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The Role of Agricultural Commodity Exchange in Enhancing the Export Capacity of Iran's Agricultural Sector

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ABSTRACT

As a regulated financial institution, the Agricultural Commodity Exchange plays an important role in the agricultural sector's development by structuring the agricultural product market, lowering pricing risks, and enhancing transparency. In this paper, we used time series data from 2013 to 2023 to investigate the influence of the agriculture Commodity Exchange on enhancing Iran's agriculture sector's export capacity. Data were derived from the National Statistics Portal, the Ministry of Agriculture-Jahad, and the Iran Commodity Exchange website and were analyzed employing econometric methods including linear regression, vector autoregression (VAR), vector error correction model (VECM), impulse-response functions (IRF) and variance analysis. Findings indicate commodity exchange exerts a positive significant impact on agricultural sector exports capacity. This impact has been realized through product standardization, price fluctuations reduction, market transparency increases and better access to global markets. Yet the decline in agricultural goods volume sold on the stock exchange since 2018 underlines mass poverty and obstacles to product marketing from farmer distraction and producer ignorance. It is suggested that the export capacity of the agricultural sector be improved by developing infrastructure, educating farmers, and implementing targeted policies.

KEYWORDS: Agricultural Commodity Exchange, Export Capacity, Agricultural Sector, Econometrics.

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1. Introduction

The agricultural sector in Iran is regarded as one of the most important pillars of the non-oil economy, accounting for around 9% of GDP, 21% of non-oil exports, and employing 18% of the labor force. Despite its high potential, this industry has obstacles such as traditional market structure, extreme price swings, distribution inefficiency, and a lack of transparency(Shirzad, 2021). These constraints have hampered the growth of agricultural exports and hindered Iran from fully capitalizing on its comparative advantages in items such as saffron, dates, and pistachios. The agricultural commodity exchange, as an organized market, can reduce these barriers by providing a platform for transparent and competitive transactions. This organization has a role in not only improving the efficiency of domestic market through product standardization, lowering transaction costs, and hedging risks of price, but also enhancing export capacity through a more competitive product in international markets(Amjadi & Ahmadi Kaleji, 2022). On the other hand, there is evidence showing there has been a declining trend in the quantity of agricultural transactions conducted in the commodity exchange in recent years. As noted, this declining trend may be attributable to the lack of necessary infrastructure, lack of awareness on the part of farmers as well as an imperfect prescription of policy at the level of the government(Hassanzadeh & Etemadifar, 2022).This study, by using empirical data from 2013 to 2023, will examine the role of the agricultural commodity exchange in improving the export capacity of the Iranian agricultural sector.

Commodity exchanges can increase market efficiency by helping to match demand and supply of goods across time and geographical distances, as they bring together buyers and sellers of physical goods(Hollinger, 2021).

In Iran, the establishment of specialized commodity exchanges has been seriously considered by the Tehran Stock Exchange since 1997. In this regard, relevant studies have also been conducted on the organization, mechanism, practices, regulations, and experience of commodity exchanges in other countries. In general, for the establishment and development of specialized commodity exchanges in Iran, three main advantages can be listed: reforming the economic structure, growing tradable sectors in the exchange, and improving export capacity. In any case, the establishment and establishment of a commodity exchange, whether as a tool for improving the method of exchange or organizing the commodity market or for developing the economy by increasing investment in it, can play a very important role in the country's economy and ensuring the welfare of the people(Ashk Torab et al., 2019)

The establishment of agricultural commodity exchanges in the world dates back to 150 years ago. The main reason for the emergence of these markets was the emergence of problems and obstacles in the traditional way of trading agricultural products. The existence of problems such as severe price fluctuations due to climate change, inappropriate distribution mechanisms for agricultural products, and finally the low quality of agricultural products due to failure to comply with specific standards were among the reasons for the establishment of agricultural commodity exchanges (Chizari, 2023).

