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An Analysis of Factors Influencing Rice Export in Egypt Based on Vector Autoregressive Model

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Abstract

Vector Autoregressive Model (VAR) lead to the integration of production and export decisions of rice. The main objective of the study is to determine the main factors influencing Egypt's rice exports. This model can also be used to study the prospects of Egyptian rice exports. The results of variance decomposition confirm that the most important variables influence the value of Egyptian rice exports is Egyptian export price, and the empirical analysis of Vector Error Correction Model relieves the possibility of improving the competitiveness of Egyptian exports of rice in global markets in the forecast period (2015:2025).
Keywords: Rice exports; Egypt; VAR model; VECM model; Variance decomposition.
JEL Classification: C51; C53; F17; Q17; Q18.

1. Introduction

Foreign trade is one of the main pillars in the economies of countries, especially developing countries; Ha *et al.* (2015), showed that free trade export policy benefits the poor in Vietnam, for both rural and urban households. Kang (2015), ensured that the rice exports are an important means of stimulating economic growth in major rice exporting countries. Also the empirical results of Ozturk and Acaravci (2010), supported export-led growth (ELG) hypothesis, and Awokuse (2009), provided strong evidence indicated that agriculture is an engine of economic growth in developing countries. Furthermore, he found that trade openness had a positive effect on GDP growth. Therefore the development of agricultural exports is one of the main pillars that attract the attention of economic policy planners in Egypt; Rice is one of the most important agricultural exports, where its share of total agricultural exports is about 29% during the period (2000:2013) (FAO, FAOSTAT).

Although Egypt enjoyed a comparative advantage in many crops, particularly rice, in many cases, these crops lose those comparative advantages, the recent poor export performance of Egypt on the international rice market is the result of the imposition of a rice export ban, the lack of coordination between the production and export sectors, the high proportion of losses and waste, the lack of quality standards and the rise of Egyptian export price compared to export prices in competitive states. The combination of these concerns is undermining international rice traders' trust in Egypt's ability to remain a reliable rice exporter in the near term (USDA FAS GAIN, 2013).

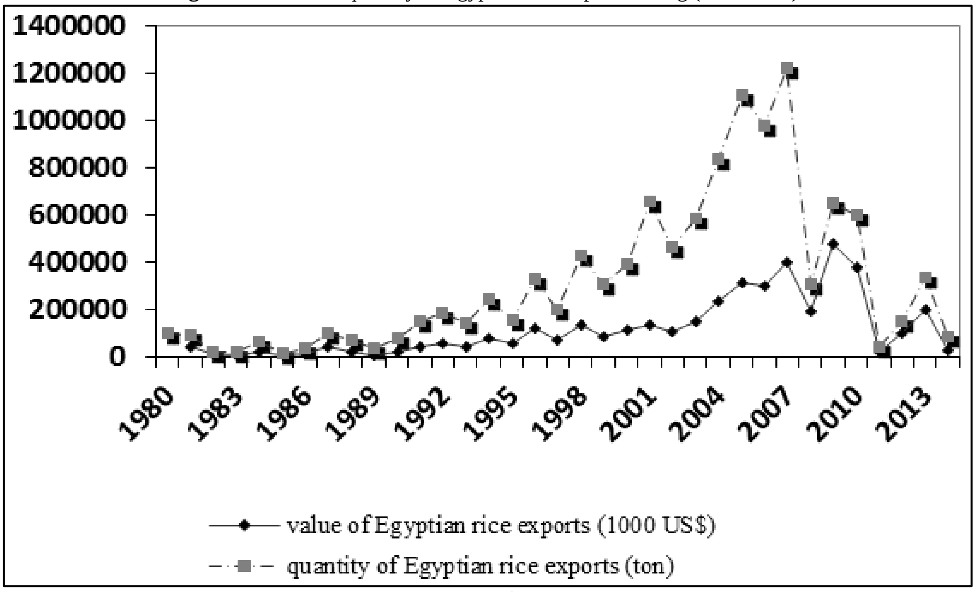
This study uses Vector Autoregressive Model (VAR), where (VAR) Model includes properties make it usable regarding the evaluation of various economic policies, also it reflects factors affecting the competitiveness of rice, whether agricultural factors (Egyptian export prices, world export price, yield) or other economic factors (non-agricultural) such as exchange rate. Therefore the study aims to determine the main factors influencing Egypt's rice exports and its the competitiveness. This model can also be used to study the prospects of Egyptian rice exports during the forecast period (2015: 2025).

