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Determining and Estimating the Factors Influencing the Export of Urea Petrochemical Products to Export Destinations (UAE, Turkey, China, and India) Using Autoregression with the Distributive Lag Model (ARDL)

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ABSTRACT

As the largest exporter of non-oil products, the petrochemical industry's growth and development have a significant role in economic prosperity. Considering the sanctions on crude oil exports in recent years and the problem of crude oil sales, it is essential to pay attention to this industry as an influential factor in circumventing sanctions and currency for the country, developing its economic strategy, and achieving sustainable economic development. In this study, the factors affecting the supply of methanol exports to the UAE, Turkey, China, and India export destinations in the period 2001–2009 are examined and analyzed. According to the studies, the factors that have affected the supply of Iranian methanol exports are the GDP of target countries, real exchange rate, exchange rate fluctuations, trade liberalization, price exchange ratio, refinery feed prices, and sanctions as the livestock variables. In this study, the actual exchange rate volatility index was estimated using the GARCH model. Then, the export supply model of Iran's methanol product was calculated by the ARDL method. According to studies, the variables of GDP and trade liberalization have a positive and significant effect on the supply of Iranian exports in the short and long term. Still, other variables have a negative and significant impact on the supply of Iranian exports in the short and long term.

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1. Introduction

One of the most critical issues widely discussed in macroeconomics is the selection of appropriate policies and tools to eliminate imbalances and create economic stability. As one of the most essential sectors of the economy, exports interact with other sectors and are mutually influenced by other sectors. It is necessary to consider the developments within this sector while considering the totality of policies adopted for all industries or macroeconomic policies so as to conduct a comprehensive study (Mileva, 2015; Sekkat, 2016). Developing countries, including Iran, have a high degree of macroeconomic instability. Exchange rates, inflation, and other critical macro variables fluctuate more than advanced and industrial economies in these countries. These fluctuations, in turn, create an uncertain environment for financiers and make economic agents and investors unable to decide on direct investment easily. To reduce the dependence of Iran's economy on revenues from oil exports and the sustainability of the country's economic development, the expansion of nonoil exports and diversification of export revenues has been raised as a necessity. Meanwhile, the petrochemical sector is essential for various reasons, including the greater dependence of products in this field on domestic resources and having a minimum valuation compared to other economic sectors. In addition, in recent years, the petrochemical sector has always had a significant role in the country's non-oil exports (Barghi Oskooi, 2014).

Given the importance of the exchange rate as a critical variable in an open economy, extensive studies on the exchange rate and issues related to exchange rate instability and uncertainty have been conducted in recent years. This rate affects many government policies in the field of economics. As a result, deviations and instability in exchange rate behavior always affect other economic sectors, including the general level of prices, total production, and especially non-oil exports. In the case of Iran, government interference in the foreign exchange market and the injection of petrodollars have disrupted the foreign exchange market and practically caused the real exchange rate to deviate from the long-run balanced path, leading the investment cost to a lack of appropriate and optimal allocation of resources and thus increasing production costs. An increase in production costs will lead to a rise in price and, consequently, a decrease in non-oil exports (Kazeruni et al., 2016).

The present work examines how the exchange rate volatility, the real exchange rate, the GDP of target countries, prices of refinery raw materials, exchange rate relation, trade liberalization, and sanctions affect the supply of Iran's urea exports from 2001 to 2019. In the next chapter, the theoretical foundations of the subject are reviewed. After that, the literature and the domestic and international history of the issue are reviewed, and in the fourth chapter, the research method is examined. The next chapter introduces the model, and the appropriate model is specified to discuss the research hypotheses. In the last chapter, the results of model estimation and analysis of research findings are presented. The final part of the article is dedicated to concluding and providing policy recommendations.

2. Theoretical foundations

In recent years, the discussion of factors affecting the supply of a country's exports, especially factors influencing the supply of non-oil exports, has become one of the main concerns of economists. Various people have proposed economic modeling to study this issue and macroeconomic factors affecting non-oil exports. One of the most important empirical studies conducted by Boug and Fagereng (2007) and Chitt et al. (2008) is the model proposed for the export supply of non-oil products, expressed in Equation (1).

$$LNOX_t = \beta 1 + \beta 2LRER_t + \beta 3LVOL_t + \beta 4LGDP_t + \beta 5LTOT_t + \beta 6\Delta LP_t \quad (E1)$$

In this equation, the dependent variable indicates the logarithm of product exports. The explanatory variables include the logarithms of the actual exchange rate, the accurate exchange rate volatility index, the GDP, the exchange relationship, and the exact exchange rate deviation.

On the other hand, in addition to the economic factors discussed in Equation (1), non-economic factors, including trade liberalization, affect the export supply of products. Trade liberalization and the lifting of trade restrictions are among the main concerns of policymakers in different countries. In Nigeria, the ARDL approach has been used to analyze the impact of trade liberalization policy on non-oil export trade. Evidence supports trade liberalization as a stimulant of non-oil export growth. Consequently, this study proposes a private partnership agreement for private sector productivity (a significant player in non-oil export

trade) to make the most of the benefits of liberalization in Nigeria (Ojike et al., 2020).

Further, regarding the effect of the real exchange rate instability on exports, it can be stated that real exchange rate instability indicates uncertainty in the process of relative prices between countries. These sharp fluctuations create an unstable and uncertain environment in the economy. Basically, with the disturbance of the real exchange rate, the savings and investment process become irrational, and the optimal allocation of resources will not be possible. In an international system, the value of the national currency plays a crucial role in determining the economic costs associated with investing, exporting, and importing and its impact on economic growth. Frequent fluctuations in the real exchange rate can cause uncertainty and volatile conditions in the field of profits from international exchanges, reducing trade and slowing the flow of capital by reducing investment in foreign activities and disrupting the portfolio of financial assets. Moreover, the diversity of actual exchange rate fluctuations raises the price of tradable goods and increases the risk of covering unforeseen changes in the real exchange rate (Mtembu and Motlaleng, 2017)

Trade liberalization is considered a non-economic variable in the model, equal to the ratio of total imports plus exports to the country's GDP. Given this issue, if diverse markets for exports are discovered, and the necessary export support is increased, this issue will increase the effectiveness of trade liberalization variables and thus increase export supply. One of the factors affecting the country's export trend is the ratio of world prices to domestic prices. In other words, this ratio shows the competitiveness of the domestic product compared to the foreign counterpart. The lower the cost price of a household product compared to a foreign one, the higher the country's export potential and the higher the global demand for the domestic product.

Moreover, the irregular instability of the real exchange rate can severely affect the value of exported goods and the cost of imported goods in the national currency. On the other hand, some importers and exporters may reduce their trading activities. Those exporters and importers who continue to operate in global markets in an uncertain and volatile environment of the real exchange rate may demand more profit to bear the risks. Accordingly, the country's foreign trade is risk-averse, and the share of business in GDP is greater. These fluctuations will have a more significant impact on reducing domestic production, increasing prices, limiting exports, and restricting the sense of stability and security required for economic planning and activities (Boug and Fagereng, 2014).