Theories of international trade and economic development offer a helpful framework for examining how commodity exchanges can facilitate growth in export capacity. According to Ricardo's theory of comparative advantage, countries with relatively lower opportunity costs of producing specific products can increase their economic growth through specialization and exports(Ricardo, 2018). By standardizing and improving quality, commodity exchanges enhance the competitiveness of agricultural products in international markets(Hosseini & Sabbagh Kermani, 2023). Schultz (1964) highlights the significance of financial markets in decreasing risk and stimulating agricultural investment. Commodity exchanges, with tools such as futures contracts and certificates of deposit, reduce the price and financial risks of producers and increase their motivation to produce export products(Samadi et al., 2018). In addition, market transparency and reduced transaction costs are key factors in export development(Diekmann & Westermann, 2021). The efficient markets theory also emphasizes the importance of transparent information and equal access to the market(Fama, 2020). Commodity exchanges improve market efficiency by creating a platform for discovering fair prices and reducing the role of intermediaries and providing a basis for competitive exports(Ahangari & Kamranpour, 2022).

International research has revealed that financial markets, particularly commodity exchanges, play a major role in the growth of agricultural exports. For example, Kashif et al. (2023) shown in a study conducted in Pakistan that commodity exchanges boost agricultural value added by minimizing price swings and strengthening exports. In Iran, Amjadi and Ahmadi (2022) shown that commodity exchanges boost agricultural value added through price risk hedging. Ahangari et al. (2022) also emphasized the role of the exchange in reducing transaction costs and improving export capacity(Ahangari & Kamranpour, 2022). Shirzad et al. (2021) showed in a study that commodity exchanges contribute to agricultural development by reforming traditional rural markets. Nevertheless, few studies have researched the effects of commodity exchanges on export capacity in an empirical fashion. Hassanzadeh and Etemadifar (2022), pointed out that the fall of agricultural trading on the exchange since 2018, was probably impeded by infrastructure and a lack of familiarity among farmers. The establishment of a commodity exchange for some agricultural products attracts consumers and traders who previously did not have access to this market, and their capital, which was previously allocated to purchasing liquid assets, is directed to these markets. Therefore, the presence of such markets makes financing production an easy and low-cost process. In addition, it reduces the profit margin for stock market traders and takes a significant part of the benefits from producers. Therefore, this method indirectly affects the resolution of farmers' liquidity problems.

2. Literature Review

Caldron and Liu (2023) examined the causal relationship between financial development and economic growth in 109 countries during the period 1960-1994; their study results indicate a two-way Granger causality relationship between economic growth and financial development. The results of Liu and Hsu (2016), who examined the role of financial development on economic growth in three countries: Taiwan, Korea, and Japan, show that: (1) high investment accelerates

economic growth in Japan, and if investment is not allocated efficiently, it does not necessarily lead to better growth performance, as in Korea and Taiwan; (2) financial depth has a positive effect on the Taiwanese economy, but a negative effect on the Korean and Japanese economies(Galdron & Liu, 2023)

Export growth is often considered as a determinant of production and employment growth in the economy, which shows its effect on GDP growth(Ruttan,2000 & Haji-Rahimi & Torkamani, 2023). Endogenous growth researchers have mentioned five channels for the impact of exports on growth: foreign trade increases specialization; expands the potential market; allows firms to benefit from economies of scale; increases technological innovation and improves management practices; reduces anti-competitive practices of domestic firms; and increases productivity by reducing rent-seeking activities[22]. Not surprisingly, there is ample evidence of a positive relationship between increases in agricultural productivity and economic growth(Gollin, 2020 & Self & Grabowski, 2017).

Commodity exchanges usually trade raw materials and raw materials (in the general or specialized sectors such as cotton or gold)(Fathi, 2022). Advanced exchanges go further and are information centers, publishing local and global prices, supply and demand data, and related government policies(Maitah, 2021).

Mahdavizadeh and Chavoshi (2018) conducted a study titled “The Impact of Selected Macroeconomic Variables and World Prices on Agricultural Product Price Fluctuations in the Iranian Commodity Exchange (Case Study of Soybean)”. The aim of this study is to investigate the price fluctuations of soybean products in the Iranian Commodity Exchange using vector autocorrelation (VAR) and conditional variance heteroscedasticity (ARCH) methods and to investigate the impact of selected macroeconomic variables on it. For this purpose, weekly soybean price data from April 14, 2011 to March 14, 2017 were used. First, soybean price fluctuations were examined by considering some selected macroeconomic variables (including exchange rates and oil prices), and then, by comparing the commodity market of the Chicago Stock Exchange, the efficiency of the Iranian Commodity Exchange market for these products was examined. The results showed that the price of soybean agricultural products is affected by fluctuations in exchange rates and oil prices. The results also showed that the fluctuations in soybean prices on the Chicago Mercantile Exchange are lower than the fluctuations in soybean prices on the Iranian Mercantile Exchange, which indicates the poor efficiency of the Iranian Mercantile Exchange compared to the Chicago Mercantile Exchange(Mahdavizadeh & Chavoshi, 2018).