2. Overview Egyptian Rice Exports in Recent Years

Figure (1) shows that the rise of value and quantity of Egyptian rice exports after 2001 because of the implementation of a new rice subsidy program that was designed to encourage rice exports. However, Egypt was unable to sustain that, exports declined sharply in 2008, the main reason for that was the imposition of a rice export ban on January 19, 2008, in response to rising domestic rice prices. This ban was imposed to force rice traders to release more rice into the domestic market and thereby stabilize rising domestic rice prices (Lakkakula *et al.*, 2015), and in 2009, Egypt began an attempt to decrease the land area used for rice production in an attempt to conserve scarce water resources (USDA FAS GAIN, 2016).

We also note the rise of value and quantity of Egyptian rice exports in 2012 as The Ministry of Industry and Foreign Trade lifted on September 27, 2012, the October 2010 rice export ban. The decree authorizes (starting October 1, 2012) the export of milled rice under specific conditions. The ministry allocated exports quotas and quantities solely based on the availability of rice for domestic consumption, and imposed an export tax about LE 1,000/MT ($144/MT) (USDA FAS GAIN, 2013),

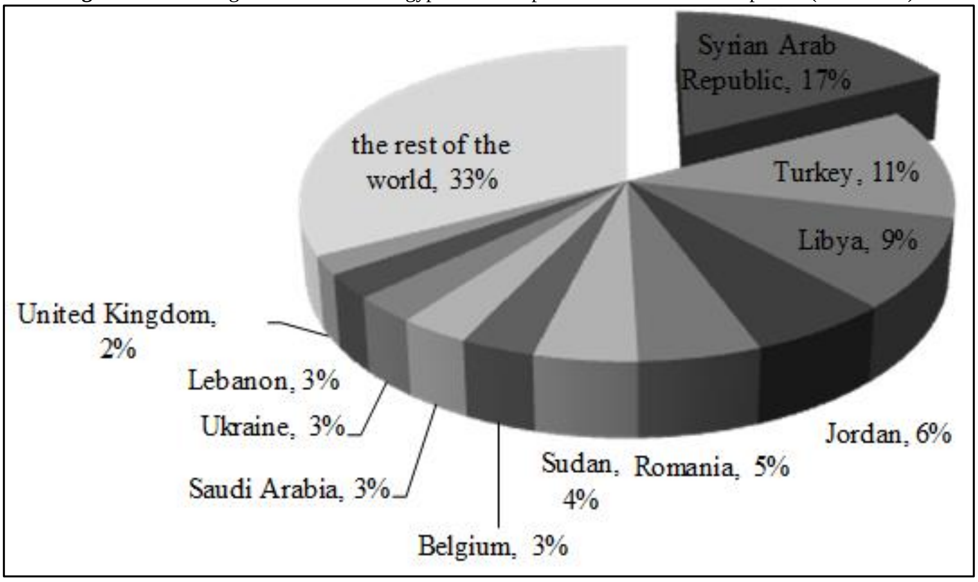
Figure-1. value and quantity of Egyptian rice exports during (1980:2014)



Sources:- Food and Agriculture Organization of United State (FAO) (2016), Available at: http://www.fao.org/faostat/en/#data - United Nations COMTRADE Database. Available at: http://unstats.org/unsd/comtrade.

While figure (2) shows the average market share of Egyptian rice exports to its major trading partners for the period (2000:2013) as follows: Syrian Arab Republic (17%), Turkey (11%), Libya (9%), Jordan (6%), Romania& Sudan (5%), Belgium, Saudi Arabia, Ukraine, Lebanon (3%), United Kingdom (2%), and the rest of the world (33%).

