0.03	0.09	0.00
	2	95.13	1.32	2.20	1.28
	4	93.21	2.27	2.54	1.98
	6	92.94	2.69	2.26	2.10
	8	90.33	4.18	3.19	2.37
DLGDP	1	0.00	74.97	0.21	24.73
	2	3.27	72.30	0.40	24.15
	4	5.23	64.92	3.27	26.52
	6	8.93	52.39	11.28	27.13
	8	11.25	50.12	12.61	26.06
DLIMP	1	6.00	0.17	93.83	0.00
	2	13.88	0.59	84.26	1.28
	4	17.37	2.45	76.11	4.06
	6	17.09	7.71	71.60	3.59
	8	18.00	10.24	67.49	4.27

The results represented in the table above depict that each variable maintains its self-explanatory rate in a high percentage. However, during the time periods, this self-explanatory rate shows a decreasing trend. For instance, it is seen that the explanatory rate of export growth by itself is roundly 91% at the end of the period. The second variable that explains the export growth more than others is GDP growth, with roundly 4% at the end of the period. Only roundly 3% of the variance in export growth is due to import growth and DLREER. The results show that variables other than export growth itself have not clear effects on variations in export growth. This situation matches the results of impulse response functions.

Table 5.9 interprets that the self-explanatory rate of GDP growth is 50% at the end of the period. DLREER is the second variable that explains GDP growth with high percentage than others. In contrast, it was determined that the explanatory rate of import growth and export growth is roughly 13% and 11% in the 8^{th} quarter,

respectively. These results are similar to those from the impulse response analysis in that all variables have clear impacts on variations in GDP growth. This situation matches the results of impulse response functions.

As a next one, considering the import growth variable, explanatory rate of import growth itself is 67% at the end of the period. The 2nd biggest impact rate belongs to export growth with 18%. In the 8th period, 10% of the variance in the import growth is explained by GDP growth and 4% variance belongs to the DLREER. Findings represent that variables rather than DLREER have a clear impact at the end of the period. This situation matches with the results of impulse response functions.

5.5 Conclusion

In this part of the thesis, we presented the impact of variables such as export growth, GDP growth, and import growth on each other and clarified the impact of oil price growth and growth rate of real effective exchange rate on those variables over the quarterly period 2001-2020.

In order to find an effective relationships among variables, we constructed the VAR model. Variables included in the VAR model as endogenous variables, only growth rate real "Brent" oil prices (DLPOIL) included as an exogenous variable. After being certain of the stability tests of the VAR model, the Granger causality WALD test provided us with the possibility and direction of the relationship between variables. As a next step, the Impulse Response Functions were studied to determine the responses of export-import growth and GDP growth to the shock each other, the responses of those variables to the one standard deviation in the DLREER. Moreover, with the help of Dynamic Multipliers functions, the effect of one standard deviation in DLPOIL as an exogenous variable on export-import growth and GDP growth was examined. Additionally, with investigating forecast error variance decompositions, the percent of changes in the export-import growth and GDP growth variables are expressed.

The results of VAR stability tests and autocorrelation tests indicate that constructed VAR for the model is quite reliable with significant test findings.

According to the result of the Granger causality WALD test, none variables are effective in explaining export growth, but there are causalities running from export growth to all variables with 5% significance level. Moreover, bidirectional causality maintains its effect between GDP growth and import growth, between GDP growth and growth rate of the REER with 5% significance level.

Interpretation of impulse responses reveals that in the short term:

- one-unit shock in export growth resulted in a positively on the response of GDP growth and a negatively on the response of import growth;
- one-unit shock in GDP growth resulted in a positively on the response of import growth;
- one-unit shock in import growth resulted in a negatively on the response of GDP growth;
- one-unit shock in growth rate of the REER resulted in a negatively on the response of GDP growth.

As can be seen from the related figures, the results we get from the Granger test match with the results of IRFs. The results that we present in bullets are significant with 95% confidence level, otherwise, the IRFs are insignificant.

The variance decomposition analysis also supports our results in IRFs and Granger causality. Such as, more than 90% of changes belong to the export growth itself. The other variables' effect on export growth is insignificant. In GDP's variance decompositions, we see that each variable significantly impacts GDP growth towards the end of period. Moreover, in the variance decomposition of import growth, the findings present that rather than DLREER, the other variables have significant effects on import growth at the end of 8^{th} period. Commonly, the consequences of the variance decomposition analysis comply with the results of IRFs and the Granger causality test.

According to the results of dynamic multiplier graphs, the impact of oil price growth on export growth, GDP growth, and import growth are significant with 95% confidence level. Such as, a shock introduced to the oil price growth affect export growth and GDP growth positively, and import growth negatively for the short term.

CHAPTER 6

VAR MODELLING OF AZERBAIJAN'S FOREIGN TRADE INTEGRATING VOLATILITIES OF OIL PRICES AND EXCHANGE RATES

6.1 Introduction

After getting volatility values from chapter 4, in this chapter, we will find out the relationship between the volatilities of the rates of changes in oil prices (DLPOIL) and real effective exchange rate (DLREER), import-export growth, and GDP growth. In order to analyze the relationship between these variables, the VAR model was constructed. As a feature of this model, variables are applied as endogenous variables in the analysis process rather than the volatility of DLPOIL, which is an exogenous variable. With the help of the Granger Causality, Impulse Response Functions, Dynamic Multipliers, and Variance Decomposition, it was possible to reveal the effect of variables on each other. Because of the purpose of this chapter, we paid attention to the impact of variables, especially the volatilities of DLPOIL and DLREER on export growth, import growth, and GDP growth.

The rest of the chapter is organized as follows: Section 2 and 3, respectively, explains the data and methodology used in this article. Section 4 is the main part of this article and gives information about empirical analysis and findings from new VAR model. This section includes the stationarity of variables used in the construction of the VAR model, determining optimal lag length for VAR model, stability checking for the VAR model, Granger causality WALD test, Impulse Response functions of the volatility of DLREER, Dynamic Multiplier functions of the volatility of DLPOIL and Forecast error variance decompositions of the volatility of DLREER variable. Lastly, Section 5 concludes the chapter.

6.2 Data

The vital objective of this chapter is to analyze the impact of the volatilities of DLREER and DLPOIL on import-export growth, and GDP growth in Azerbaijan.

In this chapter, we use the same variable employed in chapter 5 in VAR analysis except for volatilities of DLREER and DLPOIL variables. Data, here, is also quarterly and contains the period between 2001 and 2020. In the analysis, all variables are real and expressed in logarithmic forms. Student lite version of Eviews 12 program, moreover, Stata 12 program was used in the calculation of analysis.

6.2.1 Variables

Table 6.1 shows all variables used in this section and their explanations.

Table 6.1 Variables

Variables	Explanation
LGDP	Logarithm of real Gross Domestic Product (in US dollars)
DLGDP	First difference of LGDP: Growth rate of real GDP
LIMP	Logarithm of real imports (in US dollars)
DLIMP	First difference of LIMP: Growth rate of real imports
LEXP	Logarithm of real exports (in US dollars)
DLEXP	First difference of LEXP: Growth rate of real exports
VOLPOIL	Volatility of the rate of change of the real "Brent" oil prices
VOLREER	Volatility of the rate of change of the real effective exchange rate

6.3 Methodology

In this section, the difference of the second VAR model is about replacing DLREER and DLPOIL variables with VOLREER and VOLPOIL variables in the analysis. I will review my strategy, which includes the following steps and is valid for analysis:

- Test unit root of time series;
- Construct a VAR model;
- VAR diagnostics;

- Granger causality test (WALD);
- Impulse Response Functions;
- Dynamic Multiplier Functions;
- Forecast Error Variance Decompositions.

Procedures for attaining the VAR model are similar to procedures in chapter 5; as a first step, testing the stationarity is possible with the help of the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests. After checking stationarity, it is time to construct the VAR model by finding the optimal lag length. In order to examine the stability of the VAR model, some stability tests should be implemented, such as:

- The modulus or graph of roots of the autoregressive characteristic polynomial;
- VAR residual serial correlation LM test;
- VAR residual normality test.

The Granger Causality Wald test was used to determine the causal relationship between various time series. With this way, it is feasible to examine whether one variable can explain the other or not. Moreover, in order to determine the response of endogenous variables to certain shocks, IRFs are used to obtain results. Additionally, to detect the response of variables to the impulse from exogenous variables, I represented the results of the Dynamic Multiplier graphs achieved from the Stata 13 program. After observing the relationship between variables, variance decompositions of each endogenous variable were interpreted.

6.4 Empirical Analysis and Findings of new VAR model (DLEXP, DLGDP, DLIMP, VOLREER, VOLPOIL)

In this section, the unit root test, determination of lag length, the position of inverse roots of AR characteristic polynomial in the unit circle, VAR model, Granger causality WALD test, Impulse Response analysis, Dynamic Multiplier Functions, and Variance Decomposition are examined.

6.4.1 Stationarity

The results of the unit root tests are presented in Table 6.2 below. I have reported the stationarity test in both levels and in the first difference and made use of the tests with both a constant and a constant with the trend. The fact that the test statistic value is higher than the MacKinnon critical value at 1%, 5%, and 10% significance levels indicates that the series becomes stationary when the 1st difference is taken.

Table 6.2 Unit Root Test of the Variables

Variables	Levels		First difference		Decisions
	constant	constant + trend	constant	constant + trend	
ADF test					
LGDP	0.3485	0.9267	0.0869	0.0408	I (1)
LEXP	0.2759	0.8253	0.0271	0.0103	I (1)
LIMP	0.0107	0.1534	0.0000	0.0001	I (0)
VOLPOIL	0.0001	0.0000	0.0000	0.0000	I (0)
VOLREER	0.0165	0.0274	0.0001	0.0001	I (0)
PP test					
LGDP	0.0824	0.2325	0.0001	0.0001	I (1)
LEXP	0.4522	0.9163	0.0000	0.0001	I (1)
LIMP	0.0000	0.0000	0.0001	0.0001	I (0)
VOLPOIL	0.0001	0.0000	0.0001	0.0001	I (0)
VOLREER	0.0000	0.0000	0.0001	0.0001	I (0)

The Augmented Dickey-Fuller and the Philips-Perron tests represent that import, volatility of DLPOIL, and volatility of DLREER are I (0). GDP and export are only supported to be stationary in the first difference I (1). In this case, it is seen that the H_0 hypothesis is rejected, while the H_1 hypothesis is not rejected. As a result, the series is stationary and does not contain a unit root. The cointegration test should not be performed since these series are not integrated at the same order.

6.4.2 Optimal Lag Length

The optimal lag length according to Schwarz Information Criterion (SIC) and the Hannan-Quinn Information Criterion (HQ) is 4, however, according to the Final Prediction Error (FPE), the Likelihood Ratio (LR) test statistic, and Akaike

Information Criteria (AIC), the optimal lag length is 6. As a result, based on the LR and AIC criterion, I will employ six lags when estimating the VAR system.

