

Investigating the effects of political, economic and commercial components on changes in Iran's exchange rate

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Abstract

Nowadays, in developing countries, exchange rate fluctuations have gained special importance due to their influence on other economic variables. Exchange rate fluctuations increase uncertainty in society and have unpleasant effects on economic activities, which are very harmful to economic development. For this reason, these countries need to examine the behaviour of the exchange rate and the factors affecting its fluctuations. In this regard, in the current study, the factors influencing the exchange rate volatility in Iran for the period of 1975-2019 have been investigated using the Autoregressive Distributed Lag (ARDL) Model. The results of the studies show that during the period under review, in both short- and long-run models, the variables of oil revenues and the degree of trade openness have negative coefficients, an inverse effect, and the variables of economic sanctions and the multi-rate exchange system have positive coefficients. have had a direct impact on the exchange rate volatility, among them, oil revenues and political-economic sanctions have had the greatest impact on Iran's exchange rate volatility, respectively. The coefficient of the obtained error correction sentence was equal to 0.21, which shows that about five periods are necessary to adjust the imbalance in the short term and to establish a long-term equilibrium relationship.

Keywords: exchange rate volatility, Iran's economy, commercial and economic components, autoregressive models with distributive lags

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1 Introduction

After the collapse of the fixed exchange rate system or the Bretton Woods exchange rate system, the floating exchange rate system emerged in the middle of 1973. Since these years, the real and nominal exchange rates have experienced severe instability, and after that, extensive studies were conducted on the factors affecting exchange rate fluctuations in various countries with developed and developing economies. In these studies, several variables that have an impact on exchange rate fluctuations have been investigated and analyzed separately in two categories of monetary and non-monetary variables [4].

The spread of floating exchange rates in Europe, it made the nominal and real interest rates more volatile, which discouraged many investors due to the risk caused by the exchange rate, because the exchange cost of international trade became more expensive and reduced investors' profits. The originality of the order limits their decisions for the

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development of their activities. Economists believe that floating rates may be harmful to the economy because each country uses currency as a medium to purchase products and services in international trade. When the exchange rate fluctuates, they face uncertainty about agreements with other countries. The concern about exchange rate risk has become a very sensitive issue not only for policymakers but also for researchers.

From an economic point of view, the exchange rate is the price of foreign currency that connects the macroeconomics of a country to other countries through the property and goods market. The deviation and distance of the exchange rate from the long-term equilibrium rate during a certain period of time is called currency fluctuation or turbulence, which affects the economic performance of countries in different ways. High fluctuations in exchange rates cause uncertainty in many areas, which can ultimately negatively affect the economic development of a country, especially developing countries [12].

In most of the studies, inflation rate and interest rate as the most important monetary variables and per capita income, development of financial markets, economic growth, labour productivity shock and degree of commercial openness are proposed as non-monetary variables and investigated in different models. and their negative or positive effects on the exchange rate or its changes have been acknowledged. But other studies also show that the factors affecting the exchange rate and currency fluctuations cannot be considered only economic and monetary; Rather, a wide range of political and psychological factors can lead to changes in the exchange rate and currency fluctuations, and therefore, several factors can be effective on currency fluctuations. Dornbusch [6] also states that extreme exchange rate fluctuations can be caused by unexpected monetary shocks.

However, it is natural that due to the special conditions of oil countries like Iran, there are more specific variables that can be involved in exchange rate fluctuations. The most important factor that plays an essential role in the supply of foreign exchange in Iran is oil and then the factor of unfair sanctions. The price and amount of oil production play a major role in determining the exchange rate. The increase in oil revenues will change the demand for all goods (commercial and non-commercial). Since the supply of commercial goods is more attractive and the elasticity of the supply of non-commercial goods is low in the short term, the price of these types of goods will increase more than commercial goods, which causes the exchange rate to change and decrease [16] in a study to investigate the effect of sanctions on the foreign exchange market and the mechanism of its transfer to macroeconomic variables in the period from 2017 to 2014 have concluded that sanctions have three direct effects on the foreign exchange market of Iran, respectively: An increase in the exchange rate increases the gap between the official exchange rate and the free market and ultimately increases the exchange rate fluctuations [24] also experimentally investigated the effect of various economic sanctions tools on the official exchange rate fluctuations in the case of 23 target countries. (Including Azerbaijan, Pakistan, Iran, Belarus, etc.) from 1996 to 2015 and concluded that in these countries, the sanctions of the European Union, bilateral sanctions and the severity of the sanctions have a positive effect on the exchange rate fluctuations of these countries.

Therefore, it seems that due to the dependence of Iran's economy and the government's budget on oil revenues, it is better to investigate the more effective loopholes that affect currency fluctuations from these variables, and the role of variables that are related to the specific characteristics of Iran's economy. are consistent and have been less discussed in previous studies, should be explored and investigated. Based on this, the main problem of this research is to identify the impact of important political, economic and commercial variables on this key variable, i.e. currency volatility, which can be considered as the most important policy issue in short-term and long-term planning of Iran. The main question that we are looking for an appropriate answer to is what is the effect of commercial, economic and political components on exchange rate volatility in Iran?