If the exchange rate is severely volatile, exporters and importers will not have a clear idea of the export earnings and the cost of imports in domestic currency at the time of the contract. Of course, the exchange value of exported and imported goods is known at the time of the agreement. Still, since it takes a while to receive export revenue and sell imported goods, exchange rate fluctuations can severely affect the value of exported goods and the cost of imported goods. These revenues and expenses may be very different when we make a transaction. In this situation, depending on the degree of risk aversion of foreign trade actors in the country and the condition of the domestic market one of the following situations is faced (Kouchakzadeh et al., 2013).

Some importers and exporters will generally refrain from such trades because they do not bear the risk that their income will suddenly change. In such a situation, the number of foreign exchanges will be reduced. The optimal allocation of resources will be disrupted, and investors will be forced to invest their capital in a more profitable and less risky direction.

Some exporters and importers who cease their activities demand higher profits for their risk-taking. If these profits do not accrue to them, they will invest in activities that constitute global demand, and no country has the power to set world prices. Foreign trade operators will offset this increase in profits by buying cheaper from manufacturers and selling more expensively to domestic buyers. Buying more than a producer can afford will reduce the incentive to produce and decrease the production of export goods. Moreover, selling export goods at a higher price to domestic consumers will increase the general level of prices, leading to domestic inflation. Thus, the country's foreign trade agents are risk-averse, and the share of foreign trade in the GDP is higher. Exchange rate fluctuations more significantly reduce domestic production, increase prices, and threaten the foreign trade. There will be many unforeseen gains and losses in this situation, but the stability and security required for economic activities will be significantly weakened.

Having a real balance exchange rate does not mean that the real exchange rate is always in equilibrium. Conversely, in practice, the real exchange rate can deviate from its long-run equilibrium value in the short run. This deviation from the equilibrium rate at the real exchange rate is called imbalance. As an economist who

has conducted comprehensive studies on the real exchange rate of equilibrium and imbalance, Sebastian Edwards believes that one of the most important reasons for imbalance of the real exchange rate is the inconsistency between monetary and financial policy and the used equality rate system. In other words, the choice of an equality rate system places certain constraints on macro-policies. If these restrictions are not observed, unstable conditions will arise, followed by imbalances of the real exchange rate. McDonald, for example, attributes the actual exchange rate deviation from purchasing power parity to the influence of variables such as efficiency, the combination of government spending between traded and non-traded goods, government fiscal policy, private savings, and actual oil prices (Caputo, 2015).

3. A review of domestic and international empirical studies

Different studies have been conducted in Iran concerning the supply of petrochemical products and non-oil exports using other economic models discussed below.

Hosseini et al. (2016) studied a dynamic model for formulating effective capacity development policies in Iran's petrochemical industry to complete the value chain. They aim to determine the factors affecting the development of the petrochemical industry and model the mechanism of budgeting to increase capacity using the system dynamics approach. The quantitative system dynamics model is based on causal relationships and development budget allocation mechanisms among classified products. This structure is used to simulate the model and examine the essential variables related to each product, such as production capacity value, production rate, domestic sales revenue, and exports. According to the simulation results in 2025, Iran will have an approximate capacity of 104 million tons of petrochemical products, which is not desirable. In this study, the policy of improving the budget plan and allocation is introduced as the most effective solution to develop the petrochemical industry and increase exports. By implementing this policy, total production capacity and revenue in 2025 will be improved by 4% and 13%, respectively, compared to the basic plan (Hajiebrahimi Farashah et al., 2021)

In their study entitled "Real exchange rate shock and export-oriented trades in Iran", including the export of petrochemical industries as one of the industries, Saadati et al. (2016) studied using nonlinear asymmetric model (NARDL) to analyze the effects of shock. The actual exchange rate of the industry's exports took place from 2012 to 2020, and the research findings showed that when the exchange rate increases, the price of products in the international arena increases. According to this study, the positive effects of the exchange rate of the petrochemical industry were more significant. In this study, since the results of the whole NARDL model were statistically significant (based on FBound, for long-term models, and F-statistic, for dynamic short-term models), the nonlinearity of the relationship between the variables was significantly confirmed (Saadati et al., 2020)

In a study entitled "Study of the comparative advantage of petrochemical production and export of Arvand Mahshahr Petrochemical Company", Promoters and Goodarzi (2021) examined the comparative advantage of production and export of petrochemical products of this company and the factors affecting it using RCA indicators or obvious comparative advantage. The apparent comparative advantage of RSCA, trade intensity, production intensity index, and Mitchell MI index was discussed. The result demonstrates that the higher the comparative advantage of a country in producing petrochemical products is, the more exports that country has, having more and more competitiveness in global markets.

In Bahadoran's (2016) study on "The impact of international sanctions on Iran's petrochemical industry with an emphasis on exports and foreign direct investment", the research method is descriptive and analytical, and the ARDL vector autoregression method is used to study co-integration and relationships. Long-term has been used between variables. The result of model estimation shows a positive and significant effect of the total production of petrochemical complexes on attracting foreign direct investment in the petrochemical industry during the research period. The impact of the ratio of the export to production volume of petrochemical complexes on attracting foreign direct investment in the petrochemical industry is positive and statistically significant. The effect of the profit variable on attracting foreign direct investment in the petrochemical industry is positive and meaningful. The more foreign direct investment is made, the more positive and significant it will be to the export of petrochemical products.

In a study entitled "The study of the effects of price and non-price factors on Iran's non-oil exports", Karami et al. (2020) investigated the issue that invisible non-economic factors are influential in addition to economic

factors affecting exports such as prices and GDP. Therefore, the results indicate a significant difference in elasticities in estimating the export demand function despite non-price factors and without evaluating these factors. Thus, ignoring these factors in calculating the export demand function leads to covering the effect of non-price factors by price factors and skew in estimating elasticities (Karami et al., 2019)

In their work entitled "The impact of privatization on the export performance of Iranian petrochemical companies (case study: polyethylene)", Varhrami et al. (2015) investigated the effect of privatization policy on the export performance of four major petrochemical companies, namely Amirkabir, Jam, Maroon, and Ariasasol. The result demonstrated that the effect of privatization on the export of petrochemical products (polyethylene) of the mentioned companies to the two target countries, namely China and India, together and separately during the period under study was negative. In other words, the privatization of petrochemical companies with the method done in Iran has increased their export volume. The present study shows that privatization has not been successful in the petrochemical industry (with the technique done in Iran) and with the export approach that the current study sought to examine during the years under review (Varhrami et al., 2018)

Calligrapher Yazdi and Rajabzadeh (2017) in a study entitled "The effect of actual exchange rate changes on Iran's non-oil exports", examined the impact of real exchange rate changes on Iran's non-oil exports and used the ARDL method from 1982 to 2012. In the short and long term, the error correction model was estimated. The obtained results show the coefficients of the variables of GDP of Iran's trading partners, the real exchange rate, and the GDP. In Iran, at the level of 5%, it was positive and significant both in the long and short run. In contrast, the variable coefficient of credits granted to the private sector was meaningless in the short run and substantial and positive in the long run (Yazdi et al., 2017).