Table 6.3 Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	311.9835	NA	2.01e-09	-8.675592	-8.548117	-8.624899
1	335.6042	43.91444	1.62e-09	-8.890258	-8.252884	-8.636795
2	382.1954	81.37064	6.87e-10	-9.751984	-8.604709	-9.295749
3	426.4598	72.31920	3.14e-10	-10.54816	-8.890988	-9.889157
4	474.9313	73.73143	1.28e-10	-11.46285	-9.295781*	-10.60108*
5	490.8808	22.46401	1.33e-10	-11.46143	-8.784457	-10.39688
6	515.3928	31.76206*	1.10e-10*	-11.70121*	-8.514333	-10.43389
7	530.5643	17.94930	1.22e-10	-11.67787	-7.981093	-10.20778
8	545.5150	16.00367	1.40e-10	-11.64831	-7.441639	-9.975451

6.4.3 Stability of VAR Model and Autocorrelation

First step is about to check the inverse roots of AR characteristic polynomial.

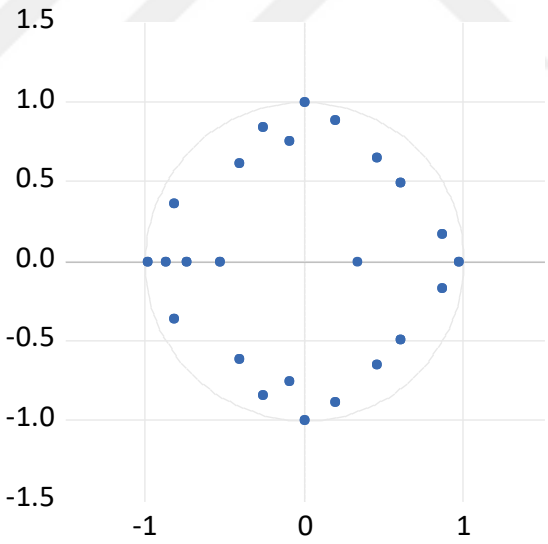


Figure 6.1 Inverse Roots of AR Characteristic Polynomial

The fact that none of the inverse roots of the AR characteristic polynomial is located outside the unit circle confirms that the established VAR system is stable. This situation reveals that the model does not have any problems in terms of stability.

The next step is to check for the presence of autocorrelation. In order to test whether the VAR model contains a structural problem, an autocorrelation test should be performed. By employing the Lagrange Multiplier (LM) test, it is possible to observe whether there is any autocorrelation in the VAR system.

Table 6.4 VAR Residual Serial Correlation LM Test

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	20.33939	16	0.2053	1.301295	(16, 125.9)	0.2064
2	11.36148	16	0.7866	0.702282	(16, 125.9)	0.7874
3	24.50631	16	0.0790	1.593366	(16, 125.9)	0.0797
4	14.72174	16	0.5451	0.921756	(16, 125.9)	0.5463
5	18.72283	16	0.2833	1.190428	(16, 125.9)	0.2845
6	16.79660	16	0.3989	1.060073	(16, 125.9)	0.4001

The null hypothesis states no autocorrelation at lag order (h). Based on the p-values in Table 6.3, I cannot reject the null hypothesis at all lag orders.

The results of the White test, which tests whether the variance of the error term is constant in all variables, that is, the problem of varying variance, are given in the table below.

Table 6.5 VAR Residual White Heteroskedasticity Test

Chi-sq	df	Prob.
518.5370	500	0.2742

According to the White test results for the varying variance, the p-value of the test is greater than 5%, and the H_0 hypothesis, which has no varying variance, is accepted. As a result, each variable in the model does not have the problem of varying variance.

Another requirement for consistent results in the VAR model is the normal distribution of residuals. For this, the “Jarque-Bera” test is applied. The test results are given in the table below.

Table 6.6 VAR Residual Normality Test

Component	Jarque-Bera	df	Prob.
1	1.511988	2	0.3974
2	1.437283	2	0.4677
3	0.432910	2	0.8053
4	1.446781	2	0.4510
Joint	4.828962	8	0.6055

When Table 6.5 is examined, the "Jarque-Bera" test statistic shows that, according to "Cholesky verticalization", under 2 degrees of freedom, the error residuals of variables are normally distributed. The p-value of the "Jarque-Bera" test statistic is greater than the 5% significance level, and the H_0 hypothesis is accepted as the error terms have a normal distribution.

6.4.4 Granger Causality WALD Test

The results obtained with the Granger causality test are as follows:

H_0 : "*X* is not Granger cause of *Y*".
H_1 : "*X* is Granger cause of *Y*".

According to Table 6.6, only the following hypotheses can be rejected at 5% significance level as a result of the Granger causality test:

- "Growth in exports" does not cause "growth in GDP";
- "Growth in imports" does not cause "growth in GDP";
- "Volatility of DLREER" does not cause "growth in GDP";
- "Growth in exports" does not cause "growth in imports";
- "Growth in GDP" does not cause "growth in imports";
- "Growth in exports" does not cause "volatility of DLREER";
- "Growth in GDP" does not cause "volatility of DLREER".

It is seen that there is not any causality running from the variables to export growth. However, there is a unidirectional causality running from export growth to GDP growth, from export growth to import growth, and from export growth to the volatility

of DLREER. Moreover, bidirectional causality maintains its effect between GDP growth and import growth, between GDP growth and volatility of DLREER.

Table 6.7 Granger Causality Test (WALD)

Equation	*Excluded*	*Chi-sq*	*df*	*P-value*
DLEXP	DLGDP	12.186	6	0.068
DLEXP	DLIMP	10.608	6	0.077
DLEXP	VOLREER	12.227	6	0.067
DLEXP	ALL	40.807	18	0.080
DLGDP	DLEXP	14.073	6	0.029
DLGDP	DLIMP	18.417	6	0.005
DLGDP	VOLREER	16.729	6	0.010
DLGDP	ALL	72.3	18	0.000
DLIMP	DLEXP	14.563	6	0.024
DLIMP	DLGDP	27.734	6	0.001
DLIMP	VOLREER	10.069	6	0.122
DLIMP	ALL	73.491	18	0.000
VOLREER	DLEXP	15.309	6	0.037
VOLREER	DLGDP	59.089	6	0.000
VOLREER	DLIMP	23.417	6	0.285
VOLREER	ALL	97.27	18	0.000

The main findings that we get from this table is about the causality of the volatility of DLREER. It is possible to see from the table that the volatility of DLREER causes only GDP growth. The volatility of DLREER is not effective in explaining import growth and export growth.

6.4.5 Impulse Response and Dynamic Multiplier Functions

As the primary purpose of this chapter is to find out the impact of the volatilities of DLREER and DLPOIL on export-import growth and GDP growth, it would be useful to determine the response of export-import growth and GDP growth when the shocks introduced to the volatilities of DLREER and DLPOIL. The indication of significance and prediction period steps are same as in Chapter 5.

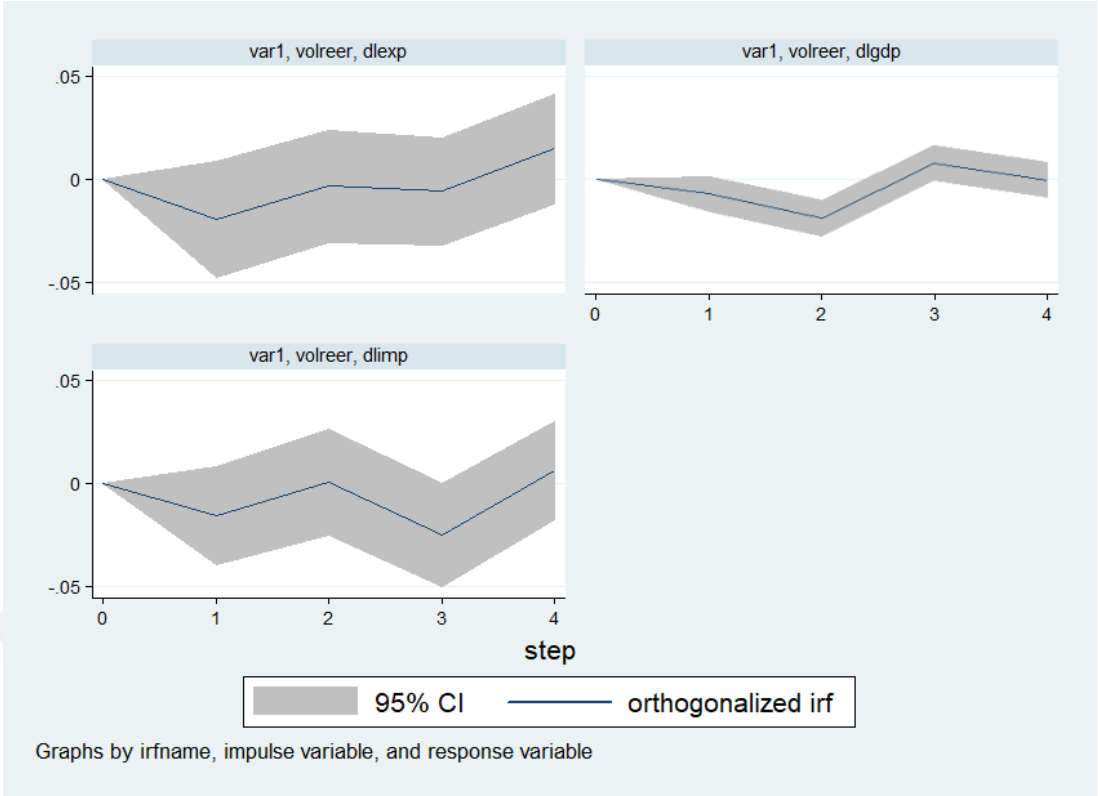


Figure 6.2 Orthogonalized IRFs of the Export Growth, GDP Growth and the Import Growth Against the Shock in the Volatility of DLREER

Figure 6.2 represents IRFs of export growth, GDP growth, and import growth after a one-standard deviation innovation in the volatility of DLREER variable. IRFs show that the response of export growth to the shock in the volatility of DLREER is uncertain. It is seen that the response of export growth starts with a negative effect, and the direction is on negative way. The decline movement was observed until the end of 1st quarter, and then there is an increasing trend till 4th quarter. Although the response shows some fluctuations along the zero line, it is insignificant. This finding matches the result the from Granger Causality test, which mentions there is not any causality running from the volatility of DLREER to the export growth.

According to the response of GDP growth to the shock in the volatility of DLREER, until the 2nd quarter, we observe a decline in the response with its lowest level. Between the 2nd and 4th quarters, real export growth increases to 0.018 percentage points with its highest positive response, then the decreasing trend follows the increasing segment. It is clearly seen from figure above that the response is significant in 2nd period and negative. This finding matches the result from the Granger Causality

test, which mentions there is a causality running from the volatility of DLREER to the GDP growth with 1% significance level.

The response of import growth to the shock in the volatility of DLREER represents almost the same trend as the response of export growth. Until the end of 1st quarter, impulse response displays decreasing movement, but then there is a significant increase in the 2nd quarter. The following quarter indicates a gradual decline, and later the impulse response returns to a positive section. As in export growth, although the response shows some fluctuations along the zero line, it is insignificant. This finding matches the result from the Granger Causality test, which mentions there is not any causality running from the volatility of DLREER to the import growth.

Generally, it is hard to measure whether the responses of variables show an increasing or decreasing tendency to the shock on VOLREER. However, if we look at the significance of responses, it is possible to say that only the response of GDP growth shows significant impulse with its 95% confidence interval, and the response is negative. After examining Table 6.6, we contend that the results we get from IRFs match with the findings of the Granger causality test.

Because the VOLPOIL variable is the exogenous variable in our VAR model, it is feasible to determine its shock on other variables with the help of dynamic multiplier functions. The IRFs mainly present the relationships among endogenous variables.