2 Theoretical framework

2.1 Exchange rate fluctuations

With the expansion of globalization and the move towards a floating exchange rate system, the study of exchange rate fluctuations has increasingly attracted the attention of scientific circles and policymakers. Exchange rate fluctuations affect global trade, capital flow and economic well-being. Fluctuations in the exchange rate by creating conditions of uncertainty in the profit from international exchanges cause a decrease in trade, the inactivity of capital flows through a decrease in investment in foreign activities, a breakdown of the portfolio of financial assets, an increase in the price of tradable goods and an increase in the risk of covering changes. The real exchange rate is not predicted [3]. In addition, the deviation of the exchange rate from the equilibrium values as well as its instability can affect the macroeconomic performance, especially the competitiveness of countries. Fluctuations in the real exchange rate indicate instability and uncertainty in the relative price trends between countries. This turbulence creates an

unstable and uncertain atmosphere in the economy. Therefore, understanding the behaviour of the exchange rate is of great importance in designing appropriate monetary policies, and therefore, analyzing and investigating the nature of exchange rate fluctuations can help to formulate appropriate policies that can reduce the negative effects of exchange rate fluctuations on economic variables.

In many reviews, the performance of fixed exchange rates models such as purchasing power parity or monetary model has been evaluated as weak and they have shown that in many countries, the behaviour of exchange rates after Brett Woods, especially in the short term, follows a random step process. Although empirical evidence shows that attention to fundamentals may increase the power of predicting exchange rate behaviour in the long run. In this regard, [5] recently used a different technique of basic factors to estimate exchange rate models and again confirmed the weak performance of these basic models in short-term forecasting of exchange rate behaviour and their good performance in long-term forecasting.

Existing studies in this field show that adding volatility as an explanatory variable in traditional vector autoregression models significantly improves the accuracy of specifying exchange rate volatility. One of these approaches was presented by [7] under the title autoregressive model with conditional heteroskedasticity (ARCH) and later expanded to its generalized form, the autoregressive model with generalized conditional heteroskedasticity (GARCH). These two models recognize the difference between conditional and unconditional turbulence of random processes in such a way that in the first one, the turbulence is variable over time, but in the second one, it is considered constant [11]. However it should be kept in mind that since many economic time series, especially the exchange rate variable, include data from different periods of time with different degrees of fluctuation, the probability of changing the conditional variance in GARCH models is high. To take into account these time-dependent changes, the coefficients of the GARCH model, especially the width from the origin, should be estimated in a time-dependent manner. In this case, it is assumed that the exchange rate volatility has two stationarity and non-stationarity processes. The variance component is a function of the time process while the variance component follows a GARCH process.

2.2 Sanctions and political factors

Sanctions are a political-economic weapon in the field of civil struggle that goes beyond dialogue and puts diplomacy into action. Economic sanctions are a set of measures that aim to achieve specific political goals while manipulating economic relations and cooperation. Therefore, an economic sanction is a planned action of one or more governments through limiting economic and financial relations to exert pressure on the target country with political objectives. In other words, sanction is a type of fine that is done to force the sanctioned party to obey the desired political will. The sanctioning body may be the government of one or more countries or an international organization such as the United Nations [9]. Currently, many countries such as Iran, Syria, Afghanistan, Russia, Venezuela, Cuba, etc. are under various sanctions. There are several classifications for sanctions. Economic sanctions are usually divided into four main categories. First, commercial control and restriction of the target countries of the embargo by the embargoing country; Second, delaying the assistance and technological support of the countries targeted by sanctions by the sanction's enforcer; Third, the confiscation of the property and assets of the sanctioned countries by the sanctioning country and fourth, the prohibition of the companies of the target countries in trade with the sanctioning country.

In a general summary of international sanctions against Iran in four groups of US sanctions (including the executive orders of presidents and the treasury organization); UN Security Council sanctions; European Union sanctions and unilateral sanctions of other US allied countries such as Canada, England, etc. can be divided. Investigations carried out in Iran show that oil sanctions have led to a significant decrease in the country's foreign exchange earnings, and in fact, from the point of view of the supply and demand of foreign exchange in the foreign exchange market, it has led to a sudden and severe decrease in the supply of foreign currency in the market, and consequently, a sharp increase in the exchange rate. has followed the currency. Iran has been under unilateral US sanctions since 1979, but the scope and extent of these sanctions have expanded since 2012. Naturally, such sanctions are of great importance due to the adverse consequences such as the weakening of regional power, the reduction of foreign trade and the reduction of the degree of integration with the world economy that follows for the sanctioned countries. Classical and neoclassical economists believe that increasing the degree of trade openness through increasing exports and imports leads to encouraging the countries of the world to increase the convergence of their economies [20].

Among the existing studies related to the impact of US and European Union sanctions on the Russian economy, [25] study, in which it is stated that economic sanctions affecting oil revenues, exchange rate, inflation rate and production The gross domestic product has influenced the Russian economy.[19] have also shown in a study that heavy economic sanctions have been the source of the instability of the informal currency market in the last two decades. This instability can be the result of the high resistance of turbulent shocks in the direction of damping towards the long-term average of the exchange rate, which shows the high stability of the process turbulence. Other

results of this study show that after the unilateral withdrawal of the United States from the Joint Comprehensive Plan of Action (JCPOA) and the return of economic sanctions after 2018, the uncertainty in Iran's unofficial currency market has intensified compared to 2011.