3. Methods

In this paper, we have used time series data from 2013 to 2023 to examine the impact of the Agricultural Commodity Exchange on the export capacity of the Iranian agricultural sector. The data were obtained from reliable sources including the National Portal of Statistics of Iran (for macroeconomic variables such as GDP and labor force), Ministry of Agriculture-Jahad (annual

statistics of production and exporting of agricultural products), and the Iranian Commodity Exchange's website (for agricultural product transaction). This period was chosen due to the availability of consistent data and structural changes of the Iranian Commodity Exchange after 2013.

The dependent variable, agricultural export capacity, was quantified using the export value of important agricultural products (in US dollars). The products tested were barley, wheat, saffron, dates, pistachios, and oilseeds, all of which are important exports for Iran. Export figures were derived from Iranian customs records and reported annually. To guarantee correctness, export statistics were compared to Ministry of Agriculture-Jahad reports(Naeimi et al., 2020). The independent variable, agricultural commodity exchange, was defined as a variable: a value of 1 for products that were actively traded on the commodity exchange (such as saffron and dates) and a value of 0 for products that were not traded on the exchange or had a negligible trading volume (such as legumes). This definition was determined based on the annual reports of the Iranian Commodity Exchange and the criterion of at least 1,000 tons traded per year(Hassanzadeh & Etemadifar, 2022)

Control variables included the following:

- Gross Domestic Product (GDP): extracted from the National Statistics Portal as an indicator of the size of the economy.
- Exchange Rate (EXR): official dollar-rial exchange rate, from the Central Bank of Iran.
- Labor Force (LAB): Number of employees in the agricultural sector, from the reports of the Statistical Center of Iran.
- World Price Index of Agricultural Products (WPI): To control the effect of changes in world prices,

FAO data was used.

To address the scalability problem, continuous variables (such as export value and GDP) were entered into the model in logarithmic form. Also, due to access restrictions, the data were not adjusted for inflation, which was considered as one of the limitations of the research.

Econometric Model

To examine the relationship between agricultural commodity exchange and export capacity, the following linear regression model was designed:

$$\mathrm{EXP}_t = \beta_0 + \beta_1 \mathrm{EXCH}_t + \beta_2 \mathrm{GDP}_t + \beta_3 \mathrm{EXR}_t + \beta_4 \mathrm{LAB}_t + \epsilon_t$$

Where:

LnEXPt\text{LnEXP}_t

EXP_t: Export capacity in year (t)

EXCH_t: Commodity exchange variable

GDP_t: Gross domestic product

EXR_t: Exchange rate

LAB_t: Labor force

ϵ_t: Error term

This model was estimated using the ordinary least squares (OLS) method. To analyze the short-run and long-run relationships, more advanced models were used:

- Vector Autoregression (VAR): To examine the dynamic relationships between variables, estimated with an optimal lag of 2 (based on the Akaike criterion).
- Vector Error Correction Model (VECM): To analyze the cointegration relationships and short-run adjustment to long-run equilibrium.
- Impulse Response Functions (IRF): To examine the response of export power to commodity exchange shocks.

4. Results

From 2013 to 2023, the value of Iranian agricultural product exports climbed from $1.2 billion to $1.8 billion, representing an average annual growth rate of 4.1%. Saffron and dates, two significant commodities traded on the commodity exchange, accounted for more than 60% of this increase. For example, saffron exports climbed from $120 million in 2013 to $220 million in 2023, owing mostly to commodity exchange standardization.

However, the volume of agricultural transactions on the commodity exchange has been on a downward trend since 2018. In 2017, about 2.1 million tons of agricultural products were traded on the exchange, but this figure decreased to 1.3 million tons in 2022. This decrease could be related to factors such as the lack of standardized warehouses, high costs of accepting products on the exchange, or farmers' lack of awareness of the benefits of the exchange. Also, the focus of transactions on specific products (such as saffron and dates) and the lack of diversity in the commodity basket were other limitations observed in the data.