Figure 6.3 depicts the dynamic multiplier functions of export growth, GDP growth, and import growth after one standard deviation innovation in the VOLPOIL variable. It is seen that the response of export growth to the shock in VOLPOIL is significant and starts from a negative section and the negative sign continues till the half of 2nd quarter. The direction is on positive way and ends up in the end of 3rd quarter. Then a gradual decrease in 4th quarter follows the previous positive movement.

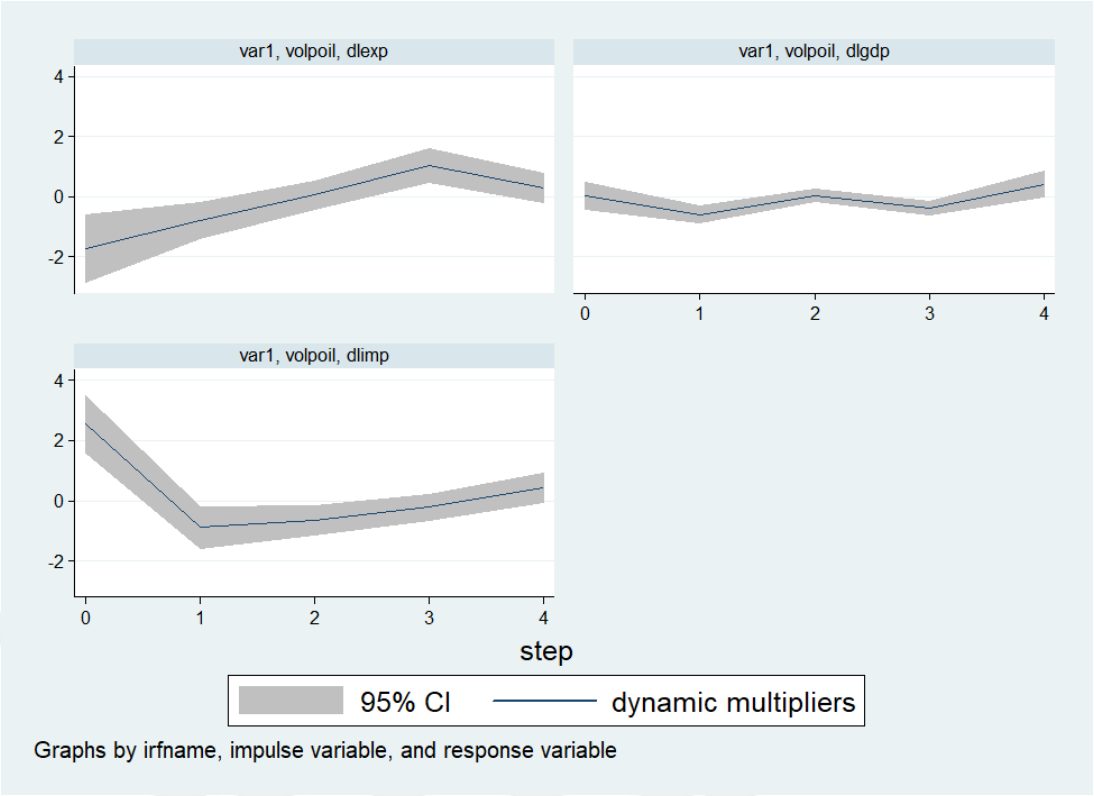


Figure 6.3 Dynamic Multiplier Functions of the Export Growth, GDP Growth and the Import Growth Against the Shocks in the Volatility of DLPOIL

When there is a one-unit shock to VOLPOIL variable, the response of GDP growth is significant and represents a diminishing direction till the end of 1st quarter reaching its lowest level. Starting from 2th quarter, we see a gradual increase for next quarters.

Moreover, the response of import growth to one-unit shock in VOLPOIL variable shows positive but diminishing reflection till the end of 1st period. It is seen that the response is significant and the impulse response changes its direction to positive way and gradually increases till the end of the examined period.

Overall, after the investigation of Figure 6.3, it is feasible to say that determining the clear sign of the response of import growth to other variables is hard. Therefore, if we consider the first quarter as an immediate reflection to shock, the sign can be accepted as negative for export growth and GDP growth. However, the sign of import growth to the DLPOIL volatility shock is positive in the short-run.

In conclusion, according to the responses with 95% confidence interval in Figures 6.2 and 6.3, one standard deviation innovation in VOLREER has a negative and

significant effect on the response of the GDP growth. However, one standard deviation innovation in VOLPOIL has a negative and significant effect on the responses of export growth and GDP growth, a positive and significant effect on the response of import growth in the short run. We cannot take into consideration the other responses due to the insignificance issue.

6.4.6 Variance Decomposition Analysis

Variance decomposition analysis results are presented in Table 6.7 below. Results were estimated with 95% confidence interval for the variance decomposition, and the prediction periods of variance decomposition are set to 8 periods.

Table 6.7 Variance Decompositions of Variables

Impulse Variable	Period	Response variables		
		DLEXP	DLGDP	DLIMP
VOLREER	1	0.00	0.00	0.00
	2	1.43	2.68	1.11
	3	1.86	8.91	1.06
	4	1.89	11.10	2.26
	5	3.68	14.54	2.20
	6	3.75	17.84	2.28
	7	3.75	19.87	2.69
	8	3.71	22.93	2.70

According to the table above, when we look at the variance decomposition of export growth and import growth, it is obvious that these variables are not significantly explained by VOLREER in all periods. However, if we look at the percentage of VOLREER on GDP growth variance decompostions, it is possible to say that the explanatory rate of VOLREER on GDP growth is quite high and can be acceptable as a significant value. Such as in the 8th quarter, the explanatory rate of the VOLREER is 22.93% which shows the importance of GDP for the volatility of rates of changes in real effective exchange rate in the economy.

6.5 Conclusion

In this chapter, we want to figure out the impact of the volatilities of DLPOIL and DLREER on export growth, import growth, and GDP growth over the quarterly period 2001-2020.

In order to determine the impacts of relationships, the VAR model was constructed. Variables included in the VAR model as endogenous variables. Only the volatility of the rate of change of the real "Brent" oil prices (VOLPOIL) is included as an exogenous variable. After being certain of the stability tests of the VAR model, the Granger causality WALD test provided us with the possibility and direction of the relationship between variables. As a next step, the Impulse Response Functions were studied to determine the effect of one standard deviation in the volatility of DLREER as an endogenous variable on export-import growth and GDP growth. Moreover, with the help of Dynamic Multipliers functions, the effect of one standard deviation in the volatility of DLPOIL as an exogenous variable on export-import growth and GDP growth was examined. Additionally, by investigating forecast error variance decompositions, the percent of change in the volatility of DLREER variable is expressed.

The results of VAR stability tests and autocorrelation tests indicate that constructed VAR for the model is quite reliable with significant test findings.

According to the result of the Granger causality WALD test, the volatility of DLREER is effective in explaining only GDP growth with 1% significance level.

Interpretation of impulse responses reveals that in the short term, the impact of one standard deviation in the volatility of DLREER variable is negative and significant with 95% confidence level for GDP growth. But the effect of one standard deviation in the volatility of DLREER for other variables is insignificant. As can be seen from the related figures, the results we get from the Granger test match with the results of IRFs.

Addition to the IRFs, the variance decomposition table also gives the same results, such as VOLREER variable significantly explains only GDP growth in examined period.

Examination of dynamic multipliers, however, presents that in the short term, the impact of one standard deviation in the volatility of DLPOIL variable is negative for export growth and GDP growth and positive for import growth. The effects are significant with 95% confidence level for all variables. Considering together both dynamic multipliers results of oil price growth (DLPOIL) from chapter 5 and dynamic multipliers results of the volatility of DLPOIL (VOLPOIL) from this chapter, it is possible to say that the impacts of these variables on export growth, GDP growth and import growth are opposite which is an interesting fact.

CHAPTER 7

FINDINGS AND DISCUSSION

7.1 Findings for the Interactions Between Growth Rates of Exports, Imports and GDP; and the Impacts of the Rates of Changes in Oil Prices and Real Effective Exchange Rate on Those Variables

In this chapter, we want to discuss the results interpreted due to empirical analysis. The findings reveal that there is a positive relationship between export growth and GDP growth due to the results of IRFs in chapter 5. Also, thanks to the unidirectional Granger causality (Table 5.8) from export growth to GDP growth, it can be stated that export growth is effective in explaining GDP growth with a 1% significance level. This evidence shows that the export-led growth theory is supported by this data for Azerbaijan. Although this result cannot be supported by Alakbarov (2010), it is possible to say that by exporting more goods to foreign markets, Azerbaijan may increase the size of its market. Effective export promotion policies should be employed to create export capacity in order to boost economic growth. The findings also imply that by boosting economic development, exports in Azerbaijan may rise even more.

Moreover, it was found that export growth is significant in explaining import growth due to the unidirectional causality (Table 5.8). Furthermore, in the short run, an increase in export growth could affect import growth negatively with 95% confidence level due to the results of IRFs in chapter 5. This negative relationship can be explained due to the weaker domestic currency of Azerbaijan. Such as, if the country's currency depreciates against foreign currencies, exports will increase because they will become cheaper, and imports will decrease because they will become expensive.

On the other hand, the relationship between GDP growth with import growth shows a difference in some cases. According to causality outcomes in chapter 5, there is bidirectional causality between import growth and GDP growth. However, IRF graphs represent this relationship negatively when shock is introduced to import growth and positively when shock is introduced to GDP growth in the short run. This study is also supported by Mehdi Taghavi (2012), which based on results, he revealed a negative relationship between import growth and GDP growth when a one-unit shock was introduced to import growth in Iran as an oil-exporting country.

Next, we want to give attention to the relationship with GDP growth as an impact of the rate of changes in REER from chapter 5. According to Granger Causality (Table 5.8), there is only one causality correlation running from DLREER to the GDP growth with 5% significance level. These findings constitute the same relations in causality as the paper of Dikkaya and Doyar (2017), which investigates causal relationships between quarterly time series of oil prices, GDP, and exchange rate for both Azerbaijan and Kazakhstan separately. The results of the impulse response of GDP growth indicate a negative and significant relationship with DLREER in the short run. Actually, it is known that growth in the appreciation of REER makes our export more valuable for foreign countries, which, in terms, reduces the growth of amount of exports in our country. Because of the oil exports' dominance on total exports, a decrease in the growth of export directly impact the growth of GDP negatively. Concerning the responses of other variables, such as export growth and import growth, would not be suitable because of insignificant causalities and impulse responses.

When we interpret the findings related to oil price growth, it is seen that this variable, which differentiates oil price growth from others, has significant effects on each export growth, import growth, and GDP growth variable.

According to the results, there is a positive relationship between oil price growth and export growth in short run. Because of Azerbaijan's dependency on oil export and constituting share of crude oil as more than 85% on general export, an increase in oil price growth affects positively export growth in the short-run. Moreover, the results of this relationship supported by Aliyev (2020), according to his research, estimation

results of the analysis reveal a positive and statistically significant impact of oil prices on economic growth, especially on export for the Azerbaijani case.

Dynamic multiplier functions also indicate the relationship between oil price growth and GDP growth. Due to this relationship, positive changes in oil price growth impact GDP growth slightly positively. The direction of the relationship was observed as expected since an increase in export growth positively triggers the GDP growth. These findings are supported by Alekhina and Yoshino (2018), which is a paper of the Asian Development Bank Institute, such as an increase in oil prices that may continuously and positively affect real GDP growth. It was interpreted that macro-economic indicators of energy exporters such as Azerbaijan are highly vulnerable to oil price changes.