In a study entitled "The effect of actual effective exchange rate deviation on Iran's non-oil exports", Kazeruni et al. (2016) assessed exchange rates and related issues, given the importance of the exchange rate as a critical variable in an open economy. The instability and uncertainty of the exchange rate have been addressed in recent years. This rate affects many of the government's economic policies. As a result, deviations and instability in exchange rate behavior always affect other economic sectors, including the general level of prices, total production, and especially non-oil exports. In the case of Iran, government intervention in the foreign exchange market and the injection of petrodollars have disrupted the foreign exchange market and effectively diverted the real exchange rate from the long-run equilibrium path. The deviation of the real exchange rate from its long-run equilibrium path in the sense of disturbing relative prices and estimating investment costs will lead to inadequate and optimal allocation of resources and thus increase production costs. An increase in production costs will lead to higher prices and, consequently, a decrease in non-oil exports, especially petrochemical products (Kazeruni et al., 2016)

A study entitled "Does trade liberalization policy improve the performance of non-oil export trade in Nigeria?" uses the ARDL method to analyze the impact of trade liberalization policy on non-oil export trades. Evidence supports a trade liberalization policy as a driver of non-oil export growth. As a result, this study proposes a private partnership agreement for private sector productivity (a significant player in non-oil export trade) to make the most of the benefits of liberalization in Nigeria (Ikpe et al., 2020).

In a study, they examined the importance of non-price competition and financial factors in explaining the performance of non-oil exports of 20 regions of Italy during 2013–2000 and the years before the crisis using the method of dynamic panel data analysis. The study results show that supply-side factors are the important determinants of export behavior and performance. Financial development also substantially impacts regional trade because higher economic development indicates that more credit is available and, consequently, the value of exports is higher. This study also shows that investment and the desire for research and development effectively increase non-oil exports (Algeria et al., 2018).

A study examined the short-term and long-term effects of Sri Lankan export determinants. The export of petrochemical products is also seen as one of the most influential sectors in the period 1980–2013 with the help of the vector error correction model. In this study, foreign direct investment, interest payments on foreign debt, imports, gross capital, and per capita income were examined as the determinants of exports. The results show that all factors significantly impact exports in the long run, including foreign direct investment and interest payments on foreign debt and imports, and the formation of gross capital and per capita income of these destination countries have a negative impact. In the short

run, the effects on foreign direct investment and the per capita income of the destination countries, as well as the effects on interest payments on foreign debt, imports, and gross capital formation, were negligible (Bhavan, 2016).

A study examined the effect of the exchange rate of Nigeria's non-oil exports during the years 1986–2013. In this study, the generalized Dickey–Fuller test (ADF) was used to investigate the staticity of the research variables, and the Johansson co-integration test was used to investigate the short-term and long-term relationships between the variables. The results of the Johansson co-integration test showed that there is a long-term relationship between the research variables. The ordinary least squares (OLS) technique was used to investigate the impact of economic factors on Nigeria's non-oil exports. This study showed that effective exchange rates, money supply, loans to the private sector, and financial performance significantly impact the growth of Nigeria's non-oil exports. This study also showed that the increase in the exchange rate harmed Nigeria's non-oil exports during the study period (Imoughele and Ismaila, 2015).

A study examined the effect of fluctuations in the exchange rate of Nigeria's non-oil exports during 1986–2008. To study the statics of variables, the generalized Dickey–Fuller and Phillips–Prone tests were used to investigate the existence of long-term relationships and estimate the model and the factors affecting non-oil exports. This study showed that exchange rates, exchange rate fluctuations, and foreign income positively affect non-oil exports in the long run. In contrast, imports have an adverse impact on exports in the long run. The results of the vector error correction (ECM) model also showed that in the short run, intermittent foreign income has a positive effect on Nigeria's non-oil exports. It has a positive impact on non-oil exports and, finally, in the short run, exchange rate fluctuations do not significantly affect non-oil exports (Akinlo and Adejumo, 2014).

Another study examined the effect of real exchange rates on non-oil exports in Azerbaijan using the method of asymmetric error correction. It used the threshold autoregressive method (MTAR) and the threshold autoregressive method (TAR) in the framework of asymmetry and asymmetric adjustment and employed the annual data during 2000–2010 quarterly. The main findings demonstrated that there is a significant relationship between non-oil exports, non-oil trade volume based on actual exchange rates, and foreign income. Still, the adjustment process is not asymmetric to the equilibrium level (Hasanov, 2012).

From the studies conducted, it is concluded that economic factors and variables such as actual exchange rates, exchange rate fluctuations, exchange rate, GDP of countries affect the supply of non-oil exports. In the present study, the proposed innovation introduces a non-economic variable, including the trade liberalization variable. This study discusses the effects of this variable on Iran's methanol exports.

4. Research method

In this research, the supply model of urea export to the target export destinations is estimated. Assuming that Iran is a small and cost-effective supplier and sells its products in a competitive market and considering the economic literature and empirical works of Boug and Fegerang (2007) and Chitt et al. (2008), the model proposed for the supply of exports of Iranian petrochemical products is defined as:

$$LX_i^s = \alpha_0 + \alpha_1 LRER_t + \alpha_2 LGDP_t + \alpha_3 LTOT_t + \alpha_4 LGP_t + \alpha_5 LCL_t + \alpha_6 LVOL_t + D_{SA} + V_t$$

where *t* indicates the time dimension, *i* represents the countries in the data, LX is the supplied export logarithm of methanol and urea, LRER denotes the real exchange rate logarithm, LGDP is the target country GDP logarithm, LTOT stands for exchange relationship logarithm, LTC is transportation cost logarithm, LGP indicates natural gas feed price logarithm, LCL is trade liberalization logarithm, LVOL indicates the real exchange rate volatility, and D_{SA} is the virtual variable of sanctions.

The real RER exchange rate is obtained by multiplying the informal market rate by the US wholesale price index ratio to the Iranian consumer price index (Abbasian et al., 2012).

$$RER = NER \times (WPI_{ic}/CPI_{IR})$$

where NER is the nominal exchange rate in the informal market (parity of one US dollar against the rial from the Central Bank), WPI_{us} denotes the wholesale price index of the destination country used as a representative of the commodity price index (the base year 2002, no unit, source of the International Monetary Fund IFS), CPI_{IR} indicates Iran Consumer Price Index (base year 90, Central Bank source).

In this project, the exchange relation is calculated by:

$$TOT = \frac{PEX}{PIM}$$

where PEX is the price index of exported products, and PIM is the price index of imported products. D_{SA}, as a virtual variable of sanctions (sanctions on the petrochemical industry that has been in force since 2010), which is number one for sanction years and zero for non-sanction years[2].