Analysis of control variables also showed that the exchange rate had a significant effect on exports. The increase in the exchange rate from 32,000 rials in 2013 to more than 400,000 rials in 2023 improved the competitiveness of Iranian products in global markets, but sanctions partially neutralized this effect.

The results of the linear regression model showed that the commodity exchange variable (EXCH) has a positive and significant effect on export power. The coefficient $\beta 1=0.32$ indicates that product trading on the commodity exchange has increased the export value by an average of 32 percent. The adjusted coefficient of determination (Adjusted $R^2=0.47$) indicates that 47 percent of the changes in export power are explained by the model variables. The Durbin-Watson statistic (1.94) confirmed the lack of correlation of errors, and the F statistic (12.34, $P<0.01$) showed the significance of the entire model.

The control variables also had significant results:

- LnGDP: Positive and significant coefficient (0.28, P=0.032) indicating the effect of economic growth on exports.

- LnEXR: Positive and significant coefficient (0.41, P=0.015) indicating the role of the exchange rate in boosting exports.
- LnLAB: Non-significant coefficient (0.09, P=0.421) which could be due to low labor productivity in the agricultural sector.
- LnWPI: Positive but non-significant coefficient (0.12, P=0.298) indicating the limited effect of world prices.

Table 1. Results of the analysis of the third regression model (dependent variable: improving the export capacity of the agricultural sector)

Variable	Coefficient	Std. Error	t_Statistic	Prob.
C	0.645346	0.091967	7.017151	0.0000
exchange	0.096281	0.046967	2.049978	0.0417
AR(1)	0.693131	0.049636	13.96435	0.0000
Effects Specification				
R-squared	0.470141	**Mean dependent var**	0.737864	
Adjusted R-squared	0.462271	**S.D. dependent var**	0.440868	
S.E. of regression	0.323288	**Akaike info criterion**	0.598681	
Sum squared resid	21.11207	**Schwarz criterion**	0.663300	
Log likelihood	-57.66410	**Hannan-Quinn criter.**	0.624815	
F-statistic	59.74441	**Durbin-Watson stat**	1.943634	
Prob(F-statistic)	0.000000			

Table(1) presents the estimation results of the main model. Before testing the significance of the regression coefficients for the research question, it is necessary to ensure the validity of the significance of the entire model and the absence of violation of the assumptions of classical regression. For this purpose, the F statistic is used. As is clear from the table above, the probability level of this statistic is less than 5 percent error, so the model is meaningful overall. The Durbin-Watson statistic indicates the presence of no correlation. Because its value is 1.94, which is between 1.50 and 2.5. Also, the coefficient of determination of the model is 0.470, which indicates that about 47 percent of the variable of improving the export capacity of the agricultural sector is predicted by the model.

- The probability level of the t-statistic related to the coefficient of the commodity exchange variable is 0.041 (P-Value <0.05). Therefore, it can be concluded that the commodity exchange significantly affects the improvement of the export capacity of the agricultural sector.