Figure-2. the average market share of Egyptian rice exports to the world for the period (2000:2013)



Source: Food and Agriculture Organization of United State (FAO). Available at: http://www.fao.org/faostat/en/#data/TM

3. Literature Review

Muthayya *et al.* (2014), introduced an overview of global rice production, supply, trade, and consumption, according to the FAO rice market monitor (2016) the major rice exporting countries are India, Thailand, Vietnam, Pakistan and United States. In 2015 the market share of rice exports in the world market was India (24.89%), Thailand (21.97%), Vietnam (18.83%), Pakistan (9.19%) and United States (7.62%). Lakkakula *et al.* (2015), analyzed Changes in the country shares of world rice exports from 1997 to 2008 using an econometric shift-share analytical framework. Results indicated a growing concentration among a few exporting countries in the world rice market, and the competitiveness effect is often significant. Government policies affecting rice trade and the competitiveness of trading partners are the main factors for the shifts in trade patterns of rice, also Ito *et al.* (1990), indicated that trade in rice exports was highly competitive using the Armington procedure (AP). Alberto *et al.* (2011), indicated that the presence of an oligopoly between rice exporters, and governments' interventions had a relevant destabilizing effect on the market.

Various empirical studies analyzed price transmission in the rice market, where Tansuchat *et al.* (2016), used the MS-BVECM from M1/2004 to M3/2014. The estimated results showed that there existed some short-run relationships between Thailand rice prices and world rice price. And John (2013), concerned with providing empirical evidence which could support the argument that rice exporting nations isolate their domestic markets through the use of stabilization pricing policies which cause international rice markets to become excessively volatile. Then John (2014), revealed that price transmission exists across major rice export markets with price relations being the most widespread between Asian markets based on vector autoregressive model (VAR). Furthermore, the direction of price transmission suggests that Asian prices act as price leaders for North and South American prices.

While Chen and Saghaian (2016), used the threshold vector error correction model (TVECM), the results of the model showed that Thailand and the United States are the price leaders, and that the Vietnamese price adjusts faster to long-run equilibrium when it is above its equilibrium level with Thai and U.S. prices. These results suggest market integration and competition rather than collusion are prevalent in world rice markets. Sirikanchanarak *et al.* (2016), proposed a new method, called the time-varying copula-based VAR model, The main results of this study ensured that there exists an obvious co-movement between rice export prices of Thailand and Vietnam, In addition, the results of impulse response functions indicated that the Vietnamese price is more appropriate as a price leader.

Wang and Lee (2009), studied marketing price transmission in the rice market in Taiwan based on a two-regime TVECM with the error correction term serving as the threshold variable to create a non-linear threshold model, on the other hand, Tharcisse and François (2013), mobilized ARCH/GARCH and ECM/VECM models to estimate and compare the conditional volatilities of imported rice prices from January 2004 to April 2012 in West Africa. The results revealed that there was a significant price transmission between the world and the domestic markets in the long run. About 65%, 57% and 56%, respectively, for Senegal, Niger and Mali, represent price variation transmitted from the world market.

While Rapsomanikis and Mugera (2011), Minot (2011); Hatzenbuehler *et al.* (2017), and Applanaidu *et al.* (2013), focused on price transmission in the food market, where Rapsomanikis and Mugera (2011), used a bivariate Vector Error Correction model to assess the transmission of price signals from selected international food markets to developing countries. Results indicated that a short-run adjustment to world price changes is incomplete in Ethiopia and Malawi. In India, the analysis supports relatively rapid adjustment and dampened volatility spillovers which are by large determined by domestic policies. Minot (2011), used an error correction model to estimate transmission of world food price changes in sub-Saharan based on more than 60 price series. The main results indicated that African rice prices are more closely linked to world markets than are maize prices.