Considering import growth and oil price growth correlation, we found a negative relationship for a short term. Since Azerbaijan's dependency on oil and less progress in non-oil sectors makes inevitable the imports of products that required for country other than oil and energy products. Thus, an increase in oil price increases the price of most of products which resulted in the decline tendency on import growth in short run due to the high prices. This situation can be supported by Figure 6 that an increase in oil prices in 2007 and 2008 boosted the export growth for these years in Azerbaijan, however, we see decreasing direction in import growth.

7.2 Findings for the Impacts of the Volatilities of Rates of Changes in Oil Prices and Real Effective Exchange Rate on Growth Rates of Exports, Imports and GDP

In this part of the chapter, we want to discuss the findings related to volatilities of rates of changes in oil prices and real effective exchange rate (VOLPOIL and VOLREER) by calculations in the Stata 12 program. VOLPOIL variable is determined as an exogenous variable, the others such as export growth, GDP growth, import growth, and VOLREER as endogenous variables.

When we look at the volatility of the rate of change in the real effective exchange rate (VOLREER), there is only one causality that running from VOLREER to the GDP growth with 1% significance level. Due to the impulse responses in chapter 6, as the

Granger causality test represents, one-unit shock in VOLREER has a significant effect only on GDP growth with 95% confidence level and impacts negatively in the short-run. The negative relationship can be explained in this way that the volatility in the appreciation of the domestic currency in Azerbaijan can affect the volume of exports which will be more expensive because of the unstable environment for foreign countries. This condition, in terms of effect on exporting volume, directly affects GDP growth negatively. Hasanov (2010), moreover, investigated the relationship between the real exchange rate and non-oil exports, and his findings in the short run are appropriate to our paper's results. According to the results, in both VAR models, the VOLREER and DLREER variables have the same causalities on export growth, GDP growth, and import growth. In both models, the significant causality is running from DLREER and VOLREER to the only GDP growth. Moreover, the results of impulse response functions related to VOLREER and DLREER show that one unit shock in VOLREER and DLREER has the same negative impact on GDP growth in the short run.

Taking the volatility of the rate of changes in oil prices (VOLPOIL) into consideration, we found that the results of the dynamic multiplier figures in chapter 6 show the opposite effect on variables when considering the dynamic multiplier figures of chapter 5. Such as, one unit shock in VOLPOIL has significant negative effects on export growth and GDP growth, significant positive effect on import growth in the short run. As Azerbaijan is a highly oil-dependent country in export, crude oil export plays a significant role in the export of goods and services. This demonstrates that while price volatility may not always help countries, an increase in the price of oil can. Therefore, oil price growth uncertainty may negatively affect the export growth and GDP growth through the country's international trading activities, as they result in unpredictable revenue or consumption. Jun E. Rentschler (2013) also supports the same results in the case of Norway as an oil-exporting country.

CHAPTER 8

CONCLUSION

Globalization trends, which have become widespread throughout the world, have increased the importance of foreign trade every year. With the effect of the globalization phenomenon, the determinants that affect economic growth have begun to be studied extensively, both at the theoretical and empirical levels.

This study aims to analyze the impact of export growth, GDP growth and import growth in each other, as well as the effects of growth rate of real effective exchange rate, oil price growth and their volatilities on import-export and GDP for Azerbaijan. In the study, quarterly data throughout 2001 Q1 – 2020 Q4 was handled, and the relationship between them was analyzed with the help of the Vector Autoregressive model (VAR). As a first step, ARCH/GARCH models for the REER and oil prices have been developed due to the requirements for solving the problems encountered in econometric models with these high-frequency time series. Since these models are conditional variable variance models, they provide us with successful results in volatility calculations. After the best prediction models were found, it was observed that the time series used was free from the ARCH effect. Taking volatilities of rates of changes in REER and oil prices into consideration in VAR analysis gives us better results in order to find the favorable relationship among the variables we use.

Due to the use of the VAR model (DLEXP, DLGDP, DLIMP, DLREER, DLPOIL) in the analysis, the data must be stationary. For this, in chapter 5, the first differences of non-stationary data were taken and made stationary with the Augmented Dickey-Fuller and the Phillips-Perron unit root tests. The lag length criterion of the stationary data was selected as seven and included in the VAR analysis. The position of the inverse roots of the AR characteristic polynomial of the predicted model in the unit circle also revealed that the model did not have any problems in terms of stationarity.

In order to test whether the VAR model contains a structural problem, autocorrelation, varying variance, and normal distribution tests were performed. According to the results of the LM test, which detected the presence of autocorrelation, and autocorrelation was removed. Thanks to the White test results, which test whether the variance of the error term is constant in all variables, there is no variance problem. Another requirement for consistent results in the VAR model is the normal distribution of residuals. For this, the "Jarque-bera" test is applied. Results revealed that the error residuals variables are normally distributed.

Another stage of the VAR analysis method is the Granger Causality WALD test. The results indicate that no variables effectively explain export growth, but there are causalities running from export growth to all variables with 5% significance level. Moreover, bidirectional causality maintains its effect between GDP growth and import growth, between GDP growth and growth rate of the REER with 5% significance level in the explanation of impacts of variables in question on economic growth in Azerbaijan between the years 2001-2020.

In the analysis, impulse-response and variance decomposition results are also consistent with the results obtained with the Granger causality test. Interpretation of impulse responses reveals that in the short term:

- one-unit shock in export growth resulted in a positively on the response of GDP growth and a negatively on the response of import growth;
- one-unit shock in GDP growth resulted in a positively on the response of import growth;
- one-unit shock in import growth resulted in a negatively on the response of GDP growth;
- one-unit shock in growth rate of the REER resulted in a negatively on response of GDP growth.

The results that we present in bullets are significant with 95% confidence level, otherwise, the IRFs are insignificant.

According to the results of dynamic multiplier graphs, the impact of oil price growth (as an exogenous variable) on export growth, GDP growth, and import growth are

significant with 95% confidence level. Such as, a shock introduced to the oil price growth affect export growth and GDP growth positively, and import growth negatively for the short term.

Additionally, in chapter 6, we analyzed the new VAR model that differentiate for volatility variables. Such as, in the new VAR model, oil price growth (DLPOIL) and growth rate of REER (DLREER) were replaced with the volatility of DLPOIL (VOLPOIL) and volatility of DLREER (VOLREER), respectively. In order to check the stability conditions of this VAR model, the same analysis tests employed in chapter 5 are used here. Furthermore, in addition to the Granger Causality Wald test, IRFs, and Variance Decompositions, Dynamic Multiplier functions represented due to find out reliable impact of VOLPOIL (as an exogenous variable) on export-import growth and GDP growth.

According to the result of the Granger causality WALD test, the volatility of DLREER is effective in explaining only GDP growth with 1% significance level.

The findings of this new VAR model interpret that in the short term, the impact of one standard deviation in the volatility of DLREER variable is negative and significant with 95% confidence level for GDP growth. But the effect of one standard deviation in the volatility of DLREER for other variables is insignificant. As can be seen from the related figures, the results we get from the Granger test match with the results of IRFs. Moreover, as it is seen from variance decompositions analysis, the most significant variable in the variance decomposition of the VOLREER after itself is GDP growth which again matches our results in IRFs. The other variables' effects are less than 4%.

Examination of dynamic multipliers, however, presents that in the short term, the impact of one standard deviation in the volatility of DLPOIL variable is negative for export growth and GDP growth, and positive for import growth. The effects are significant with 95% confidence level for all variables.

Considering together both dynamic multipliers results of oil price growth (DLPOIL) from chapter 5 and dynamic multipliers results of the volatility of DLPOIL

(VOLPOIL) from this chapter, it is possible to say that the impacts of these variables on export growth, GDP growth and import growth are opposite in these VAR models.

As a final observation, it is possible to say that the recent decline in oil prices has caused Azerbaijan's foreign exchange reserves to rapidly decline. A fall in export growth and GDP growth was inevitable for these decades because oil exports make up the majority of the Azerbaijani economy's export earnings. The manat's value is now reliant on oil prices as a result of the significant devaluations in nations with international trade links. As a result, the dollar-manat exchange rate has been significantly impacted by the drop in oil prices. Although a negative tendency in export growth and GDP growth, a decrease in oil prices stimulated import growth for that period. These relationships are also supported by impulse response graphs and dynamic multiplier graphs of related variables. In general, it was shown that deliberate efforts focused at enhancing infrastructure and broadening the economy's export and import base may be used to attain exchange rate stability, even in the face of fluctuating oil prices.

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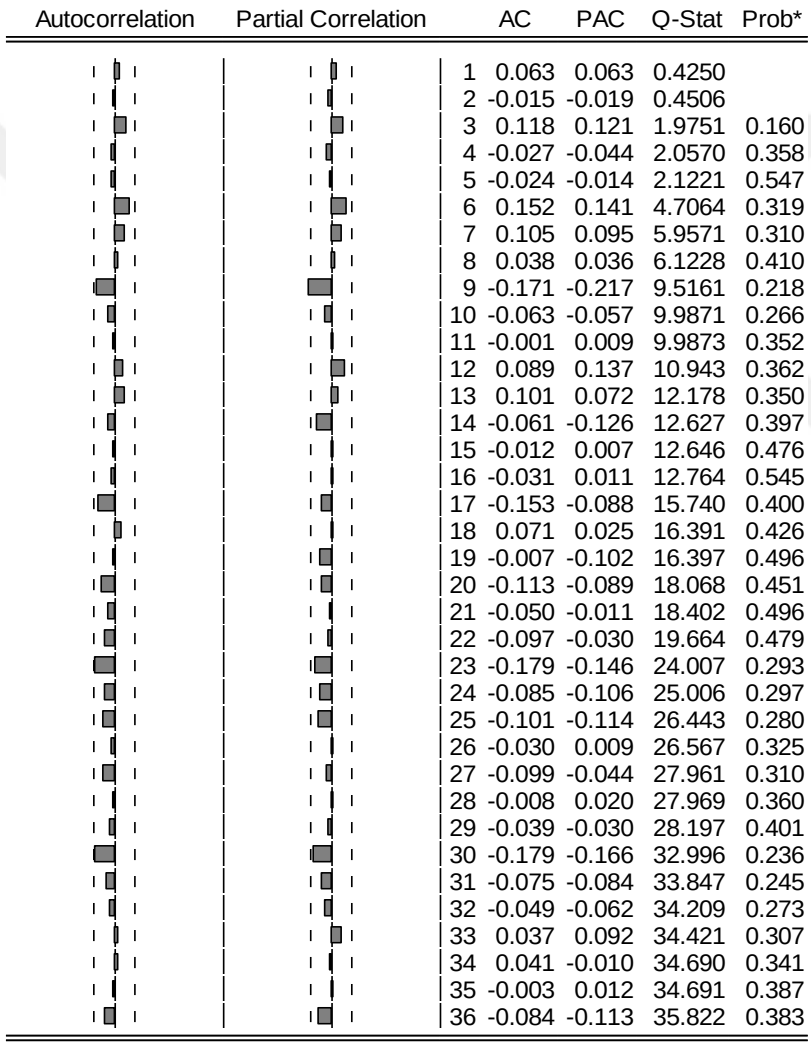
APPENDICES