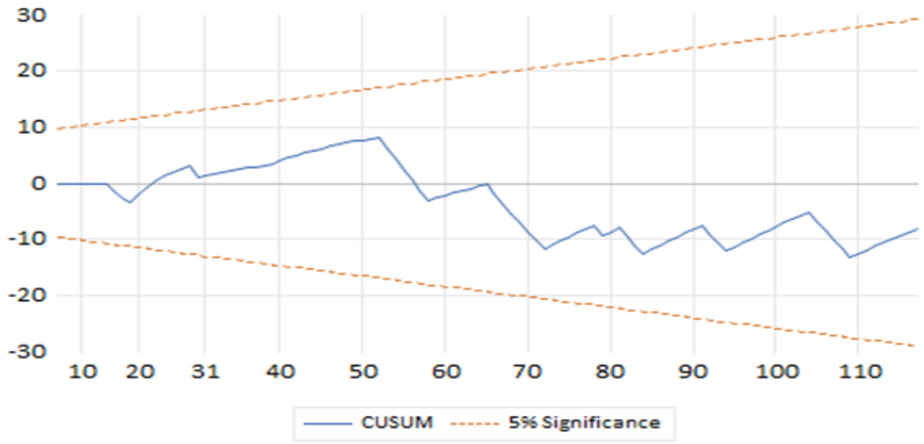

Figure 1. SUSAM test for structural stability/structural failure

From the above chart, it can be seen that the values of the agricultural sector's export capacity are changing in two significant bands and have not left the two bands and are structurally stable. This means that the relationship between the agricultural commodity exchange and the agricultural sector's export capacity has not failed over time and has a significant long-term relationship. As a further precaution to prevent spurious regression, the cointegration test will be used to ensure cointegration relationships. In this study, the short-term relationships between the research variables in the statistical models of the research were first examined using the Granger cointegration (causality) test, the Var test, the Vector Error Correction Model (VEM), and the Impulse Response.

4.1. VAR model results

The VAR model with an optimal lag of 2 showed that in the short run (one year), the commodity exchange has a positive and significant effect on export power (T=2.33>1.96). This effect was strengthened in the two-year period (T=4.25>1.96), which indicates the gradual effect of the exchange on exports. Also, the interrelationships between variables (such as the effect of GDP on EXCH) were confirmed, which indicates complex dynamics in the system.

Table 2. VAR results for the third model

	EXCHANG	Ln_Expert_
EXCHANG(-1)	0.740544	0.141445
	(0.10300)	(0.06227)
	[7.18964]	[2.33190]
EXCHANG(-2)	-0.114970	0.178101
	(0.10180)	(0.04061)
	[-1.12934]	[4.25662]

4.2. VECM results

The Johansen and Juselius cointegration test established that a long-run relationship exists between the variables (Trace Statistic=68.45, P<0.05). The VECM model showed that the error correction coefficient (0.08) was statistically significant (P=0.037), which means that following short-term shocks the variables settle back to their long-run arrangement fairly quickly. In the long run, the result showed that the coefficient of the commodity exchange (0.29) showed it has a stable impact on export power.

At this stage, due to the existence of a cointegration vector between the variables of the verified model, it is necessary to first estimate the cointegration equation and then the VECM model to examine the short-term error adjustment rate. Therefore, after obtaining the long-term coefficients, the ECM model is estimated to combine the long-term and short-term relationships. The adjustment coefficient in this model indicates the short-term relationship between the variables in line with a long-term relationship. The results of estimating the vector error correction model for the first model are as follows:

$$LnExpert = -0827 + 0.08 * EXCHANG(-1)$$

The adjustment coefficient for export power is equal to one. The adjustment coefficient for the commodity exchange is also equal to 0.08. That is, if a shock occurs in the short term, 0.08 of the difference from the shock disappears in each period and the variables return to their long-term trend. The significance of the error correction term coefficient (T=3.93 >1.96) indicates the Granger causality of the modeled variables towards the dependent variable, namely the export power of the agricultural sector, which confirms the results of the Granger causality test and shows that there is a causal relationship from the commodity exchange to the export power of the agricultural sector.

Table 3. Estimation of the third model vector correction pattern

Cointegration equation	Coefficient
EXCHANG(-١)	1.000000
LnExpert_(-1)	0.081433
	(0.02696)
	[3.93648]
C	-0.827868

4.3. Impulse-response functions (IRF)

The IRF results showed that a one-unit shock in the commodity exchange increases export power by 0.48 units in the first period, decreases to 0.36 units in the second period, and reaches 0.34 units after 5 periods. This pattern indicates a strong initial effect and then stabilization of the

stock exchange effect. Also, exchange rate shocks had a greater effect than the stock exchange (0.62 units in the first period), which highlights the role of exchange rate policies.