After specifying the export supply function, the present study uses the ARDL method to investigate the factors affecting the export of petrochemical products (urea). Then, after examining the reliability of the model variables by export destinations of UAE, Turkey, China, and India [3] for the years 2001–2009, the model is specified and estimated separately by the self-regression vector model with wide distribution intervals (ARDL).

The novelty of the present study, compared to previous studies, is that this study uses non-economic variables, including trade liberalization variable in the export supply model, and economic variables. It also investigates the effects of these variables on the export supply performance of the country's urea product.

4.1. Checking the reliability of variables

One of the essential requirements in estimating economic equations with time-series data and estimating the model by the conventional least-squares method is to perform a reliability test. There are several methods for distinguishing stable time series from unreliable, the most important of which is the generalized Dicky–Fuller and Dicky–Fuller unit root test. Therefore, first, the reliability of the proposed model variables based on the generalized Dickey–Fuller (ADF[4]) test is examined to determine whether the regression is false or not. The null hypothesis of this test based on the unit root of time series variables based on McKinnon test statistics is examined in the following tables.

Table 1. Results of the reliability of variables for Turkey.

LCL	LVOL	LGP	LTOTu	LGDPtur	LRER	Lxutur	Variable name
I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(1)	Condition
–3.7700	–12.3500	–3.8207	–4.4320	–5.7264	–3.7121	–5.4975	Statistics
0.0126	0.0000	0.0121	0.0034	0.0012	0.0141	0.0021	Prob.

Source: Research Findings

Table 2. Results of the reliability study of variables for China.

LGDPch	Lxuch	Variable name
I(1)	I(1)	Condition
–4.8468	–3.4738	Statistics
0.0082	0.0259	Prob.

Source: Research Findings

Table 3. Results of the reliability of variables for India.

LGDPin	Lxuin	Variable name
I (1)	I (1)	Condition
–4.8167	–3.9626	Statistics
0.0070	0.0092	Prob.

Source: Research Findings

Table 4. Results of the reliability of variables for the UAE.

LGDPuae	Lxuuae	Variable name
I (1)	I(1)	Condition
–4.0947	–5.2266	Statistics

[2] Statistical information related to the data was derived from the National Iranian Petrochemical Company.
[3] The reason for selecting these four countries as export destination countries in the present study is that in recent years, the largest volume of urea exports has been toward these destinations.
[4] Augmented Dickey–Fuller

0.0255	0.0007	Prob.

Source: Research Findings

4.2. Specifying the exchange rate instability model

The final step in estimating the actual exchange rate volatility index is to evaluate the conditional variance equation, including the disorder under variance heterogeneity conditions. The squared squares of the mean equation disorder are estimated to assess the dependent variance equation. Then the self-regression order and the moving average are determined based on the correlation graph. In addition, it is necessary to test the distribution of disorders in the conditional variance equation and, if the distribution is not normal, use the generalized error distribution. The test results of the conditional variance equation disorder distribution are as follows:

Table 5. Results of Jarque-Bera test to check the normality of the conditional variance equation distribution terms.

Probability value	Jarque-Bera statistic value (J-B)
0.0000	81.34

Source: Research Findings

The above table shows that the mean equation disorder sentences does not have a normal distribution. Therefore, the generalized error distribution can estimate the conditional variance equation.

It is necessary to use the GARCH model in Ives software to study and estimate exchange rate fluctuations, and before assessing the GARCH model, the effect of the arch must first be examined. This model is the background for evaluating the GARCH model, according to the results obtained from the ARCH model estimate, shown in the table below. The results indicate that Arch affects estimating the actual exchange rate volatility model.

Table 6. Results of ARCH test for standardized wastes of GARCH model (0,1).

F-statistic	7.6372	Prob. F (1,14)	0.0021
Obs*R-squared	6.2195	Prob. Chi-Square (1)	0.0043

Source: Research Findings

The results obtained from estimating the mean model and conditional variance are as follows:

Mean equation:

DL(VOL) = –0.001621 + 0.174 (12) + AR 0/412 MA (1) + ε
(0.00023) (0.031) (0.054)

Equation of variance:

h_t = 2.45 εt – 12 + 0/483 H_{t-1}
(0.761) (0.275)

Further, to estimate the conditional variance equation of the perturbation sentences, the square diagram of the perturbation sentences of the mean equation should be used, based on which the optimal autoregressive interference and the moving average in the variance equation should be determined. Therefore, the most suitable model for estimating the actual exchange rate volatility index is the GARCH model (0,1), the results of which are presented in Table 7.

Table 7. GARCH model estimation (0.1)

Probability value	The statistical value of Z	Coefficient	Variable name
----	----	----	H_t
0.0347	2.1122	0.004	C
0.0000	6.4678	0.86	H_{t-1}

Source: Research Findings

The GARCH (0,1) model is suitable compared to other competing models considering the necessary and sufficient conditions of the generalized self-regression model under the conditions of variance heterogeneity. Therefore, the exchange rate fluctuations were extracted by the GARCH model and entered the model using Ives

software. According to the model estimation results, the negative impact of this variable on the supply of methanol and urea exports has been proven.

5. Estimation of the research model

In this section, to estimate the effect of actual exchange rate deviation and nominal exchange rate instability on methanol and urea exports, it is calculated using the ARDL method and annual data from 2009 to 2010. Before estimating the model, the mana test should be performed using the generalized Dickey–Fuller method, conducted in the previous section to ensure that none of the many variables are higher than one. In this case, false regression is prevented. Because when there are many variables of order higher than one in the model, calculated F is not reliable and meaningful. The F test is based on the assumption that all variables in the model are I(0) or I(1). The results show that the time series are either staggered from zero and at a static level or are stationary with a one-time differentiation. Therefore, there is no problem in terms of the existence of variables I(2) and more, and the results can be assured. Then, using the bond co-integration test, the presence of a long-term relationship in the model is examined. The classical hypotheses test, the coefficient stability test, and the presentation of a long-term relationship are discussed. Finally, the short-term relationship of the model is presented. The results of diagnostic tests and structural stability tests show that the classical assumptions for the desired estimate are established, and the coefficients are stable.

Given that the order of co-accumulation of the variables is the same, the Johansson summative test can be used to determine the convergence vector. The concept of cohesiveness evokes a long-term equilibrium relationship to which the economic system moves over time. In multivariate analysis of time series, there may be more than one long-run aggregation relationship between variables. Through maximum likelihood estimators, Johansson can detect multiple aggregation and the best aggregation vector. In addition, this method can test the aggregate vector in a constrained manner and estimate the speed adjustment parameters. Therefore, this test is one of the complete tools in estimating economic time-series patterns.