Hatzenbuehler *et al.* (2017), examined price transmission in Nigerian food markets, the results implied that rice price transmission is high across all markets, while coarse grain price correspondence is low with world prices but high with neighbour country market prices. Applanaidu *et al.* (2013), analyzed the dynamic relationship between selected macroeconomic variables and food security in Malaysia using the VAR approach. The variance decomposition results showed that biodiesel production, exchange rate and government expenditure on rural development variables will give the highest shock to food security in the long run. This model is a useful tool to understand how food security reacts and is affected by the integration of domestic and global markets.

Others empirical studies analyzed the different methods of improving and preserving the competitiveness of rice exports where Rusmevichientong and Kaiser (2009), supported the hypothesis that the export promotion programs have had a positive impact on demand for U.S. rice exports. The export promotion elasticity was 0.21, which is statistically significantly different from zero, while Farook and Kannan (2015), used VAR model to examine the impact of climate change on rice yields in India. The results showed that suitable adaptive techniques are recommended to overcome the risks of climate change on rice yield, and the results of Wang *et al.* (2012), indicated that size of farm, type of land and market are the main determinants of the rice farmers' modern variety adoption based on a household survey conducted in 2010 in Cambodia.

Henson and Jaffee (2006), contended that developing countries need to adopt food safety standards. while Seck *et al.* (2012), determined the Priorities for rice sector development include (i) continued and increased research efforts to close yield gaps and innovate new rice improved varieties, and (ii) strengthened and equitable public-private sector partnerships, with special emphasis on mechanization of rice farming from land preparation to harvest and rice processing practices, also Mo (2009), indicated that government support, technological innovation, huge industrial chain and strong exporting structure could be the main determinants of improvement the competitiveness of Hunan rice.

Bui and Chen (2015), revealed that the most important factors influencing rice exports in Vietnam based on gravity model are gross domestic product (GDP), price, population, and exchange rate. Also Hatab *et al.* (2010), used a gravity model approach to analyze the main factors influencing Egypt's agricultural exports to its major trading partners during the period 1994 to 2008, and results showed that the exchange rate volatility has a significant positive coefficient, indicating that depreciation in Egyptian Pound against the currencies of its partners encourages agricultural exports. Hung *et al.* (1993), applied cointegration and error correction analysis to estimate the long-run steady state and short-run dynamic relationships between the exchange rate and export prices in industrial and newly industrializing economies. Results showed that the exchange rate has smaller effects on the export price than previous studies would indicate.

Considering the above facts, the objective of the study is to determine the main factors influencing Egypt's rice exports based on Vector Autoregressive Model and its competitiveness, this model can also be used to study the prospects of Egyptian rice exports.

4. Materials and Methods

4.1. The Data

The study employs observations for the period 1980 to 2014 for five variables used. All the variables are in logarithmic form. The data sets were obtained from United Nation (Comtrade), and Food and Agriculture Organization (FAO). The five variables used in this paper are defined as Table (1).

Table-1. Introduction of the model variables

Variable title	Used sign
Exchange rate	ER
The value of Egyptian rice exports	VEX
Egyptian export price of rice	EXPE
World export price of rice	EXPW
Egyptian rice yield	Y

4.2. Methodology

This study used Vector Autoregression (VAR) model which is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR methodology superficially resembles simultaneous-equation modeling in that we consider several endogenous variables together. But each endogenous variable is explained by its lagged values and the lagged values of all other endogenous variables in the model; usually, there are no exogenous variables in the model (Brandt and Williams, 2007; Lütkepohl, 2013), as follows:

$$y_t = A_1 y_{t-1} + \dots\dots\dots\dots + A_p y_{t-p} + Bx_t + \varepsilon_t \quad (1)$$

Where y_t is a k vector of endogenous variables.

x_t is a vector of exogenous variables.

$A_1,\dots,A_p$,B matrices of coefficients to be estimated.

ε_t is a vector of innovations .