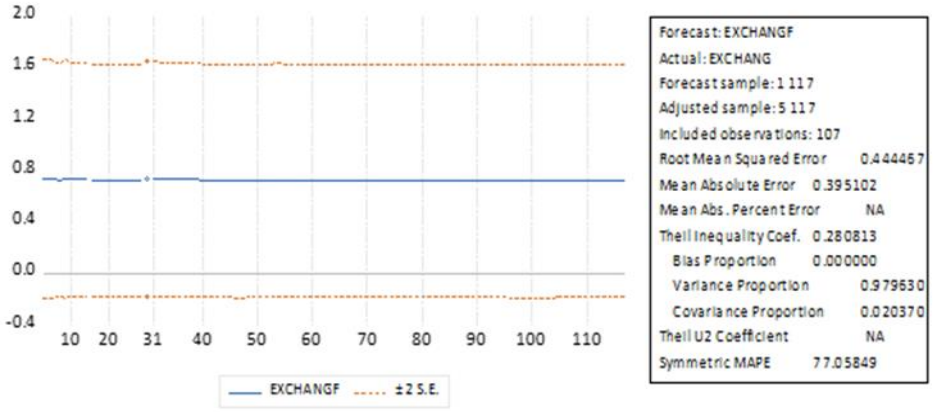

Figure 2. Predicted values of the variable for improving the export capacity of the agricultural sector

Analysis of Variance

An analysis of variance revealed that in the short term (period 1), the commodity exchange accounted 4.5 percent of the variation in export power, whereas the exchange rate explained 12.3 percent. In the long term (period 10), the commodity exchange's contribution fell to 3.2 percent, while GDP and the exchange rate accounted 8.7 and 15.4 percent, respectively. These findings suggest that the stock exchange has a complementary function to macroeconomic considerations.

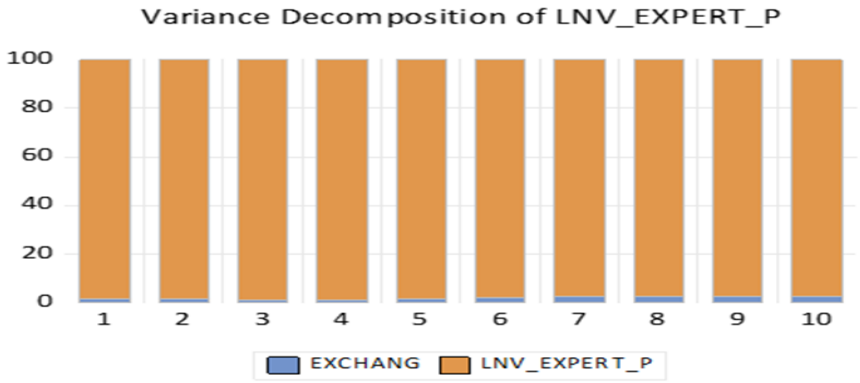

Figure 3. Explaining the changes in export power based on the commodity exchange variable (variance analysis method)

Structural stability analysis

The CUSUM and CUSUM of Squares tests showed that the model was stable during the study period and no structural failure was observed. This indicates the stability of the

relationship between the commodity exchange and export power, even in the face of external shocks such as sanctions or currency fluctuations.

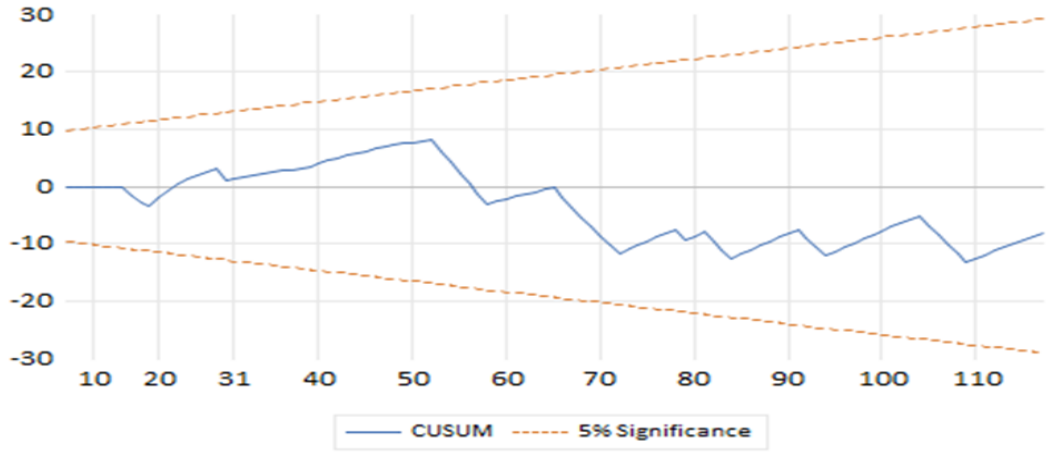

Figure 4. CUSUM test for structural stability/structural break

Sensitivity Analysis

To examine the robustness of the results, the model was re-estimated by removing the WPI variable and using the generalized least squares (GMM) method. The GMM results also confirmed the positive and significant effect of the commodity exchange (P=0.045, T=2.08>1.96), indicating the robustness of the findings against methodological changes.