In the combined test of this research, a systemic approach has been prevailing although the principle of modeling has been a single equation. In this method, the determination and estimation of convergence vectors (determination of coefficients related to long-run equilibrium relationships) between variables is done using the vector coefficients of the self-explanatory model (VAR). The basis of this method is based on the relationship between the order of a matrix and its characteristic root. In this method, two types of tests are presented to obtain the number of integral vectors.

The Eviews computer package and the Johansson summative test, called the Ratio Likelihood, are introduced as the basis for the judgment. If the LR is less than the critical values of the table at different confidence levels, the assumption of the existence of a cohesive vector is accepted. The following table, related to the Johansson summative test, was performed with the Eviews program. The existence of a long-run relationship between dependent and explanatory variables was tested, and the presence of a long-term relationship was proved.

Table 8. Results of the collective test of urea exports to China.

Statistics of maximum eigenvalues		Effect test		Special amount	Hypothesis zero
Critical value at 95% level	Statistics of maximum eigenvalues	Critical value at 95% level	Effect statistics		
75.88736	117.36212	145.23174	263.28214	0.993413	r = 0
45.96429	67.82613	96.35271	168.37322	0.945321	r ≤ 1
39.36481	42.23743	73.64829	83.92713	0.853852	r ≤ 2
34.35795	21.44721	53.27452	45.43094	0.725520	r ≤ 3
22.77497	11.36492	27.63781	20.47252	0.648227	r ≤ 4
16.37462	5.26487	11.73521	6.36260	0.362494	r ≤ 5
4.24772	0.53728	2.74210	0.75381	0.013592	r ≤ 6

Source: Research Findings

Confirmatory factor analysis evaluates the degree of conformity between the theoretical structure and the experimental structure of the research. The below shows the factor analysis model with standardized path coefficients and loads (Figures 3 and 4).

Table 9. Distribution of variables based on Kolmogorov–Smirnov test.

Parameters	Kolmogorov–Smirnov test		Distribution type
	Statics value	Significance level	
Human resources	0.113	0.00	Abnormal
Leadership	0.157	0.00	Abnormal
External environment	0.097	0.00	Abnormal
Internal processes	0.199	0.00	Abnormal
Financial factors	0.108	0.00	Abnormal
Production and procurement	0.161	0.00	Abnormal
Marketing	0.079	0.00	Abnormal

Source: Research Findings

Table 10. Results of the collective test of urea exports to Turkey.

Statistics of maximum eigenvalues		Effect test		Special amount	Hypothesis zero
Critical value at 95% level	Statistics of maximum eigenvalues	Critical value at 95% level	Effect statistics		
48.37642	74.58732	167.37255	224.53126	0.995742	r = 0
44.50392	60.37573	104.74824	169.37214	0.936614	r ≤ 1
35.018355	35.95742	83.76309	94.28452	0.858391	r ≤ 2
27.60031	25.55829	59.32758	58.37251	0.757690	r ≤ 3
23.91836	11.58463	28.47673	25.85626	0.549581	r ≤ 4
15.99058	7.80537	18.49462	14.95984	0.446640	r ≤ 5
2.45193	1.44429	3.857443	2.598375	0.071913	r ≤ 6

Source: Research Findings

Table 11. Results of the collective test of urea exports to the UAE.

Statistics of maximum eigenvalues		Effect test		Special amount	Hypothesis zero
Critical value at 95% level	Statistics of maximum eigenvalues	Critical value at 95% level	Effect statistics		
48.48772	115.82092	128.48261	217.31065	0.990021	r = 0
43.57392	49.94025	97.47414	163.82014	0.957251	r ≤ 1
36.47620	46.94762	79.47203	121.47359	0.927553	r ≤ 2
30.57495	29.57360	75.39203	73.28502	0.827453	r ≤ 3
27.36103	24.90736	49.88508	46.38104	0.756625	r ≤ 4
14.47200	4.58610	15.74924	11.59373	0.394014	r ≤ 5
2.57391	1.15029	3.89201	2.457750	0.083501	r ≤ 6

Source: Research Findings

To estimate the primary relationship of the research model, first, due to the limited number of observations, the maximum value of one interrupt was considered for the dependent variable, and the interrupt was not considered for explanatory variables due to alignment between variables and the impossibility of estimating the model. Ordinary squares were calculated, then using the Schwartz–Bayesian criterion, one of the estimated equations was selected as the dynamic relationship between the variables. The following table presents the obtained dynamic relation. The optimal interruption of the total export of methanol and urea petrochemical products and the other variables were considered without disruption, and the model was estimated as ARDL (1,0,0,0,0,0,0). Exports of urea to China in 1982, 1987, and 1994 jumped and caused structural failure, so these seals are entered the model as a livestock variable. Due to the current years, the shock has entered the model. The model has experienced fluctuations in the country's export supply, which has affected the dependence of the dependent variable on the explanatory variables. These seals have had a significant negative impact on urea exports to China in the short term. Classic assumptions are also appropriate. For the analysis of coefficients, for brevity in the paper, a case is referred to as an example of the exchange relationship in the short term. If it increases by one percent, the export rate decreases by 2.74 percent.

Table 12. Results of dynamic model estimation (short-term estimation of urea export supply function to China).

t statistic	Standard deviation	Coefficient	Variable name
2.985 (0.0235)	0.0621	1.059	LXUCH (–1)
–5.190 (0.0020)	0/7524	3.905	LGDPCH
–2.920 (0.0266)	1.0026	–2.928	LRER
1.928 (0.0121)	0.3873	–2.747	LTOTU
–4.912 (0.0027)	1.8817	2.341	LCL
4.529 (0.0040)	0.4442	–2.012	LGP
6.025 (0.0009)	0.3855	–2.322	LVOL
–0.3558 (0.7341)	0.3548	–0.126	DSA
–2.1837 (0.0717)	0.3085	–0/673	Dum82
–3.7227 (0.0098)	0.3679	–1.369	DUM87
–14.667 (0.0000)	0.3662	–5.371	DUM94
R^2 = 0.991	F(11,4) = 67.095	DW = 2.1211	–
Assumption test			
Analysis of variance χ^2= 0.3310 [0.4218] Self-correlation test χ^2 = 0.8543 [0.9653] Normality test χ^2 = 1.1792 [0.5545]			

Source: Research Findings

Table 13. Results of dynamic model estimation (short-term estimation of urea export supply function to India).

t statistic	Standard deviation	Coefficient	Variable name
9.101 (0.0003)	0.0960	0.874	LXUIN (–1)
–1.518 (0.0214)	0.9227	1.401	LGDPIN
–2.642 (0.0459)	0.6160	–1.627	LRER
–0.094 (0.928)	0.2969	–0.027	LTOTU
–4.1526 (0.0089)	1.2732	5.287	LCL
–1.944 (0.1094)	0.4647	–0.903	LGP

t statistic	Standard deviation	Coefficient	Variable name
1.774 (0.0012)	0.3461	–0.614	LVOL
–2.335 (0.0667)	0.4937	–1.153	DSA
–6.895 (0.0010)	0.2308	–1.591	Dum82
–3.543 (0.0165)	0.4342	–1.538	DUM88
4.811 (0.0048)	0.3447	1.658	DUM91
2.4523 (0.0578)	0.2215	0.543	DUM96
R^2=0.997	F (12,5) =154.68	DW = 3.144	–
Assumption test			
Analysis of variance χ^2= 0.4369 [0.6203] Self-correlation test χ^2 = 0.6591 [0.6512] Normality test χ^2 = 0.5076 [0.7758]			

Source: Research Findings

According to Table 14, urea exports to India jumped in 1982, and the exchange rate and the real exchange rate jumped in 1988, 1991, and 1996. Further, in 1991 and 1996, trade liberalization showed a jump, so these years have been included in the model as livestock variables. The embargo has had a significant negative impact on urea exports to India in the short term. For example, with a one percent increase in sanctions, exports will decrease by 1.15 percent.