2.3 Oil revenues

Another important factor that plays a key role in the supply of currency in countries like Iran is oil. Therefore, it is clear that the price and amount of oil production play a major role in determining the exchange rate. The increase in oil revenues will change the demand for all goods (commercial and non-commercial). Since the supply of commercial goods is more attractive and the elasticity of the supply of non-commercial goods is low in the short term, the price of these types of goods will increase more than commercial goods, which causes the exchange rate to decrease [15].

Basically, the supply and demand of currency determine the amount of currency fluctuations, so the factors affecting the supply of currency, one of the most important of which is oil income, play a significant role in the occurrence of currency fluctuations. In countries that export resources, the increase in the price of the export resource will lead to an increase in foreign exchange earnings and an increase in the value of the domestic currency or a decrease in the exchange rate. Therefore, because oil has a very large share in the country's exports and the amount of foreign exchange earnings, changes in the price of oil and the occurrence of oil shocks can affect the exchange rate. In addition, due to the dependence of the government budget on the export revenues from oil, the exchange rate is strongly influenced by the policies of the government through the central bank, but because the revenues from this sector are dependent on the global price of oil, therefore, oil revenues with wide uncertainties are encountered which ultimately lead to disruption of currency supply and demand and ultimately currency turbulences.

Several studies have shown that fluctuations in oil prices and, by nature, oil revenues, affect macroeconomic indicators such as exchange rates in oil-rich countries [17] in a study related to the economy of seven member countries OPEC concluded that in these countries there is a long-term and positive relationship between the real oil price, oil revenues and the real exchange rate. Other studies have pointed to the existence of a causal relationship between the exchange rate and the price of oil. It depends on countries with natural resources. In fact, turning the income from natural gifts into the cause of problems or economic prosperity depends on the efficiency of the government's policies.

2.4 Degree of openness of trade

This important component is obtained from the total ratio of exports and imports to the GDP, which is known as one of the important independent variables and has an effect on exchange rate fluctuations, which expresses the degree of trade relations of a country with other countries. Therefore, the higher the value of this index, the higher the volume of cross-border exchanges and the freer foreign trade of the country. According to international trade theories, the greater the amount of global free trade or the higher the degree of economic openness, the higher the level of production and national income in the world and the improvement of the financial and commercial relations of countries. Free trade theorists believe that countries can have more production and consumption after establishing international exchange. Policies that emphasize the degree of commercial openness always follow the development of financial markets and exchange rate behaviour because exchange rate fluctuations can have a serious effect on the volume of foreign trade and consequently the degree of commercial openness [21].

Based on the results obtained from the studies conducted in the field of trade liberalization and foreign investment, positive and significant effects have been obtained on financial development. In fact, trade liberalization will increase the volume of foreign trade and increase the diversity of exports and imports for countries. This will reduce the reliance on a specific foreign exchange income and will result in the instability of foreign exchange income and ultimately increase the stability in the foreign exchange market.

2.5 GDP per capita

GDP is also one of the most important indicators that show the economic strength of countries. Economic researches show that GDP per capita has a positive effect on the exchange rate, and therefore they have introduced GDP as a variable that is effective on the exchange rate in the short term [22]. In other words, at the same time as the gross domestic product per capita increases, the exchange rate increases and as the per capita GDP decreases, the exchange rate also decreases, because, with the increase in the gross domestic product, disposable income increases, which causes that the demand for imported goods and services will increase, and this increase in imports will decrease the supply of foreign currency and decrease the value of the national currency in the country.

Of course, it is said that the relationship between GDP and the exchange rate is a two-way relationship; Therefore, contrary to the previous situation, in the conditions of an unexpected increase in the exchange rate, consumers tend to use domestic goods and the intensity of consumption of imported goods is reduced, in which case, this time, it is the GDP that increases. However, it should be kept in mind that the reverse of this situation is not true, that is, with the decrease in the exchange rate, the price of foreign goods is lower than domestic goods, which causes a tendency to consume imported goods and reduce domestic production [15]. Therefore, the gross domestic product is one of the most important economic variables that shows great sensitivity to the changes in the exchange rate, and while influencing the fluctuations in the exchange rate, it is also affected by the fluctuations in the exchange rate, and if the exchange rate is proportionately and harmoniously If the economy is not adjusted to the internal and external world, it will slow down the growth of the economy and reduce the GDP.

3 Research background

Several studies have been conducted regarding the determinants of exchange rate volatility, some of the most recent ones are mentioned below. Among the available studies in this regard, we can refer to [1] research, during which they examined the dynamics of the US trade balance and the real exchange rate in the form of examining the J curve and trade costs. The findings of this study show that the degree of commercial openness in the short term is 0.21% and in the long term, as much as 0.19% has been able to influence the flexibility of the exchange rate. Therefore, it was seen that the trade balance of the United States has been able to take steps to reduce the volatility of the exchange rate over time. In another study, Zhao [25] investigated the impact of trade openness by emphasizing the role of the bond market on the exchange rate and foreign exchange income of China and the role of the bond market in foreign trade on the volatility of the country's currency. The results of this investigation show that the increase in gross domestic product and the increase in the volume of foreign trade, i.e. the increase in the degree of commercial openness, have a significant effect on the exchange rate volatility in the studied period.