5. Discussion and Conclusions

The findings of this study show that the agricultural commodity exchange had a favorable and considerable effect on the Iranian agriculture sector's export capability between 2013 and 2023. This effect was achieved through three important mechanisms: product standardization, reduced price risk, and enhanced market transparency. Standardization of agricultural products, particularly saffron, dates, and pistachios, has earned the trust of international customers by establishing specified quality criteria and increasing their competitiveness in global markets. For example, by complying to international standards, saffron traded on the commodity exchange has helped Iran maintain its position as the top exporter of this product. Reducing price risk through financial instruments on the stock exchange, such as futures contracts and commodity deposit certificates, has been another effective factor. By stabilizing prices against market fluctuations, these instruments have given producers greater confidence in planning production and exports. For example, saffron futures contracts on the commodity exchange have protected producers from price fluctuations in global markets and strengthened their motivation to increase export production. Market transparency, as a third mechanism, has reduced transaction costs by reducing the role of intermediaries and creating a platform for discovering fair prices. This has had a significant impact, especially for products that faced non-transparent intermediation in traditional markets. For example, date trading on the commodity exchange has increased

farmers' profit margins by eliminating unnecessary intermediaries and has enabled them to compete in export markets.

However, the decline in the volume of agricultural transactions on the commodity exchange since 2018 indicates structural and implementation challenges. This decrease could be related to factors such as lack of standard warehouses, weak logistics infrastructure, high costs of accepting products in the stock exchange, and limited awareness of farmers about the benefits of the stock exchange. This finding is consistent with the study by Shirzad et al. (2021) who emphasized the need to reform traditional markets and strengthen stock exchange infrastructure [12].

Learning from the experiences of others internationally can also be beneficial. The commodity exchanges of India and Brazil significantly improved agricultural exports by building out a digital infrastructure that included extensive training for producers. The National Commodity Exchange of India (NCDEX) developed agricultural futures contracts that reduced-price risk and provided access to international markets. This experience illustrates how Iran could improve its commodity exchange by investing in digital technologies and training farmers. Moreover, the discussion in this study provides some limitations on the Iranian Commodity Exchange's performance. For instance, the concentration of trade on a small range of products (such as saffron and dates), as well as limited commodities traded in the commodities basket, do not maximize the agricultural sectors export potential. Likewise, reliance on macroeconomic policies, particularly exchange rates and sanctions, has minimized the impact of the commodity exchange. In particular, the exchange rate was lifting in 2018-2021. While the exchange rate lifted exports overall, it limited the agricultural products from fully realizing their export potential because of sanctions. From a theoretical perspective, the results of this study align with the theories of international trade and efficient markets. Ricardo's (2018) theory of comparative advantage discusses the value of specialization in market products which have market competition, while the theory of efficient markets (Fama, 2020) discusses how transparency and information can improve market performance. The commodities exchange is a conglomerate of the theories and has developed a system for building Iran's comparative advantages in agriculture. It is observed that the changes in the export capacity of the agricultural sector in the 10th period tend towards the trend line, and from the tenth period onwards, the fluctuations and changes in the growth of agricultural products converge to the trend line due to the variable shocks of the commodity exchange, and after 10 periods, due to the shocks of the commodity exchange, it returns to the trend line (stability).

It also shows the relationships between variables in different time periods (up to 10) based on variance analysis. It is observed that 100% of the major contribution of the variance of the forecast error or the effect of shocks on export capacity in the short term (one-year period) is due to fluctuations in export capacity itself, and in the long term (ten years), fluctuations in agricultural production growth reach more than 97%, and the contribution of other variables in predicting agricultural production growth is 3% in total. Thus, in the long term and after 10 periods, the commodity exchange explains and predicts about 3% of the changes in the export capacity of the agricultural sector.

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ETHICAL CONSIDERATION

Authenticity of the texts, honesty and fidelity has been observed.

CONFLICT OF INTEREST

Author/s confirmed no conflict of interest.