Table 14. The results of dynamic model estimation (short-term estimation of urea export supply function to Turkey).

T statistic	Standard deviation	Coefficient	Variable name
4.530 (0.0062)	0.0724	0.328	LXUTUR (–1)
–3.164 (0.0612)	0.7096	0.115	LGDPTUR
–3.424 (0.018)	0.5472	–1.873	LRER
4.944 (0.0043)	0.2537	–1.254	LTOTU
–0.293 (0.7806)	0.9433	0.277	LCL
–3.554 (0.0163)	0.2490	–0.885	LGP
2.713 (0.0421)	0.3093	–0.839	LVOL
3.565 (0.0161)	0.1633	–0.582	DSA
–5.042 (0.0040)	0.1833	–0.924	Dum83
–2.708 (0.0424)	0.1803	–0.488	DUM85
9.879 (0.0002)	0.1737	1.716	DUM93
–4.675 (0.0055)	0.1789	–0.836	DUM96
R^2 = 0.999	F (12,5) = 445.51	DW = 2.606	-
Assumption test			
Analysis of variance χ^2= 0.2036 [0.1244] Self-correlation test χ^2 = 0.7231 [0.1321] Normality test χ^2 = 03358 [0.8454]			

Source: Research Findings

In the export of urea to Turkey and the UAE, some years have been used as a variable due to fluctuations in model variables in these years.

Table 15. Results of dynamic model estimation (short-term estimation of urea product supply to UAE).

t statistic	Standard deviation	Coefficient	Variable name
–6.894 (0.0023)	0.1250	–0.862	LXUUAE (–1)
3.689 (0.0210)	2.2410	8.269	LGDPUAE
2.984 (0.0406)	2.1945	–6.549	LRER
–1.729 (0.0312)	0.7698	–1.331	LTOTU
2.389 (0.0752)	4.634	11.076	LCL
–2.925 (0.0430)	0.8210	–2.402	LGP
–1.864 (0.0120)	0.7189	–1.340	LVOL
–2.945 (0.0421)	0.3974	–1.170	DSA
–5.216 (0.0064)	0.5234	–2.730	Dum81
–2.374 (0.0765)	0.4094	–0.972	DUM90
9.761 (0.0006)	0.3443	3.361	DUM92
9.143 (0.0008)	0.4761	4.353	DUM93
6.519 (0.0029)	0.3985	2.598	DUM96
$R^2 = 0.994$	F (13,6) = 55.071	DW = 2.453	-
Analysis of variance $\chi^2 = 0.1894$ [0.4312]			
Self-correlation test $\chi^2 = 0.5310$ [0.2508]			
Normality test $\chi^2 = 0.3788$ [0.8274]			

Source: Research Findings

In estimating the above tables, all variables had a high t-statistic and were primarily significant at the 5% error level. The hypothesis test also indicated the establishment of classical hypotheses.

6. Comparison of short-term coefficients of urea export supply function

The urea export supply variable with one lag has the greatest impact on China's export model (1.059), followed by India, the UAE, and Turkey. The important point is that this variable has a negative and significant effect on the UAE model. UAE GDP with a coefficient of 8.269, China with a coefficient of 3.905, India with a coefficient of 1.401, and Turkey with a coefficient of 0.115 have the greatest impact on exports. The real exchange rate in the UAE model with a coefficient of –6.549 has the most negative impact on exports, followed by China, Turkey, and India. The urea exchange relationship has a negative and significant effect on exports. In the estimated models, the Chinese model has the most negative impact (–2.928), followed by the UAE (–1.331) and Turkey (–1.254). For India, this variable is meaningless. Trade liberalization for the UAE has a coefficient of 11.076, followed by India with a coefficient of 5.287 and China with a coefficient of 2.341; this variable is not significant in the export model to Turkey. The variable of feed price has a negative and significant effect on the supply of exports. The most impact is related to the UAE (–2.402), followed by China (–2.012) and Turkey (–1.885). This variable is not significant in the export model to India. Real exchange rate volatility has a significant negative effect on all models of urea export supply. The most influential models are China (–2.332), UAE (–1.340), Turkey (–0.839), and India (–0.614), respectively. In the short term, the embargo variable has harmed exports to India (–1.153) and the UAE (–1.170) and has a negative and significant impact on Turkey (–0.582). This variable is not significant for the supply model of urea exports to China.

6.1. Long-term estimate of urea export supply

After ensuring the classical hypotheses, a long-term relationship, and the stability test, the coefficients of long-term results are presented. The results of long-term estimation by the ARDL method, with a maximum of one interval and based on Schwartz–Bayesian criteria, are listed in the following tables.

Table 16. Results of long-term estimates of supply of urea exports to China ARDL (1,0,0,0,0,0,0).

Probability	t statistic	Standard deviation	Coefficient	Variable
0.0020	–5.190	0.7524	3.905	LGDPCH
0.0266	–2.920	1.0026	–2.928	LRER
0.1020	1.928	0.3873	–0.747	LTOTU
0.0027	–4.912	1.8817	9.243	LCL
0.0040	4.529	0.4442	–2.012	LGP
0.0009	6.025	0.3855	–2.322	LVOL
0.7341	–0.3558	0.3548	–0.126	Dsa

Source: Research Findings

The results of long-term estimates of the supply of urea exports to China show that China's GDP ratio is 3.905, i.e., with a one percent increase in China's GDP, exports increase by 3.905 percent. Trade liberalization has a coefficient of 9.243. Indeed, with a one percent rise in trade liberalization, exports increase by 9.243 percent. The actual exchange rate coefficient is –2.928, i.e., with an increase of one percent in the real exchange rate, exports decrease by 2.928 percent. The feed price coefficient is equal to –0.012, i.e., with a rise of one percent in the feed price, urea exports fall by 2.012 percent. The accurate exchange rate volatility coefficient is –2.232, i.e., with a one percent increase in actual exchange rate volatility, urea exports to China decreased by 2.322 percent.

Table 17. Results from the long-term estimate of supply of urea exports to India ARDL (1,0,0,0,0,0,0).