A. STABILITY TESTS OF BEST MODELS FOR DLREER AND DLPOIL



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.063	0.063	0.4250	
		2	-0.015	-0.019	0.4506	
		3	0.118	0.121	1.9751	0.160
		4	-0.027	-0.044	2.0570	0.358
		5	-0.024	-0.014	2.1221	0.547
		6	0.152	0.141	4.7064	0.319
		7	0.105	0.095	5.9571	0.310
		8	0.038	0.036	6.1228	0.410
		9	-0.171	-0.217	9.5161	0.218
		10	-0.063	-0.057	9.9871	0.266
		11	-0.001	0.009	9.9873	0.352
		12	0.089	0.137	10.943	0.362
		13	0.101	0.072	12.178	0.350
		14	-0.061	-0.126	12.627	0.397
		15	-0.012	0.007	12.646	0.476
		16	-0.031	0.011	12.764	0.545
		17	-0.153	-0.088	15.740	0.400
		18	0.071	0.025	16.391	0.426
		19	-0.007	-0.102	16.397	0.496
		20	-0.113	-0.089	18.068	0.451
		21	-0.050	-0.011	18.402	0.496
		22	-0.097	-0.030	19.664	0.479
		23	-0.179	-0.146	24.007	0.293
		24	-0.085	-0.106	25.006	0.297
		25	-0.101	-0.114	26.443	0.280
		26	-0.030	0.009	26.567	0.325
		27	-0.099	-0.044	27.961	0.310
		28	-0.008	0.020	27.969	0.360
		29	-0.039	-0.030	28.197	0.401
		30	-0.179	-0.166	32.996	0.236
		31	-0.075	-0.084	33.847	0.245
		32	-0.049	-0.062	34.209	0.273
		33	0.037	0.092	34.421	0.307
		34	0.041	-0.010	34.690	0.341
		35	-0.003	0.012	34.691	0.387
		36	-0.084	-0.113	35.822	0.383

Figure A.1 Autocorrelation Test of DLREER ARCH (1) Model

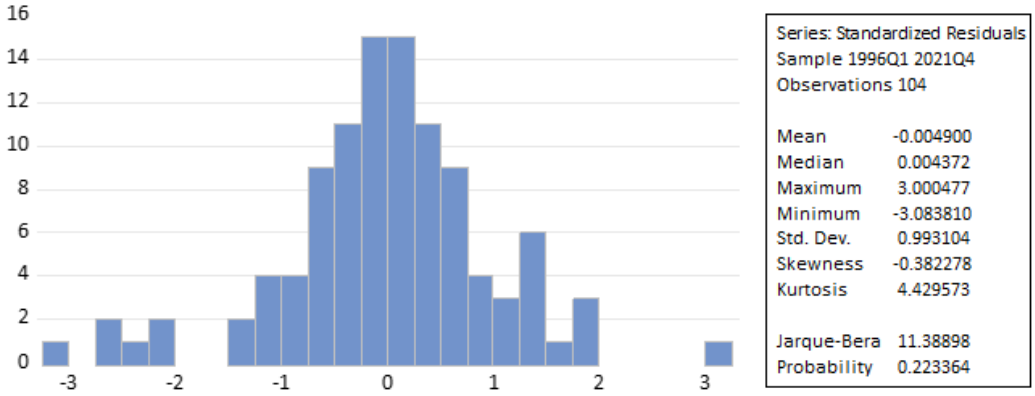
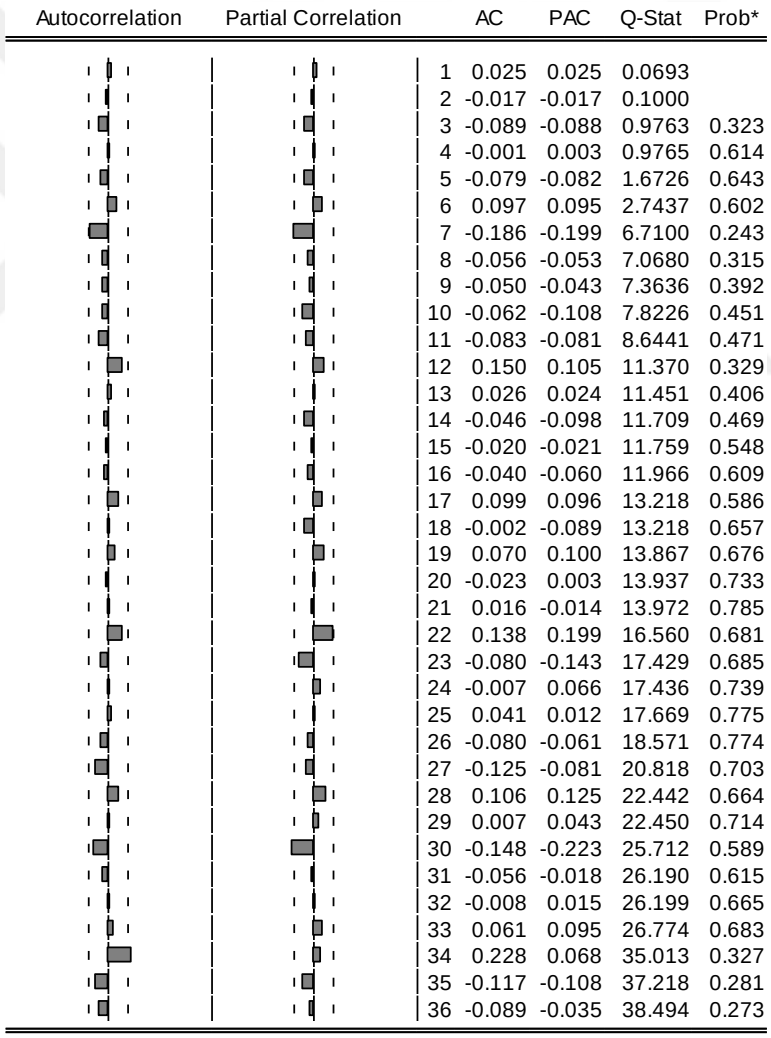


Figure A.2 Normality Test of DLREER ARCH (1) Model



	AC	PAC	Q-Stat	Prob*
1	0.025	0.025	0.0693	
2	-0.017	-0.017	0.1000	
3	-0.089	-0.088	0.9763	0.323
4	-0.001	0.003	0.9765	0.614
5	-0.079	-0.082	1.6726	0.643
6	0.097	0.095	2.7437	0.602
7	-0.186	-0.199	6.7100	0.243
8	-0.056	-0.053	7.0680	0.315
9	-0.050	-0.043	7.3636	0.392
10	-0.062	-0.108	7.8226	0.451
11	-0.083	-0.081	8.6441	0.471
12	0.150	0.105	11.370	0.329
13	0.026	0.024	11.451	0.406
14	-0.046	-0.098	11.709	0.469
15	-0.020	-0.021	11.759	0.548
16	-0.040	-0.060	11.966	0.609
17	0.099	0.096	13.218	0.586
18	-0.002	-0.089	13.218	0.657
19	0.070	0.100	13.867	0.676
20	-0.023	0.003	13.937	0.733
21	0.016	-0.014	13.972	0.785
22	0.138	0.199	16.560	0.681
23	-0.080	-0.143	17.429	0.685
24	-0.007	0.066	17.436	0.739
25	0.041	0.012	17.669	0.775
26	-0.080	-0.061	18.571	0.774
27	-0.125	-0.081	20.818	0.703
28	0.106	0.125	22.442	0.664
29	0.007	0.043	22.450	0.714
30	-0.148	-0.223	25.712	0.589
31	-0.056	-0.018	26.190	0.615
32	-0.008	0.015	26.199	0.665
33	0.061	0.095	26.774	0.683
34	0.228	0.068	35.013	0.327
35	-0.117	-0.108	37.218	0.281
36	-0.089	-0.035	38.494	0.273

Figure A.3 Autocorrelation Test of DLPOIL E-GARCH (1.1) Model

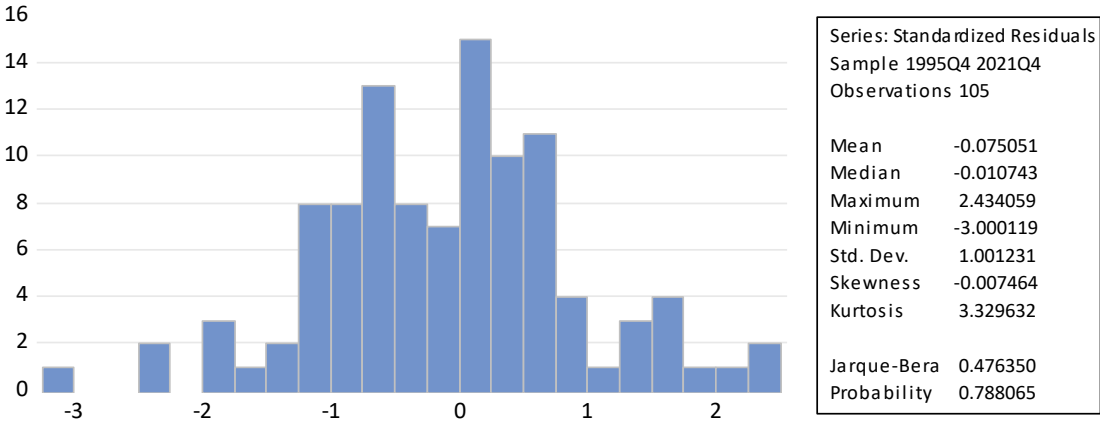


Figure A.4 Normality Test of DLPOIL E-GARCH (1.1) Model

B. TURKISH SUMMARY / TÜRKÇE ÖZET

Son birkaç yılda dünya ekonomisi daha entegre hale geldi. Bu eğilim, ekonomilerin başlıca ekonomik değişkenlerde eş hareketler göstermeye başladığı hipotezine yol açmaktadır. Bu nedenle, dış şokların belirli ekonomiler üzerindeki etkilerini kontrol etmek önemli bir görevdir. Bu görev, özellikle gelişmekte olan ve kaynak bakımından zengin ekonomilerde büyük önem taşımaktadır, çünkü bu ekonomiler küresel ekonomik dalgalanmalara karşı daha savunmasızdır.

Ekonomiyi önemli ölçüde etkileyen ihracat ve ithalat da ekonomik büyüme ile karşılıklı etkileşime sahiptir. İhracat milli gelire ve ekonomiye katkı olarak kabul edilirken, ithalat ekonomiden çıkış olarak kabul edilir. Hem ekonomistlerin, hem de ülkelerin vurguladığı en önemli göstergelerden biri olan ekonomik büyüme, küreselleşen dünyada ve değişen ekonomik konjonktürlerde makroekonomik tartışmaların ön saflarında yer almaktadır.

Doğal kaynaklar bakımından zengin ülkeler, uluslararası emtia fiyatlarına bağlı olarak iç ekonomik faaliyetlerini yürütürler. Gelişmekte olan ülkelerde hammadde fiyatlarındaki dalgalanmaların makroekonomik istikrarsızlığın kaynağı olabileceği genel olarak kabul edilmektedir. Petrol rezervleri bakımından zengin olan ve ekonomisi petrol ihracatına bağlı olan ülkeler, uluslararası piyasalardaki fiyat dalgalanmalarından etkilenmektedir. Özellikle petrol ürünleri açısından ihracata bağımlı olan Azerbaycan gibi ülkelerde uluslararası pazardaki fiyat değişimleri döviz kurlarını etkilemekte ve ülkenin krize girmesine neden olabilmektedir.