Among the studies related to Iran, we can mention [8] who concluded in their study that the gross domestic product has a negative and significant effect on the exchange rate, so that a unit increase in the gross domestic product, the exchange rate reduces by 1.27 units [23] in a study to analyze the origin of exchange rate volatility, investigated the effectiveness of macroeconomic variables as well as economic instability caused by exchange rate volatility in Iran. The results of this study show that in the past years, the sanctions of Western countries against Iran have been the main factor in the formation of currency fluctuations and the entry of speculative demand into the currency market.

4 Research methodology

4.1 Description and method of data collection

In this study, according to previous similar research related to the factors affecting currency volatility in the countries of the world, the variables that are often given less attention in Iran's internal studies have been selected and investigated from 2018 to 2018. Therefore, according to the special economic and political characteristics of Iran, variables such as oil revenues, gross domestic product per capita and the degree of trade freedom were selected along with other important variables such as political and economic sanctions against Iran and also following the multi-rate exchange rate system. and will be used in the analysis. Virtual variables have been used to separate the years when sanctions started or when the exchange rate was multi-rate. In such a way that in the years when the exchange rate was a single rate or there were no sanctions, the value of the virtual variable is equal to zero, and in the years when we have multiple exchange rates or political-economic sanctions are applied, the value of the virtual variable is equal to consider with a dependent variable of this research is exchange rate volatility, whose behaviour is measured by 5 introduced variables. The data related to all the variables will be annual, and their values have been collected through Central Bank statistics, Iran Statistics Center and OPEC databases.

4.2 Data analysis method

A- Modeling exchange rate volatility

Basically, in order to investigate the volatility of the exchange rate and its effectiveness on other economic variables, as well as to identify the factors affecting it, it is necessary to first measure the volatility of the exchange rate as a quantitative variable. For this purpose, in the evolution of econometrics, various methods have been introduced to calculate the net loss. In this context, we can refer to Autoregressive Conditional Heteroskedasticity ARCH and especially Generalized Auto Regressive Conditional Heteroskedasticity GARCH model.

Engel [7] stated for the first time in 1982 that ARCH can be used to predict and create time series to express the instability of variables. In this way, by simultaneously examining the conditional mean of the conditional variance and explaining the conditional variance based on past information, GARCH methods succeed in solving the problem of variance heterogeneity. In such a situation, the maximum likelihood function in the general case of the q th order of ARCH will be in the form of equation (4.1):

$$y_t | \psi_{t-1} N(x_t \beta, h_t)$$

$$\sigma_{t+1|t}^2 = h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \hat{\varepsilon}_{t-i}^2 + \nu_i \quad (4.1)$$

This model was generalized a few years later and expressed in the form of CARCH model. if ε_t is error sentences and a random process with numbers, and ψ_t includes a set of statistics and time series data during a specific period, then the CARCH model will be in the form of equation (4.2) [2]:

$$\varepsilon_t | \psi_{t-1} N(0, 1)$$

$$h_t = \alpha_0 + \sum_{i=1}^q \alpha_i \hat{\varepsilon}_{t-i}^2 + \sum_{i=1}^p \beta_i h_{t-i} + \nu_i \quad (4.2)$$

In the generalized ARCH(p, q) model, which is called (p, q) CARCH in economic texts, autoregression and moving average components are seen in the variance equation. Conditional variance is also included in the model with an intercept. Here, the series related to the exchange rate is first collected and based on the above and after estimating the relevant time series, we extract the exchange rate volatility and put it in the model to examine the effect of the exchange rate volatility on the volatility of foreign exchange income.

In order to calculate exchange rate volatility using the GARCH model, first the ARIMA model is estimated using the Box-Jenkins method, and then the GARCH model is based on the disturbance sentences of the ARIMA model.

B- Autoregressive Distributed Lag (ARDL) Model

The Auto-Regressive Distributed Lag (ARDL) econometric method was introduced by Pesaran and Shin [18] in order to investigate the long-term relationship between explanatory variables. This method is based on OLS estimation of an unrestricted error correction model (UECM) for cointegration analysis. The ARDL test method has several advantages, among them are things like: the possibility of co-accumulation relationship in small samples in the form of work; Determining cointegration regardless of whether the regressors are $I(0)$ or $I(1)$; He pointed out the possibility of multiple interruptions of variables in the model as well as the possibility of virtual variables in the cointegration test process in the model. This model can be introduced as relation (4.3) according to the opinion of [18]:

$$\Phi(L, P)Y_t = c_0 + \sum_{i=1}^k \beta_i(L, q_t)X_{it} + \delta_t w_t + \mu_t; \quad t = 1, \dots, n \quad (4.3)$$

where Y_t is the dependent variable, C is the width from the origin, X_{it} is the independent variable, L_t is the interval operator, and W_t includes predetermined variables such as dummy variables, trend variables, and other exogenous variables with fixed intervals. This method has many advantages compared to other similar models and is therefore widely used. The most important advantage of this method is the ability to use this method to check the relationships between variables, regardless of whether they are stationary or not. In this method, in addition to calculating the long-term relationship between variables, it is also possible to calculate dynamic and short-term relationships. In addition, the adjustment speed of the short-term imbalance in each period can also be calculated to reach the long-term balance. Now according to this approach, the initial model that can be fitted will be as described in relation (4.4):

$$YTV_t = \beta_0 + \sum_{i=1}^p \beta_{1i} YTV_{t-i} + \sum_{i=1}^q \beta_{2i} EXOV_t + \sum_{i=1}^q \beta_{3i} GDP_t + \sum_{i=1}^q \beta_{4i} OP_t + T_t NZ_t + U \quad (4.4)$$

where, NTY : exchange rate volatility; $EXOV$: oil revenues; GDP : gross product per capita; OP : degree of freedom of trade; T : economic sanctions; NZ : It is an exchange rate system that will be estimated after determining appropriate intervals for each variable.