Probability	t statistic	Standard deviation	Coefficient	Variable
0.0432	–1.518	0.9227	1.401	LGDPIN
0.0459	–2.642	0.6160	–1.627	LRER
0.9287	–0.0941	0.2969	–0.027	LTOTU
0.0089	–4.152	1.2732	5.287	LCL
0.1094	–1.944	0.4647	–0.903	LGP
0.1362	1.774	0.3461	–0.6140	LVOL
0.0667	–2.335	0.4937	–1.153	Dsa

Source: Research Findings

In the long-run supply model of urea exports to India, only the variables of India's GDP, real exchange rate, and trade liberalization have significant coefficients. As the coefficient of GDP is equal to 1.401, i.e., with a one percent increase in India's GDP, urea exports increase by 1.401 percent. The accurate exchange rate coefficient is –1.627, i.e., with a one percent increase in the real exchange rate, the export rate decreases by 1.627 percent. Finally, the trade liberalization coefficient equals 5.287, indicating that with a 1% increase in trade liberalization, exports increase by 5.287%. The embargo variable harms the trend of methanol exports to the UAE. Thus, its coefficient equals –1.153, i.e., with a one percent increase in the embargo on urea exports to India, it decreases by 1.153 percent.

Table 18. Results from the long-term estimate of supply of urea exports to Turkey ARDL (1,0,0,0,0,0,0).

Probability	t statistic	Standard deviation	Coefficient	Variable
0.8770	–0.162	0.7096	0.115	LGDPTUR
0.0188	–3.424	0.5472	–1.873	LRER
0.0043	4.944	0.2537	–1.254	LTOTU
0.7806	–0.293	0.9433	0.277	LCL
0.0163	–3.554	0.2490	–0.885	LGP
0.0421	2.713	0.3093	–0.839	LVOL
0.0161	3.565	0.1633	–0.582	Dsa

In the long-run supply model of urea exports to Turkey, the estimation results are that the accurate exchange rate coefficient is –1.873, i.e., with a one percent increase in the real exchange rate, the export rate decreases by 1.873 percent. The exchange ratio has a coefficient of –1.254, i.e., with a rise of one percent in the exchange ratio, the export amount decreases by 1.254 percent. The feed price variable has a coefficient of –0.885, i.e., with a one percent increase in feed prices, exports fall by 0.885 percent. The actual exchange rate instability coefficient is –0.839, i.e., with a one percent increase in natural exchange rate instability, the export rate decreases by 0.839 percent.

Table 19. Results from the long-term estimate of the supply of urea exports to the UAE ARDL (1,0,0,0,0,0,0).

Probability	t statistic	Standard deviation	Coefficient	Variable
0.0210	3.689	2.2410	8.269	LGDPUAE
0.0406	2.984	2.1945	–6.549	LRER
0.1588	–1.729	0.7698	–1.331	LTOTU
0.0752	2.389	4.6347	11.076	LCL
0.0406	–2.925	0.8210	–2.402	LGP
0.1357	–1.8644	0.7189	–1.340	LVOL
0.0421	–2.945	0.3974	–1.170	Dsa

Source: Research Findings

In the supply model of urea exports to the UAE, the UAE GDP is equal to 8.269, i.e., with a one percent increase in the UAE GDP, exports increase by 8.269 percent. Contrary to the results of other models in terms of exports to the UAE, the actual exchange rate coefficient is positive and significant and is equal to 6.549. With a one percent increase in the real exchange rate, the amount of exports decreases by 6.549 percent. The coefficient of trade liberalization is equal to 11.076, that is, with a one percent increase in trade liberalization, urea exports to the UAE increase by 11.076%. The feed price coefficient equals –2.402, i.e., with a one percent increase in the feed price of refineries, exports decrease by 2.40 percent. Other variables in this model are not significant in the long run.

7. Comparison of long-term coefficients of urea export function of destination countries

The GDP variable has the most impact on the export model to the UAE with a coefficient of 269.8, followed by China with a coefficient of 3.905 and India with a coefficient of 1.407. This variable is meaningless for Turkey. The actual exchange rate for the UAE has a coefficient of –6.549, followed by China with a coefficient of –2.928, Turkey with a coefficient of –1.873, and India with a coefficient of –1.627. The exchange relationship is meaningless for all countries except Turkey in the long run. This coefficient for Turkey is –1.254. Trade liberalization is 11,076 for the UAE, 9,243 for China, and 5,287 for India, and it is

meaningless for Turkey. In the long run, the food price is –2.402 for the UAE, –2.232 for China, and –0.885 for Turkey, and it is pointless for India. Exchange rate volatility is –2.322 for China and –0.839 for Turkey; it is meaningless for Zappa and other countries. In the long run, the coefficient of variable livestock of sanctions has the most significant impact on exports to India with a coefficient of –1.153, the UAE –1.170, and Turkey –0.582.

8. Results of estimating the error correction model with Schwartz–Bayesian criterion

The error correction model (ECM) is used to investigate how much of the deviation in the supply function of urea product exports from its long-term path is corrected by pattern variables in the next period when moving from one period to the next. This model is given in the following tables.

Table 20. Results of estimating the error correction model with Schwartz–Bayesian relationship (urea export to China).

t Statistic (probability)	The standard error	Coefficient	Variable
–1.201 (0.2749)	0.7524	–0.903	dLGDPCH
–1.623 (0.1556)	1.0026	–1.627	dLRER
–0.072 (0.9448)	0.3873	–0.027	dLTOTU
–2.809 (0.0308)	1.8817	5.287	dLCL
–3.153 (0.0197)	0.4442	–1.401	dLGP
1.592 (0.1623)	0.3850	0.6140	dLVOL
–3.249 (0.0175)	0.3548	–1.153	dDsa
–2.022 (0.0896)	0.0621	–0.125	ECM (–1)
DW = 2.121		F (7,4) = 67.095	R^2 = 0.991

Source: Research Findings

As presented in Table 21, the coefficient of determination indicates the high explanatory power of the pattern. The error correction factor states that when we move from one period to the next, what percentage of the deviation in the studied regression function from its long-term path is corrected by the pattern variables in the next period. The error correction factor is significant and negative. When we move from one period to the next, 12.5% of the deviation in the supply function of urea exports to China from its long-term path by pattern variables in the next period is corrected.

Table 21. Results of estimating the error correction model with Schwartz–Bayesian relationship (urea export to India).

t Statistic (probability)	The standard error	Coefficient	Variable
–1.518 (0.1894)	0.9227	–1.401	dLGDPIN
–2.6421 (0.0459)	0.6160	–1.627	dLRER
–0.094 (0.9287)	0.2969	–0.027	dLTOTU
–4.152 (0.0089)	1.2732	5.287	dLCL
–1.944 (0.1094)	0.4647	–0.903	dLGP
1.774 (0.1362)	03461	0.614	dLVOL
–2.335 (0.0667)	0.4937	–1.153	dDsa
–1.308 (0.0238)	0.0960	–0.165	ECM (–1)
DW = 3.144		F (7,4) = 154.68	R^2 = 0.997

Source: Research Findings

As listed in Table 22, the coefficient of determination indicates the high explanatory power of the pattern. The error correction factor is significant and negative, and it shows that when we move from one period to the next,

16.5% of the deviation in the supply function of urea exports to India from its long-term path by pattern variables in the next period is corrected.