Reel efektif döviz kuru (REER) ve petrol fiyatlarındaki değişkenliklerin neden olduğu asimetrik şokların ekonomik büyüme üzerindeki etkisinin analizi, son birkaç yıldır akademisyenler ve politika yapıcılar için önemli bir meşguliyet olmuştur. Bir yandan literatürde döviz kurundaki değer kaybının ihracatı artırma ve ithalatı azaltma eğiliminde olduğu da kabul edilmiştir. Buna karşılık, döviz kurunun değer kazanması bazı ülkeler için ihracatı zayıflatmış ve ithalatı ise teşvik edemiştir. Bu nedenle, döviz

kurunun değer kaybetmesi, hem ithalatçı, hem de ihracatçı ülkelerin ekonomik büyümesini etkileyen ticaret açısından bir değişim yoluyla ithalatçı ülkelerden ihracat yapan ülkelere gelir transferine yol açmaktadır. Öte yandan, petrol fiyatlarındaki artışların ekonomiler üzerinde ciddi olumsuz etkileri olduğu algısı, büyük ölçüde petrol fiyatlarındaki artışların zamanlaması ile ekonomik gerilemeler arasındaki yakın ilişkiye dayanmaktadır.

Örneğin, Hamilton (1983) petrol ithal eden ülkelerde petrol fiyatları ile makroekonomik faaliyet arasında olumsuz bir ilişki bulmuş ve petrol fiyatlarındaki olumlu değişikliklerin üretim artışını azalttığını yorumlamıştır. Daha yüksek petrol fiyatlarının ekonomik büyümeyi olumsuz etkilediğine dair bulgular, bu ilişkinin döviz kurlarında panik yarattığını ve nihayetinde parasal ve finansal istikrarsızlığa neden olan enflasyon ürettiğini savunan McKillop (2004) tarafından da desteklenmektedir. Ayrıca, Jin (2008), uluslararası petrol fiyatlarındaki ani artışın ve döviz kurundaki büyük değişikliklerin ekonomik büyümeyi zayıflatmanın nedenleri olduğunu ortaya koymuştur.

Ancak petrol ihraç eden ülkeler için petrol fiyatlarındaki değişikliklerin etkisi farklıdır. Petrol ihraç eden ülkelerin çoğu büyük ölçüde petrol gelirine bağımlıdır ve petrol fiyatlarındaki artış, kalkınma projelerini finanse etmek için mevcut para miktarını artırmak anlamına gelir. Bu nedenle, para ve maliye politikaları petrol fiyatlarındaki dalgalanmalardan önemli ölçüde etkilenmektedir (Saddiqui ve ark., 2018). Bununla birlikte, olumsuz etki, özellikle kusurlu sermaye piyasalarında, petrol fiyatlarındaki oynaklık nedeniyle finansal ve reel toplamları daha belirsiz hale getirmektedir (Hausmann ve Rigobon, 2003). Aksine, petrol fiyatı düştüğünde hükümetler harcamalarını hemen kesemez ve büyük bir bütçe açığıyla karşı karşıya kalabilir. Bu nedenle, petrol fiyatlarındaki değişikliklerin petrol ihraç eden ve petrol ithal eden ülkelerdeki makroekonomik performans üzerinde önemli bir etkisi vardır.

Örneğin 2015 yılında dünya ekonomisindeki belirsizlikler Azerbaycan ekonomisini etkileyerek ülke ekonomisinde bir miktar istikrarsızlığa neden olmuştur. Petrol fiyatlarındaki keskin düşüşler, manatın değer kaybetmesine ve ihracattaki düşüş eğilimi ve ithalat üzerindeki olumlu etki gibi makroekonomik değişkenleri etkilemesine neden olmuştur. Bütün bunlar, petrol fiyatlarının yüksek olduğu

dönemde döviz piyasasındaki dengeyi değiştirmiş ve manat (Azerbaycanın döviz kuru) üzerindeki baskıları arttırmıştır. Aynı zamanda, diğer ülkelerdeki yüksek oranlı devalüasyonlar Azerbaycan ekonomisinin uluslararası rekabet gücü açısından ciddi riskler yaratmıştır.

1994 yılından bu yana Azerbaycan ile bazı uluslararası şirketler arasında imzalanan petrol üretimine ilişkin anlaşmalar, ülke için gerekli altyapının yeniden kurulmasına olanak sağlamış ve ekonomik büyümeyi hızla teşvik etmiştir. Bu nedenle, ekonominin yeniden yapılandırılması, kalkınması ve dünya ekonomileriyle bütünleşmesiyle Azerbaycan, en önemli direklerden biri olarak enerji kaynaklarının ihracatına izin veren iletim hatlarına ulaşmıştır.

Petrol ihracatının artmaya başladığı 2000 yılından bu yana ihracatın önemli bir rol oynadığı görülmektedir. 2001 Yılında ihracatın GSYİH üzerindeki payı %37 iken, 2007 yılında ihracat rakamları %64'e yükselmiştir. Dünya petrol fiyatlarındaki düşüş nedeniyle, sonraki yıllara yönelik eğilim olumsuz yönde olmuştur. İhracatın GSYİH üzerindeki payı 2020'de ise yaklaşık % 30'dur.

Azerbaycan ihracat gelirlerinin çoğunu petrol ve petrol ürünlerinden elde etmiştir. Dış ticaret dengesindeki gelişme Hazar enerji kaynağına ilişkin uluslararası anlaşmalar çerçevesinde petrol üretimi ve ihracatı sonucu ülkenin petrol ihracatı ile ilgilidir. Petrol ve petrol ürünlerinin ihracattaki payı, incelenen dönemde (2001-2020) çoğu yıl ihracatın ağırlıklı olarak % 80'ine yakın dalgalanmakta ve bazı iniş çıkışlara rağmen öncelikle artan bir eğilim görmekteyiz. Artış esas olarak ham petrol ihracatından kaynaklanmaktadır. Bu nedenden dolayı ham petrolün fiyatı artarken ihracatın hacmi de artıyordur. Böylece, Azerbaycan'ın başlıca ihracatı ham petrol ve petrol ürünleri olduğu için Azerbaycan ekonomisinin enerji fiyatlarına bağımlı hale geldiğini söylemek mümkündür. Bu durum Azerbaycan ekonomisi için sadece bir sektöre bağımlı olması nedeniyle önemli bir sorunu ortaya koymaktadır.

Dünya genelinde ham petrole olan talep her geçen gün artarken, petrol fiyatlarının döviz kurları ve döviz kuru volatilitesi üzerindeki etkisi daha belirgin hale gelmiştir. Azerbaycan söz konusu olduğunda, petrol fiyatı Azerbaycan'ın reel döviz kurunu belirleyen en önemli değişkendir. Petrol fiyatlarındaki dalgalanmalar Azerbaycan'da petrol gelirlerinin büyük ölçüde girişine veya çıkışına neden olmaktadır. Bu durum,

ekonominin petrol dışı sektörünün rekabet gücünü baltalayan döviz kurunun değer kazanmasını ve değer kaybetmesini doğrudan etkiler.

Petrol fiyatları ve döviz kurları gibi değişkenler oldukça oynak olan makroekonomik değişkenler arasındadır. Dahası, bu iki değişken, özellikle gelirler için petrole büyük ölçüde bağımlı olan Azerbaycan gibi ülkelerde para politikasının uygulanmasında ana bileşenleri oluşturmaktadır. Ülkede makroekonomik yönetimin önündeki başlıca engellerin genellikle petrol fiyatı ve döviz kuru dalgalanmaları olduğu bilinmektedir. Petrol fiyatı ve döviz kurundaki bu dalgalanmaların ticaret, büyüme ve ekonomi yönetimi üzerinde gerekli etkileri vardır.

Literatürde petrol fiyatları, reel efektif döviz kurları ve makroekonomik değişkenler arasındaki ilişkiyi araştıran çok sayıda çalışma bulunmaktadır. Ancak araştırma hedefimize göre Azerbaycan gibi petrol ihraç eden ekonomilerde özellikle petrol fiyatlarının ve reel efektif döviz kurunun ithalat-ihracat ve GSYİH üzerindeki etkilerini inceleyen çalışmalara odaklanmaya çalışmışızdır. Dünya genelinde, bir çalışma içerisinde bu değişkenlerin hepsinin dahil olunarak araştırılma yapılması, aynı zamanda bu değişkenlerin değişim oranlarının ve volatilitelerinin göz önünde bulundurulmuş bir araştırma yapılması çok zor bulunuyordur. Azerbaycan için ise böyle tip bir araştırma hiç yapılmamıştır ve bu çalışma kendi ülkemin literatürüne yeni katkıda bulunacaktır. Dar araştırma yönü ve hedefimizle ilgili literatür eksikliği nedeniyle, petrol fiyatlarındaki dalgalanmaların ve reel efektif döviz kurunun petrol ihracatçıları ve ithalatçıları durumunda GSYİH, ihracat ve ithalatı nasıl etkilediğini gösteren bazı çalışmaların kısa bir literatür taramasını sunmuşuzdur.

Hasanov'un (2010) ampirik makalesi, ham petrol fiyatlarının Azerbaycan ulusal para birimi olan Manatın reel döviz kuru üzerindeki etkisini araştırmaktadır. Hasanov (2010), 2000'den 2007'ye kadar üç aylık verileri uygulamış ve bu ilişkiyi tahmin etmek için Hata Düzeltme Modelini ve Johansen entegrasyon yaklaşımlarını kullanmıştır. Çalışma, petrol fiyatları ile Azerbaycan'ın reel döviz kuru arasında istatistiksel olarak anlamlı ve pozitif bir ilişki olduğunu, petrol fiyatlarındaki %1'lik artışın reel efektif döviz kurunda %0,7'lik bir artışa neden olduğunu ortaya koymuştur.

Bir diğer makalede, Muhtarov, Aliyev ve Zeynalov (2020) Azerbaycan'da petrol fiyatlarındaki değişimin enflasyonu, döviz kurunu, ekonomik büyümeyi ve ihracatı

nasıl etkilediğini bulmaya çalışmışlar. Yazarlar, 2005'ten 2019'a kadar olan verileri kullanarak Johansen eşbütünleşmesi ve Vektör Hata Düzeltme Modeli (VECM) yöntemlerini uygulamış, petrol fiyatları ile ekonomik büyüme, enflasyon ve ihracat arasında istatistiksel olarak anlamlı ve pozitif bir ilişki olduğunu, petrol fiyatlarının ise döviz kurunu olumsuz etkilediğini ortaya koymuşlardır. Benzer bir çalışmada Muhtarov, Memmedov ve Ahmedov (2019), Azerbaycan'da petrol fiyatındaki %1'lik artış enflasyonun %0,58 oranında artmasına neden olduğundan, petrol fiyatı ile enflasyon arasındaki ilişkiyi bir kez daha doğrulamaktadır.

Ayrıca, Zulfigarov (2020), 2001'den 2018'e kadar üç ayda bir petrol fiyatlarının Azerbaycan ekonomisine etkisi üzerine bir araştırma yapmıştır. Araştırmasının bulguları, reel petrol fiyatlarındaki düşüşün Azerbaycan'ın tüm makro değişkenleri üzerinde daha büyük bir olumsuz etkiye sahip olduğunu ortaya koymaktadır. Sonuçlardan dolayı hem olumlu, hem de olumsuz petrol fiyat şokları enflasyonist etkilere neden olmakta ve döviz kurunun değer kazanmasına ve değer kaybetmesine neden olmaktadır.