In the ARDL method, to check the existence of a long-term relationship between variables, the F test is performed. But since the asymptotic distribution of Wald and F statistics are non-standard, to test the existence of a long-term relationship between the variables of the model, it is necessary to use the upper and lower bound values simulated by Pesaran et al [18] calculated two asymptotic critical values: first, for when the variables are assumed to be zero, and the other when the variables are cumulative from degree 1. These critical values are called the lower critical limit and the upper critical limit, respectively. If the test statistic exceeds the upper critical limit, evidence is provided to prove the long-term relationship between the variables. The last step in this method is to examine the short-term relationship between variables and calculate the adjustment speed of short-term imbalances in each period to reach a long-term balance by the EMC (-1) error correction model.

5 Research findings

5.1 Unit root test and stationarity of variables

The prerequisite for using the ARDL method is that none of the variables are quadratic or $I(4.2)$, this model is suitable when some of the variables are $I(0)$ and some of them are $I(1)$. Therefore, before estimating the ARDL model, it is necessary to check the stationarity of the variables. Dickey-Fuller and Phillips-Perron tests were used to check the significance of the variables. Table 1 shows the numbers in parentheses of the probability and statistics of the coefficients. According to the results of the test, except for the real effective exchange rate volatility variable, which was stationarity at the level, the rest of the variables of GDP per capita, oil revenues, and the degree of trade openness were insignificant, which are moderated by first-order differentiation. Therefore, it is possible to use the ARDL method.

Table 1: Unit root test results

Test level Variable	level		First order difference	
	ADF	P-P	ADF	P-P
Exchange rate volatility	-2.6281 (0.0394)	-2.2170 (0.0120)	-	-
Oil revenues	-1.2390 (0.9826)	-1.5698 (0.5180)	-5.3489 (0.0289)	-5.6091 (0.0409)
GDP per capita	-0.6427 (0.8640)	-0.8933 (0.7691)	-4.7618 (0.0031)	-4.9822 (0.0011)
Degree of trade openness	-3.5731 (0.5424)	-3.9035 (0.6741)	-7.5560 (0.0002)	-7.8903 (0.0000)

5.2 Structural break test

In economic time series, the existence of shocks such as sanctions, climate fluctuations, war, etc. is the reason for structural failure. Structural failure causes regression results to lose their validity. The structural change of the economy is related to the wide change and transformation in the short and long term of the structure of the economy.

There are two types of structural breaks, which are divided into impulse and step breaks. Impulse failure is temporary and step break is permanent. Both types of breakdowns in the mean or trend of the time series can be influential. In this research, for the periods when more severe fluctuations are observed in the exchange rate fluctuation graph, the Chow test was used to check whether a break occurred in those periods or not.

5.3 Estimation of ARMA model for exchange rate volatility

To calculate the volatility of the exchange rate using the GARCH model, first, a preliminary model is estimated to explain the behaviour of the variable, which is estimated using the Box-Jenkins method of the ARIMA model, and then the GARCH model is based on the disturbance statements of the ARIMA model. Therefore, first, by Akaike's criterion, the model with the lowest value of statistics is selected as the best model. According to the overall autocorrelation chart AC and the partial autocorrelation coefficient PAC, also through the Box-Jenkins method, it was found that the effective real exchange rate process follows the ARMA (0, 1) model. The results of this estimation are shown in Table 2.

Table 2: ARIMA (1.0) model estimation

variable	Coefficient	Prob
C	21281.97	0.003
$AR(1.0)$	0.8821	0.000
R^2	0.9713	
F	3146.190	0.000

5.4 ARCH effect test

To obtain the volatility of the exchange rate, the existence of ARCH effects must be checked and confirmed. Therefore, if the model is specified correctly, there should not be a serial correlation in the disturbance components. For this purpose, this issue was investigated and confirmed using the Lagrange coefficients (LM) test. Therefore, considering that the significance level of F and LM tests is less than 5%; Therefore, it can be said that the real effective exchange rate has an ARCH effect. The results of this test are shown in Table 3.

Table 3: ARCH-LM effect test

statistics	value of the statistic	Prob
F	4.8532	0.0314
LM	4.1680	0.0215

5.5 GARCH model

After confirming the ARCH effect, the GARCH model has been estimated to estimate the conditional heterogeneity variance relationship, and the results of its fitting are reported in Table 4.

Table 4: CHARCH Model

variable	Coefficient	standard deviation	statistics	Prob
c	513.6790	79.289	2.490	0.0281
RESID (-1) Λ^2	1.4381	0.2762	6.5934	0.000
R^2	0.9813			

5.6 Structural failure test

According to the instabilities observed in the exchange rate fluctuation chart, it was found that during the years 1974 to 1984 and 1990 to 1994, there were more severe fluctuations, so we feel the need to introduce the dummy variable of sanctions and we enter it into the model. In the continuation of the research, we performed the structural failure test (Chow test) to determine whether failure occurred in the mentioned courses. In Table 5, the results of Chow's test during the mentioned periods are reported, which confirms the presence of saccharin failure.