Table 22. Results of estimating the error correction model with Schwartz–Bayesian relationship (urea export to Turkey).

t Statistic (probability)	The standard error	Coefficient	Variable
–1.974 (0.1053)	0.7096	–1.401	dLGDPTUR
–2.974 (0.0310)	0.5472	–1.627	dLRER
2.420 (0.0601)	0.2537	0.614	dLTOTU
–5.604 (0.0025)	0.9433	5.287	dLCL
–3.629 (0.0151)	0.2490	–0.903	dLGP
–0.090 (0.9315)	0.3093	–0.027	dLVOL
–7.057 (0.0009)	0.1633	–1.153	dDsa
–1.734 (0.0328)	0.0724	–0.198	ECM (–1)
DW = 2.606		F (7,4) = 445.51	R^2 = 0.999

Source: Research Findings

As presented in Table 23, the coefficient of determination indicates the high explanatory power of the pattern. The error correction coefficient is significant and negative, and it shows that when we move from one period to the next, 19.8% of the deviation in the supply function of urea exports to Turkey from its long-term path by pattern variables in the next period is corrected.

Table 23. Results of estimating the error correction model with Schwartz–Bayesian relationship (urea export to the UAE).

t Statistic (probability)	The standard error	Coefficient	Variable
–0.625 (0.5657)	2.2410	–1.401	dLGDPUAE
–3.741 (0.0453)	2.1945	–1.627	dLRER
–0.036 (0.9827)	0.7698	–0.027	dLTOTU
–1.140 (0.3176)	4.6347	5.287	dLCL
–1.1007 (0.3328)	0.8210	–0.903	dLGP
0.8540 (0.4412)	0.7189	0.614	dLVOL
–2.901 (0.0441)	0.3974	–1.153	dDsa
–2.004 (0.0342)	0.1250	–0.205	ECM (–1)
DW = 2.453		F (7,4) = 55.071	R^2 = 0.994

As presented in Table 27, the coefficient of determination indicates the high explanatory power of the pattern. The error correction coefficient is significant and negative, and it shows that when we move from one period to the next, 20.5% of the deviation in the supply function of urea exports to the UAE from its long-term path by pattern variables in the next period is corrected.

9. Conclusions and suggestions

In recent years, with the growth and development of the petrochemical industry, the need for special attention to this industry is evident. The abundance of oil and gas resources in the country and the availability of cheap raw materials for refineries to produce petrochemical products is one of the suitable opportunities to expand production in this area and have extensive exports. Given

the stated conditions, investing in the refinery and downstream industries of the oil and gas industry, including petrochemicals, is essential to prevent crude sales, create high added value, and circumvent sanctions. Due to the stated importance, creating appropriate infrastructure to increase production and discover new markets for the country's petrochemical products is one of the most important issues to be addressed.

In this study, in the proposed model, the supply variable of urea export was introduced as a dependent variable. The variables of trade liberalization, GDP of the destination country, real exchange rate, natural exchange rate instability, raw materials price, exchange relation, and sanctions (livestock variable) were included in the model as the explanatory variables. According to the fitted results, the variables of trade liberalization and GDP of destination countries in the short and long term have a positive and significant effect on the supply of urea exports.

In the short-term urea export supply model, the highest GDP coefficient was related to the UAE, which had the most positive and significant impact on Iran's urea export supply. The trade liberalization variable in the supply model of urea exports in the short term has also the most positive effect on the export model to the UAE. The coefficient of this variable is estimated to be larger than that in the other countries. The actual exchange rate had a negative and significant coefficient in the short and long term. In the supply of urea exports, the coefficient of this variable was higher than the supply of exports to the UAE compared to the other three countries. The natural exchange rate instability has a significant negative impact on the supply of urea exports in the short term, having the most negative impact on the supply model of the urea exports to China. The exchange relationship has a negative and significant effect on the supply of urea exports in the short term. The most negative impact on the supply model of urea exports is related to China. The feed price coefficient harmed the country's exports, and in the urea export supply model, the most negative impact is related to the export supply model to the UAE. This coefficient is meaningless for Turkey in urea exports. The livestock variable of sanctions as a virtual variable has a negative and significant impact on exports in the short term. In the short run, the highest negative coefficient in the urea export supply model is related to the export model to the UAE and then India; it was not significant for the two other countries. In the supply model of urea exports, the variables of GDP and trade liberalization have a positive and significant effect on the country's exports in the long run. It has the most positive impact on GDP to the UAE and in trade liberalization to the UAE. The actual exchange rate has a negative and significant impact in the long run, and the most negative effect is related to the export model to the UAE. The volatility of the real exchange rate harms the supply of urea exports in the long run. For India and the UAE, this variable has become meaningless. In the long run, the food price has a negative and significant effect on the country's export supply. The most damaging impact is related to the supply of exports to the UAE, and the most negligible impact is related to the supply of exports to Turkey. In the long run, the exchange relationship in the supply model of urea exports also harms exports and has the most significant impact on the export model to Turkey. For other countries, this meaningless variable has been fitted. The sanction variable also had a negative effect, and the most negative impact was on the export market to the UAE; this variable was empty in the export model to China. In the short and long term, the real exchange rate has a significant negative impact on the supply of Iranian urea exports to target destinations. Therefore, if the real exchange rate increases in the short term, it will further affect the export market to the UAE and reduce exports to this country. Therefore, preventing exchange rate fluctuations and increasing them by implementing appropriate exchange rate policies are recommended. The relationship between the exchange, as the ratio of the foreign price of methanol to its domestic price, as one of the short and long-term variables has a negative and significant effect on urea exports. Therefore, concerning this issue, the policy that can be proposed is that domestic prices are partially lower than world prices due to the cheapness of raw materials, so we can reduce this ratio to increase exports. Not providing cheap feed to petrochemicals increases the price in this sector, which minimizes the price gap inside and outside.

The trade liberalization variable, equal to the ratio of the sum of imports and exports to the country's GDP, has been mentioned as one of the variables having a positive and significant effect in the short and long term. Therefore, according to this matter, the discussion of increasing trade liberalization, removing trade restrictions and customs formalities, and establishing economically active diplomacy is one of the essential strategies in increasing petrochemical exports to countries. As one of the variables harming urea exports in the short term, exchange rate fluctuations most significantly affects India's export destination, so the government should create a deep foreign exchange market and prevent rents and corruption in the foreign

exchange market by establish stability and transparency in the foreign exchange market.

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