Aliyu (2009), 1986-2007 yılları arasında üç aylık verilerle ampirik bir araştırma yapmış ve reel ekonomik değişkenlerin petrol fiyatlarındaki değişikliklere ve reel döviz kuru volatilitesine duyarlılığını incelemek için Johansen VAR tabanlı eşbütünleşme tekniğini kullanmışlar. Bu çalışmanın bulguları olarak, petrol fiyatlarındaki şok ve döviz kuru seviyesindeki değer kazanmanın Nijerya'daki reel ekonomik büyüme üzerinde olumlu bir etkisi olduğu görülmektedir.

Mevcut bir makalede, Mehdi Taghavi, Masomeh Goudarzi, Elham Masoudi ve Had Parhizi Gashti (2012), 1962-2011 döneminde İran'da ihracat, ithalat ve ekonomik büyüme arasındaki ilişkiyi VAR yöntemiyle incelemişler. Bulgulara dayanarak, ihracatın uzun vadede ekonomik büyüme ile doğrudan ve pozitif bir ilişkisi olduğunu, ithalatın ise uzun vadede ekonomik büyüme ile %95 güvenli ve olumsuz bir ilişkisi olduğunu belirtmişler.

Sunulan literatür taraması genellikle kendi araştırmamızda kullandığımız verileri ayrı-ayrılıkta inceliyor ve bu araştırmanın amacıyla farklılıklar oluşturuyor. Mevcut literatürde, hiçbir araştırma materyali Azerbaycan ekonomisi için bu tür bir ilişkiyi tam olarak araştırmamaktadır. Bu araştırmanın temel amacı, şu soruya mümkün olan

en iyi cevabı bulmaktır: “Petrol fiyat artışında, reel efektif döviz kurunun büyüme hızında ve bu değişkenlerin volatilitelerinde şoklar olduğunda Azerbaycan ekonomisine etkileri nasıl olur? Bu araştırma, (a) ihracat-ithalat büyümesi ile Gayri Safi Yurtiçi Hasıla (GSYİH) büyümesi arasındaki ilişkileri, (b) petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının (DLPOIL&DLREER) ve bu verilerin volatilitelerinin (VOLPOIL&VOLREER) ihracat-ithalat büyümesi ve GSYİH büyümesi üzerindeki etkilerini analiz etmeyi amaçlamaktadır. Bu nedenle, bu çalışma, Azerbaycan örneğinde petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının ve ayrıca bu verilerin volatilitelerinin ithalat-ihracat büyümesi ve GSYİH büyümesi üzerindeki etkilerinin analizini yaparak bu kıt literatüre katkıda bulunmaktadır.

Tez üç ana ampirik çalışmadan oluşmaktadır. İlk çalışma, ARCH/GARCH modellerini kullanarak 2001-2020 yılları için üç aylık dönemde petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının volatilite değerlerini sağlıyor. İkinci çalışmada, öncelikle ihracat-ithalat büyümesi ile GSYİH büyümesi arasındaki ilişkiyi analiz edilmiş, sonra petrol fiyat artışının ve reel efektif döviz kurunun büyüme hızının ihracat büyümesi, GSYİH büyümesi ve ithalat büyümesi üzerindeki etkilerini incelenmiştir. Son çalışmada, petrol fiyat artışının ve reel efektif döviz kurunun büyüme hızının volatilitelerinin ithalat-ihracat büyümesi ve GSYİH büyümesi üzerindeki etkisi analiz edilmiştir.

İlk çalışma olarak, petrol fiyatı ve döviz kuru değişkenleri oynak olduğundan ve Azerbaycan'ın ekonomik performansı üzerinde yüksek bir etkiye sahip olduğundan, petrol fiyatlarındaki ve döviz kurundaki değişim oranlarının volatilitelerini modellemek gerekir.

Modern ekonomi teorisinde kullanılan zaman serilerinde yüksek frekanslı verilerdeki zamana bağlı değişkenliği analiz etmek için koşullu varyans modellerinin kullanılması yaygındır. Bu, otoregresif koşullu değişen varyans (ARCH) ve genişletilmiş otoregresif koşullu değişen varyans (GARCH) modellerinin yardımıyla mümkündür. ARCH modeli ilk olarak Engle (1982) tarafından tanıtılmıştır. ARCH modeli basit olmasına rağmen, bir varlık getirisinin volatilite sürecini açıklamak için genellikle birçok parametreye ihtiyaç vardır. Bollerslev (1986) ARCH modelini genişletmiş ve

daha tarihsel ve daha esnek bir gecikme yapısına sahip olan Genelleştirilmiş ARCH modelini önermiştir. Bu model esas olarak tahmini parametrelerin yüksek sırasını yalnızca birkaç parametreye indirmiştir. Bu nedenle, GARCH modeli, zamanla değişen zaman serisi varyansını tahmin etmek için kullanışlıdır. Ayrıca, kaldıraç etkisinin ayrıştırılmasına izin veren model olarak bilinen Üstel GARCH (E-GARCH) gibi başka bir model daha vardır.

Bu çalışma, koşullu varyans modellerini modellemek için reel efektif döviz kuru ve "Brent" petrol fiyatlarını veri olarak kullanmaktadır. Veriler 1995 Q1–2021 Q4 dönemini kapsamaktadır. Reel efektif döviz kuru ve "Brent" petrol fiyatları sırasıyla Bruegel veritabanından ve ABD Enerji Enformasyon İdaresi'nden (EIA) alınmıştır. Her değişken için toplam gözlem sayısı 108'dir. Kullanılan tüm veriler logaritmik getirilerdedir. "Brent" petrol fiyatları verileri reel anlamda değildir; Bu nedenle, bunları reel terimlere dönüştürmek için GSYİH Deflatörü kullanılmaktadır. Reel terimlere dönüştürülürken 2010 4. çeyrek baz yıl olarak alınmıştır. Bu reel efektif döviz kuru değişkeni için de kabul edilebilir. Modeller, Eviews 12 programının Student Lite sürümü ile tahmin edilmiştir.

İlk olarak, ARCH/GARCH tipi modelleme, serinin sabit olmasını gerektirir. Bu nedenle, analizin ilk kısmı, dönüş serisinin birim kök özelliklerine odaklanmıştır. Serilerin durağanlığı, zaman yolu grafikleri ve korelasyonlar incelenerek Artırılmış Dickey-Fuller (ADF) ve Philips-Perron (PP) birim kök testleri ile test edilmiştir. Durağan olmayan seriler için birinci dereceden farklılıklar alınarak durağanlık elde edilmiştir. Serinin otokorelasyon ve kısmi otokorelasyon fonksiyonları birlikte değerlendirilerek seriye en uygun ARMA modelleri belirlenmiştir. Belirlenen bu modellerin hata şartları üzerinde ARCH etkisinin olup olmadığı ARCH-LM testi ile test edilmiş ve ARCH etkisi olan veriler için ARCH/GARCH modelleri elde edilmiştir. En uygun ARCH/GARCH modeli belirlendikten sonra artıklara ARCH-LM testi uygulanmış ve seride ARCH etkisinin kaybolup-olmadığı araştırılmıştır. Ayrıca değişkenler için ayrı-ayrı tahmin yöntemi ile en iyi modelin tahmini kullanılmıştır. Son olarak, serinin volatillik grafikleri değerlendirilmiş ve önümüzdeki dört çeyrek için tahmin grafiği temsil edilmiştir.

İstatistiksel olarak anlamlı bulunan ARMA (3, 4) ve ARMA (2, 2) modelleri, ilk fark alındıktan sonra durağan hale gelen DLREER ve DLPOIL serileri için en uygun model olarak belirlenmiştir. Bu modelin hata terimleri için uygulanan ARCH-LM testi sonucunda hatalar üzerinde ARCH etkisinin olduğu ortaya çıkmıştır. Bu etkiyi ortadan kaldırmak için farklı değerlere sahip ARCH/GARCH modelleri denenmiştir. Bu etkiyi ortadan kaldırmak için en uygun ARCH/GARCH modeli, sırasıyla DLREER ve DLPOIL değişkenleri için ARCH (1) modeli ve E-GARCH (1.1) modeli olmuştur. Bu modellerin uygunluğu yine ARCH-LM testi ile test edilmiş ve hatalar dizisinde ARCH etkisinin kaybolduğu tespit edilmiştir. Ayrıca, DLREER ve DLPOIL serileri için en iyi modelleri seçmek için alternatif bir yöntem denenmiştir: tahmin yöntemi. Bu yöntem, otoregresif koşullu değişen varyans denklemlerinden elde edilen sonuçların aynısını vermiştir. ARCH ve E-GARCH modelleri ile incelenen koşullu standart sapma ve varyans tahmin grafiklerinin benzer olduğu gözlemlenmiştir. Bu çalışmanın bir sonucu olarak, Vektör Otoregresif (VAR) ekonometrik analizinde kullanmak için DLREER ve DLPOIL serilerinin volatilite değerleri alınmıştır.

İkinci çalışmada, GSYİH büyümesi, ihracat artışı, ithalat artışı arasındaki ilişkiyi ve reel efektif döviz kurlarının ile petrol fiyatlarının büyüme oranlarının bu verilere etkisini bulmak istiyoruz. Sonuçları yorumlamak için, değişkenlerin bir diğeri üzerindeki doğrudan etkisini ve oluşturulan Etki-Tepki Fonksiyonlarını (IRF) göstermek için VAR modeli kullanılmıştır. Bu analizin sonuçları Azerbaycan ekonomisi için bazı durumları açıklığa kavuşturmuş ve esas olarak günümüzde ekonominin durumuna benziyordur.

Ham petrol ve petrol ürünleri Azerbaycan'ın başlıca ihracatı olduğu için petrol fiyatlarının Azerbaycan ekonomisi üzerinde büyük etkisinin olduğu bilinmektedir, örneğin petrol ihracatının toplam ihracat üzerindeki payı çoğu yıl için %80'in üzerindedir. Ekonomide bu tür bir bağımlılık, petrol fiyatı değişkeninin diğer değişkenler üzerindeki etkisini ayrı ayrı analiz etmemizi sağlıyor. Ancak petrol fiyatları esas olarak Azerbaycan'ın ham petrol üretimine bağlı olmadığından ve bazı ülkelerin dünya piyasalarında devasa petrol üretiminin fiyatları yönlendirdiğinden, analizde petrol fiyatlarını dışsal bir değişken olarak kullanılmıştır. Bu nedenle, petrol fiyatı eksojen bir değişken olarak kabul edilmiş, ancak diğerleri VAR modelinde endojen bir değişken olarak dahil edilmiştir. Petrol fiyatlarındaki artış ve diğer

değişkenlerle pozitif ve negatif ilişkileri temsil eden grafikleri tespit etmek amacıyla, aynı zamanda, petrol fiyatının VAR modeline eksojen bir değişken olarak dahil edilmesi nedeniyle bu bölümde Dinamik Çarpan fonksiyonları kullanılmıştır. Ayrıca, endojen değişkenler arasındaki ilişkiyi belirlemek için ise Stata 12 programında etki-tepki fonksiyonları kullanılmıştır.

Çalışmada, 2001Q1 – 2020Q4 döneminde üç aylık veriler dikkate alınarak ithalat, ihracat, reel efektif döviz kuru, petrol fiyatları ve GSYİH arasındaki ilişki analiz edilmiştir. Bir zaman serisi analizinin yapılabilmesi için gözlem sayısının en az 30 olması gerektiğinden, bu dönemler arasında üç aylık verilerle ekonometrik analiz yapılarak sonuçlar elde edilmiştir. Dahası, bu zaman dilimini seçmemin bir başka nedeni de üç aylık verilerin mevcudiyetidir.