Table 5: Results of Chow's test

period	F	Prob
1374-1384	2.5681	0.0341
1390-1394	5.6802	0/0023

5.7 Cointegration test and determination of optimal intervals

To use the ARDL model, the existence of cointegration between the variables must be proven. To analyze the cointegration of [18] bounds, we need to estimate the unconstrained error correction model (UECM) in which the optimal intervals of the variables are determined by criteria such as Akaike (AIC), Schwartz Bayesian (SBC), Hanan Quick (HQC). or R2 are determined. In this study, the best interval was estimated based on the Schwartz Bayesian criterion for each of the variables, during which: the maximum optimal interval of currency volatility and GDP per capita was obtained as 1 and for the variable of oil income as 2 and without an interval for the degree of trade freedom.

5.8 Bound cointegration test

If we want to examine the asymmetric long-term relationship between model variables; We use the Bound test of [18]. Based on the critical values and the calculated F statistic, the existence of a long-term equilibrium relationship between asymmetric variables at all levels is confirmed, because the value of the calculated F statistic (27.89) at the 95% confidence level is greater than the upper limit values provided by Pesaran et al [18]. It is 1, 2.5, 5 and 10 percent in all four levels.

Table 6: The results of the Bound cointegration test

Significance level	Lower bound I(0)	Upper bound I(1)
10%	2.082	3.047
5%	2.396	3.459
2.5%	2.884	3.951
1%	3.091	4.170

5.9 Estimation of short-run relationships

The results of estimating the short-run relationship according to the optimal intervals of the variables are presented in Table 7.

Table 7: Estimation of short-run coefficients results

Variable	Coefficient	t statistic	Prob
<i>C</i>	32.541	17.431	0.234
<i>NTY(-1)</i>	0.262	3.458	0.022
<i>EXOV</i>	-0.152	-2.589	0.004
<i>EXOV(-1)</i>	-0.179	-2.201	0.009
<i>EXOV(-2)</i>	-0.092	-1.432	0.789
<i>GDP</i>	-0.210	-0.720	0.342
<i>GDP(-1)</i>	-0.178	-0.218	0.902
<i>OP</i>	-0.211	-2.690	0.032
<i>T</i> ₁₉₉₅₋₂₀₀₅	0.128	3.521	0.002
<i>T</i> ₂₀₁₁₋₂₀₁₅	0.219	6.612	0.000
<i>NZ</i>	0.169	2.189	0.033
-	$R^2=91.29$	DW=1.91	

The results show that in the short term, the dependent variable of currency volatility with an interruption period will have a significant and positive effect on the creation of current period rate volatility with a coefficient equal to 0.262. The independent variable of oil revenues also has a negative sign only in the current period (with a coefficient of 0.082) and a previous period (with a coefficient of 0.179) and has had a significant and inverse effect with the exchange rate volatility, but the negative relationship of this variable with two periods of interruption, from a statistical point of view It is not significant. Therefore, it can be said that with the increase in Iran's oil revenues in the previous period and the current period, which is one of the main sources of the country's currency supply, the amount of volatility in the current period's exchange rate has decreased, and due to the existence of enough currency in the country to meet the demands, the volatility The exchange rate will be lower. According to the results of GDP per capita in both the current period and the previous period, it is not statistically significant and therefore it is not considered a significant variable in exchange rate fluctuations. The degree of openness of foreign trade is another important variable with a negative sign and a coefficient equal to 0.211, which has a statistically significant relationship with exchange rate fluctuations. Therefore, it can be expected that with the increase in the degree of freedom of trade and economic interactions and the entry of more currency into the country, the exchange rate fluctuations will decrease. The results related to economic sanctions in both periods of 1995-2005 and 2011-2015 with positive coefficients which are 0.128 and 0.219 respectively have a significant relationship with exchange rate volatility, and according to the numerical value of the coefficients, the effect of the sanctions of 2011 - 2015 is bigger than the previous period, which has increased trade restrictions and foreign exchange earnings. The currency system variable, which indicates the existence of a multi-rate currency system, is also seen to be significant, with a positive numerical coefficient equal to 0.169, which has influenced the increase in exchange rate fluctuations. The DW statistic shows that there is no autocorrelation problem in the model, and the R^2 coefficient of explanation is 0.91, which shows the high explanatory power of the behaviour of the dependent variable of exchange rate volatility by the independent variables of the model.

5.10 Examining classical assumptions and diagnostic tests

To ensure the correct estimation of the variables and to check the correctness of the model, we need to check the diagnosis tests. Therefore, to ensure the establishment of the classical assumptions of non-autocorrelation, homogeneity of variance, the normality of the residual sentences and the correct subordinate form, diagnostic tests are used, which are given in Table 8. Since the probability related to tests of autocorrelation (Breusch-Godfrey), heterogeneity of variance (White), the correct form of the model (Ramsey Reset) and normality (Jarque Bera) are all greater than 0.05, so normality cannot be rejected. The estimated model satisfies all the classical assumptions.