GSYİH ile ilgili veriler reel ve milyon ABD doları cinsindendir ve Azerbaycan Cumhuriyeti Devlet İstatistik Komitesi'nden (AZSTAT) indirilmiştir. İhracat ve ithalat da reel ve milyon ABD doları cinsindendir ve bu veriler Azerbaycan Cumhuriyeti Merkez Bankası (CBAR) "Ödemeler Dengesi" yayınlarından toplanılmıştır. Reel efektif döviz kuru, enflasyonun etkilerine göre ayarlanan Azerbaycan Para Biriminin (manat) ABD Dolarına göre ağırlıklı ortalamasıdır. Nominal efektif döviz kurunu alıp ülkenin fiyat endeksine göre ayarlanması bize reel efektif döviz kurunu veriyordur. Ülkenin reel efektif döviz kurundaki artışın ihracatı değerli kılması ve ithalatı daha ucuz hale getirmesi gibi ticari rekabet gücünün bir göstergesidir. Reel efektif döviz kuru ile ilgili veriler "Bruegel" veritabanından alınmıştır. Ardından, "Brent" ham petrol fiyatlarına ilişkin üç aylık veriler ABD Enerji Enformasyon İdaresi (EIA) web sitesinde dolar cinsinden yayınlanmaktadır. Tüm değişkenler reel anlamda olmadığından, GSYİH Deflatörü bunları reel terimlere dönüştürmek için kullanılmıştır. GSYİH deflatörü verileri de CBAR web sitesinde yayınlanmaktadır ve açık kaynaktır. 2010 yılının 4. çeyreği reel terimlere dönüştürülürken baz yıl olarak alınmıştır. Seriler analizde önemli değerlere sahip olduğundan, tüm değişkenler logaritmik değerlerle ifade edilir. Hesaplamalarda EViews 12 ve Stata 12 programları kullanılmıştır.

VAR modelinin stabilite testlerinden emin olduktan sonra Granger nedensellik WALD testi bize değişkenler arasındaki ilişkinin olasılığını ve yönünü sağlamıştır. Bir sonraki

adım olarak, ihracat-ithalat büyümesinin ve GSYİH büyümesinin birbirilerinin şoklarına tepkilerini, aynı zamanda bu değişkenlerin DLREER`deki tek standart sapmaya tepkilerini belirlemek için Etki-Tepki fonksiyonları incelenmiştir. Ayrıca, Dinamik Çarpanlar fonksiyonlarının yardımıyla, DLPOIL'deki bir standart sapmanın eksojen bir değişken olarak ihracat-ithalat büyümesi ve GSYİH büyümesi üzerindeki etkisi incelenmiştir. Ek olarak, Tahmin Hatası Varyans Ayrışmalarının (FEVD) araştırılmasıyla, ihracat-ithalat büyümesi ve GSYİH büyüme verilerindeki değişikliklerin yüzdesi ifade edilmektedir.

VAR stabilite testleri ve otokorelasyon testlerinin sonuçları, model için oluşturulan VAR'ın %95 güven düzeyinde test bulguları ile oldukça güvenilir olduğunu göstermektedir.

Granger nedensellik WALD testi sonucuna göre, ihracat artışının açıklanmasında hiçbir değişken etkili olmamakla birlikte, ihracat artışından %5 anlamlılık düzeyine sahip tüm değişkenlere kadar uzanan nedensellikler bulunmaktadır. Ayrıca, çift yönlü nedensellik, GSYİH büyümesi ile ithalat büyümesi arasındaki, GSYİH büyümesi ile reel efektif döviz krurunun büyüme oranı arasındaki etkisini % 5 anlamlılık düzeyinde sürdürmektedir.

Etki-tepki fonksiyonlarının yorumlanması, kısa vadede:

- ihracat büyümesindeki bir birimlik şok, GSYİH büyümesinin tepkisine pozitif, ithalat büyümesinin tepkisine negatif yönde etki etmiştir;
- GSYİH büyümesindeki bir birimlik şok, ithalat büyümesinin tepkisi üzerinde pozitif bir etkiye neden olmuştur;
- ithalat büyümesindeki bir birimlik şok, GSYİH büyümesinin tepkisini negatif yönde etkilemiştir;
- REER'in büyüme oranındaki bir birimlik şok, GSYİH büyümesinin tepkisini negatif yönde etkilemiştir.

İlgili rakamlardan da görüleceği üzere Granger testinden elde ettiğimiz sonuçlar Etki-Tepki fonksiyonlarının sonuçları ile eşleşmektedir. Yukarıda sunduğumuz sonuçlar %95 güven seviyesindedir.

Varyans ayrışma analizi, Etki-Tepki fonksiyonları ve Granger nedensellik sonuçlarımızı da desteklemektedir. Örneğin, değişikliklerin %90'ından fazlası ihracat büyümesinin kendisine aittir. Diğer değişkenlerin ihracat artışı üzerindeki etkisi önemsizdir. GSYİH'nın varyans ayrışmalarında, her değişkenin dönem sonuna doğru GSYİH büyümesini önemli ölçüde etkilediğini görüyoruz. Ayrıca, ithalat büyümesinin varyans ayrışmasında elde edilen bulgular, DLREER`den başka diğer değişkenlerin 8. dönem sonunda ithalat büyümesi üzerinde önemli etkileri olduğunu ortaya koymaktadır. Sonuç olarak, varyans ayrışma analizinin sonuçları, Etki-Tepki fonksiyonlarının ve Granger nedensellik testinin sonuçlarına uygundur.

Dinamik Çarpan grafiklerinin sonuçlarına göre, petrol fiyat artışının ihracat artışı, GSYİH büyümesi ve ithalat artışı üzerindeki etkisi %95 güven düzeyi ile önem arz etmektedir. Örneğin, petrol fiyat artışına getirilen bir şok, ihracat büyümesini ve GSYİH büyümesini pozitif yönde, ithalat büyümesini ise kısa vadede negatif etkilemektedir.

Son çalışmada ise volatilite değerlerini ilk çalışmanın sonucunda aldıktan sonra petrol fiyatlarındaki ve reel efektif döviz kurundaki değişim oranlarının volatiliteleri (VOLPOIL&VOLREER) ile, ithalat-ihracat artışı ve GSYİH büyümesi arasındaki ilişkiyi öğreniyoruz. Bu değişkenler arasındaki ilişkiyi analiz etmek için yeni VAR modeli oluşturulmuştur. Bu modelin bir özelliği olarak değişkenler, eksojen bir değişken olan VOLPOIL`den ziyade analiz sürecinde endojen değişkenler olarak uygulanmaktadır. Granger Nedenselliği, Etki-Tepki Fonksiyonları, Dinamik Çarpanlar ve Varyans Ayrışmasının yardımıyla değişkenlerin birbirleri üzerindeki etkisini ortaya çıkarmak mümkün olmuştur. Bu bölümün amacı, VOLREER ve VOLPOIL'in Azerbaycandaki ithalat-ihracat büyümesi ve GSYİH büyümesi üzerindeki etkisini analiz etmektir.

Bu bölümde, DLREER ve DLPOIL değişkenlerinin volatilitelerinin dışında VAR analizinde ikinci çalışmada kullanılan değişkenlerin aynısını kullanıyoruz. Buradaki veriler de üç ayda birdir ve 2001 ile 2020 arasındaki dönemi içerir. Analizde tüm değişkenler reeldir ve logaritmik formlarda ifade edilir. Analizlerin hesaplanmasında Eviews 12 programının Student lite versiyonu, ayrıca Stata 12 programı kullanılmıştır.

İlişkilerin etkilerini belirlemek için VAR modeli oluşturulmuştur. VAR modelinin stabilite testlerinden emin olduktan sonra Granger nedensellik WALD testi bize değişkenler arasındaki ilişkinin olasılığını ve yönünü sağlamıştır. Bir sonraki adım olarak, endojen bir değişken olarak DLREER'in volatilitesindeki (VOLREER) bir standart sapmanın ihracat-ithalat büyümesi ve GSYİH büyümesi üzerindeki etkisini belirlemek için Etki-Tepki Fonksiyonları incelenmiştir. Ayrıca, Dinamik Çarpanlar fonksiyonlarının yardımıyla, dışsal bir değişken olarak DLPOIL'in volatilitesindeki bir standart sapmanın ihracat-ithalat büyümesi ve GSYİH büyümesi üzerindeki etkisi incelenmiştir. Ek olarak, tahmin hatası varyans ayrışmaları araştırılarak, DLREER değişkeninin volatilitesindeki değişim yüzdesi ifade edilmiştir.

VAR stabilite testleri ve otokorelasyon testlerinin sonuçları, model için oluşturulan VAR'ın %95 güven düzeyinde test bulguları ile oldukça güvenilir olduğunu göstermektedir.

Granger nedensellik WALD testinin sonucuna göre, DLREER'in volatilitesi yalnızca GSYİH büyümesini %1 anlamlılık düzeyinde açıklamada etkilidir.

Etki-tepki yanıtlarının yorumlanması, kısa vadede, DLREER değişkeninin volatilitesindeki bir standart sapmanın etkisinin, GSYİH büyümesi için %95 güven düzeyi ile negatif ve anlamlı olduğunu ortaya koymaktadır. Ancak DLREER'in volatilitesindeki bir standart sapmanın diğer değişkenler için etkisi önemsizdir. Aynı zamanda, Granger testinden elde ettiğimiz sonuçlar etki-tepki fonksiyonlarının sonuçları ile eşleşmektedir.

Etki-tepki fonksiyonlarına ek olarak, varyans ayrıştırma tablosu da aynı sonuçları vermiştir, örneğin VOLREER değişkeni yalnızca incelenen dönemde GSYİH büyümesini önemli ölçüde açıklamıştır.

Bununla birlikte, Dinamik Çarpanların incelenmesi, kısa vadede, bir standart sapmanın DLPOIL değişkeninin volatilitesindeki etkisinin ihracat büyümesi ve GSYİH büyümesi için negatif ve ithalat büyümesi için pozitif olduğunu göstermektedir. Etkiler, tüm değişkenler için %95 güven düzeyi ile anlamlıdır.

Çalışmaların sonucu olarak, 2001-2020 dönemi itibarıyla:

- ihracat büyümesinin GYSİH büyümesinden, ithalat büyümesinden ve reel efektif döviz kurunun değişim oranından etkilenmediğini;
- Hem ikinci çalışmadaki reel efektif döviz kurunun değişim oranının (DLREER) etki-tepki sonuçları, hem de son çalışmadaki DLREER'in volatilitesinin (VOLREER) etki-tepki sonuçları birlikte ele alındığında, bu değişkenlerin yalnızca GSYİH büyümesi üzerinde etkilerinin ve bu etkilerin aynı yönde olduğunu;
- Hem ikinci çalışmadaki petrol fiyat artışının (DLPOIL) dinamik çarpan sonuçları, hem de son çalışmadaki DLPOIL'in volatilitesinin (VOLPOIL) dinamik çarpan sonuçları birlikte ele alındığında, bu değişkenlerin ihracat büyümesi, GSYİH büyümesi ve ithalat büyümesi üzerindeki etkilerinin zıt olduğunu söylemek mümkündür.

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