Table 8: Results of diagnostic tests

Classical assumption	LM test		F test	
	statistics	Prob	statistics	Prob
-				
Breusch-Godfrey	6.652	0.0671	2.790	0.0953
White	13.568	0.1176	1.983	0.0991
Jarque Bera	3.982	0.2341	-	-
Ramsey Reset	0.179	0.875	0.076	0.7621

5.11 Estimation of long-run coefficients

According to the results of Table 9, the only variable is GDP per capita that is not significant and its relationship with exchange rate volatility has not been statistically confirmed. Therefore, in the long run, oil revenues with the largest negative coefficient of 0.194 have had the greatest impact on the exchange rate volatility in Iran, and with the reduction of oil revenues, it has caused the greatest exchange rate volatility during the period in question. After this variable, respectively, the sanctions of 2011-2015 and the degree of openness of foreign trade and finally the sanctions of 1995-2005 had an effect on the exchange rate volatility. Two basic points are noteworthy in the results of the long-term model. First, the sign of the coefficients of significant variables is the same as the sign of the coefficients of the short-term model, and secondly, despite the similarity of the sign of the coefficients, the numerical values of all the variables in the long-term model are smaller than the short-term model. Therefore, it can be stated that the influence of independent variables on exchange rate volatility will be greater in the short term than in the long term. DW and R^2 values, like the short-run model, show the lack of autocorrelation and the high explanatory power of the independent variables in determining the behavior of the dependent variable.

Table 9: Estimation of long-run coefficients

Variable	Coefficient	t statistics	Prob
<i>EXOV</i>	-0.1941	3.4517	0.0021
<i>GDP</i>	-0.1102	1,2450	0.3269
<i>OP</i>	-0.1530	2.5621	0.0431
$T_{1374-1384}$	0.1192	2.3318	0.0257
$T_{1390-1394}$	0.1678	4.4123	0.0010
<i>NZ</i>	0.1241	3.5621	0.0391
-	$R^2=82.11$	DW=1.93	

5.12 Error correction model (ECM)

Error correction model (ECM) is used to relate short-run fluctuations of variables to long-run fluctuations. Error correction determines the speed of adjustment of variables; That is, the speed of returning the variables to equilibrium when the variables are out of equilibrium. After the long-term model, the error correction model is estimated. can be the coefficient of the error correction term ECM (-1) shows the speed of adjustment towards the long term and it is expected that the sign of this variable is negative and its value changes from negative one to zero. The coefficient of the error correction term is equal to 0.2102, which shows that if a short-term shock occurs, 0.21 of the difference caused by the shock disappears in each period, and the variables return to their long-term trend. Therefore, it takes about five periods for a shock to return to equilibrium. Also, the adjustment coefficient smaller than one indicates the convergence of the model in the long term.

Table 10: ARDL-ECM error correction model results

Variable	Coefficient	t statistics	Prob
$D(NTY(-1))$	0.241	4.783	0.0000
$D(EXOV(-1))$	-0.1673	-2.678	0.0213
$D(GDP(-1))$	-0.1470	-0.785	0.3561
$D(OP)$	-0.1411	-2.402	0.0378
$D(T_{1374-1384})$	0.1048	2.690	0.0043
$D(T_{1390-1394})$	0.1489	4.673	0.0012
$D(NZ)$	0.1099	3.701	0.0278
$ECM(-1)$	-0.2102	-6.872	0.0000
-	$R^2=96.72$	DW=2.081	Pro F=0.000

5.13 CUSUM test results

The final step in estimating the ARDL model is the stability test of the coefficients using the CUSUM method. The results of this test are presented in the chart below. Based on the results of the model, the coefficients of the variables are stable during the study period. The stability of the parameters is tested at a significant level of five percent. The confidence interval in this test is the distance between two straight lines, which shows a confidence level of 95%. Since the test statistic is between these two lines, the null hypothesis based on the stability of the coefficients cannot be rejected.

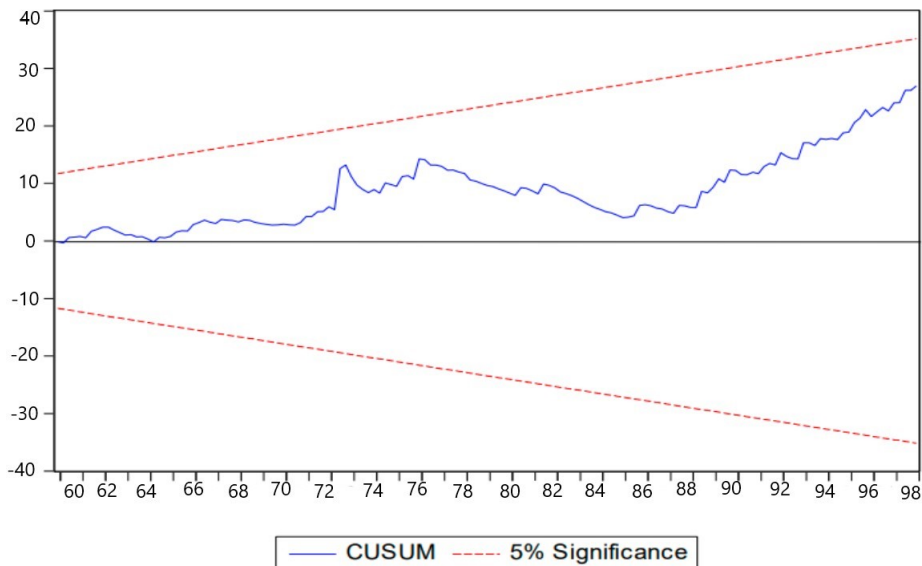


Figure 1: CUSUM test for exchange rate volatility model in Iran

6 Discussion and conclusion

Currency fluctuations have always played an important role in the fluctuations of various economic variables, including economic growth rate, production rate, inflation rate, etc., each of which is considered a separate topic in economic literature. Various studies in the economy of Iran and the world show that there are various factors on the exchange rate volatility, and their intensity and effectiveness can be different according to the amount and size of the shocks created.

Most of the studies conducted in the field of exchange rate volatility in Iran's economy with emphasis on indicators such as government spending, the volume of money, exports, and the degree of openness of the economy, etc. are few. Therefore, this study, taking into account the importance of political variables such as economic sanctions and the type of single-rate or multi-rate currency system, as well as per capita gross domestic product and oil revenues, which in previous studies in Iran's economy did not pay much attention to They had not been done, using an econometric model called "Autoregressive model with distributive interval (ARDL)" to investigate the short-run and long-run effects of economic, political and commercial variables affecting exchange rate volatility in Iran. The results of the

investigations showed that in the short run, except for GDP per capita, which has no relationship with exchange rate fluctuations, the rest of the variables of oil revenues from the current period and a previous period have a negative coefficient, the degree of trade openness has a negative coefficient and economic sanctions. - The two political sanctions periods of 1995-2005 and 2011-2015 and the governance of the multi-rate system with a positive coefficient, as well as the existence of currency fluctuations in a previous period with a positive coefficient, have a statistically significant correlation with exchange rate fluctuations. The results of the long-run model also showed that again, except for GDP per capita, the other independent variables of oil revenues, the degree of trade openness and economic sanctions, and the multi-rate exchange rate system, had a significant relationship with the volatility of the exchange rate during the years 1975-2019. The comparison of the obtained coefficients of both models also showed that the coefficient of the significant variables in the short-term model is larger than the coefficients of the long-term model, which shows that due to these components, the increase or decrease in the exchange rate changes in Iran is larger than the period It will be long term.

By comparing the findings of this study with previous studies, it can be seen that there are similarities and sometimes inconsistencies with previous studies in this field, including the results of [1], [25] in confirming the relationship between the degree of trade openness; [25], [15] for role of oil revenues; The study of [23] and [19] confirmed the positive impact of Western sanctions against Iran and the creation of currency turbulence and the entry of speculative demand into the foreign exchange market. In addition, the findings of this study were inconsistent with the findings of [8] regarding the significant and negative role of GDP on the exchange rate, and no significant relationship was observed in our study.

At the end of this study, the coefficient estimated in the error correction model also indicated that about five periods are necessary to adjust the imbalance in the short term and to establish a long-term equilibrium relationship. Therefore, to achieve these conditions, it seems that it is possible to control its turbulence by establishing a stable economic condition and clarifying the future trend of the exchange rate. Of course, a set of other measures is necessary, and according to the findings of this study, the following suggestions can be made:

1. *Management and diversification of income sources:*

- Reducing dependence on oil revenues: due to oil price fluctuations in the world market, relying on this source of income can increase exchange rate volatility. Therefore, it is necessary to reduce dependence on oil revenues by developing non-oil exports and attracting foreign investment.
- Scientific and more rational use of foreign currency reserve funds (development fund): by saving part of the oil revenues in this fund, we can use these resources for stability when we face a decrease in oil revenues, budget deficit, or an increase in the demand for foreign exchange. exchange rate used. Therefore, it is necessary to avoid the unnecessary use of the fund's resources and withdraw only for the main purposes of this fund.

2. *Structural reforms in the currency system:*

- Choosing the right currency system: Considering Iran's economic conditions, the correct implementation of the managed floating currency system can be considered as a suitable option for the stability of the exchange rate.
- Unification of exchange rate: The existence of different exchange rates for different goods and services can lead to rent-seeking and corruption and increase exchange rate volatility. Therefore, it is necessary to provide transparency and competition in the currency market by equalizing the exchange rate.

3. *Increasing the degree of openness of foreign trade:*

- Development of non-oil exports: With the increase of non-oil exports, the demand for foreign exchange increases and helps to stabilize the exchange rate.
- Reduction of import tariffs: By reducing import tariffs, competition in the domestic market will increase and benefit consumers.

4. *Reducing political and economic tensions:*

- Establishing diplomatic and economic relations with other countries: Political and economic tensions can lead to economic sanctions and increased exchange rate fluctuations. Therefore, it is necessary to provide stability and peace in the economic environment by establishing diplomatic and economic relations with other countries.

5. Implementation of disciplinary monetary and financial policies:

- Inflation control: High inflation can lead to an increase in demand for currency and exchange rate volatility. Therefore, it is necessary to control inflation at a stable level by adopting appropriate monetary and financial policies.
- Reducing the budget deficit: the government budget deficit can lead to an increase in liquidity and inflation and increase the volatility of the exchange rate. Therefore, it is necessary to minimize the budget deficit by reducing government expenses and increasing tax revenues.

Of course, it should be noted that the implementation of these policies should be done simultaneously and taking into account the economic conditions of the country. Also, before implementing any policy, its effects on other economic sectors should be carefully investigated.

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