Several information criteria have been proposed to select the appropriate number of lags in the (VAR) model, including the Akaike Information (AIC), Schwarz Information criterion (SIC), Hannan-Quinn information criterion (HQ), and Likelihood Ratio (LR). The smaller the value of the information criteria, the better the model. (Gujarati, 2003; Reed and Smith, 2016). (VAR) model required (i) testing unit root for examining stationary of the series, and (ii) testing cointegration between the time series (Jueslius, 2006; Luo, 2011).

(i) Tests of Stationarity are required to check for the non-stationarity as the linear model can produce invalid results when the non-stationary series are include. we will use unit-root tests using the augmented Dickey-Fuller (ADF) test[1]. And that test depends on 3 equations as follows: (Choi, 2015; Dobre and Alexandru, 2008),

$$\Delta y_t = \alpha_1 y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (3)$$

$$\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-j} + \delta_t + \varepsilon_t \quad (4)$$

Where: $\Delta y_t = y_t - y_{t-1}$, ε_t is *White Noise Process*

And we test (H_0: $\alpha_1 = 0$) which mean there is unit root.

(ii) Tests for Cointegration:

Engle and Granger (1987), pointed out that a linear combination of two or more non-stationary series may be stationary. If such a stationary, or I(0), linear combination exists, the non-stationary (with a unit root), time series are said to be cointegrated. The stationary linear combination is called the cointegrating equation and may be interpreted as a long-run equilibrium relationship between the variables (Rao, 2016).

A vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with nonstationary series that are known to be cointegrated. The VEC specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. The cointegration term is known as the error

[1] There are other methods to test Stationarity (Rahman, 2010): Graphical Analysis (See Bisgaard and Murat, 2011; Kirchgassner et al.,2012), and Autocorrelation function (ACF) (See Dobre and Alexandru, 2008; Chatfield, 2016)

correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments (Gujarati, 2003). Johansen (1988), introduced Johansen's Cointegration test as follows:

Consider a VAR of order p as equation (1), we can rewrite the VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + Bx_t + \varepsilon_t \tag{5}$$

Where: $$\Pi = \sum_{i=1}^{p} A_i - I, \Gamma_i = -\sum_{j-i+1}^{p} A_j$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank r<k, then there exist (k x r) matrices α and β each with rank r such that $\Pi=\alpha\beta'$ and $\beta' y_t$ is stationary. r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the vector error correction model. Johansen's method is to estimate the Π matrix in an unrestricted form, then test whether we can reject the restrictions implied by the reduced rank of Π. The results of the Johansen's Cointegration Test determine the number of the cointegrating relationship among the variables in the model (Awokuse, 2007; Hjalmarsson and Österholm, 2007).

5. Results and Discussions

The stationary of variables was tested by Augmented Dickey Fuller (ADF) test; optimal rank of VAR model was extracted. The long-term relationship between variables was also estimated based on Johansen cointegration test, and variables affecting rice exports were studied using Vector Error Correction Model (VECM) based on variance decomposition, at the end, the results of (VECM) model were used to forecast Egyptian rice exports.

5.1. Vector Autoregressive Model (VAR) Estimation

Before we run the VAR, we perform unit-root tests using the augmented Dickey-Fuller (ADF) test. Table (2) shows that all the variables have unit roots in levels and are stationary in first-differences.

Table-2. Results of Dickey Fuller (ADF) test for determining the stationarity of the time series

	Augmented Dickey Fuller (ADF)			
	Log level		Log difference	
	Intercept	Trend and intercept	Intercept	Trend and intercept
Exchange rate	-.995	-1.45	-3.06**	-3.16
The value of Egyptian rice exports	-1.70	-2.70	-7.90***	-7.83***
Egyptian rice export price	-2.43	-2.61	-4.95***	-4.99***
World rice export price	-1.07	-2.41	-3.72***	-3.79**
Egyptian rice yield	-1.71	-0.32	-3.06**	-3.49*

Source: Compiled by researcher from unit root test depending on the program E-Views
Note: *** indicates statistical significance at 1%level, **significance at 5%level, * significance at 10%level

One way of determining the optimum lag order of the VAR model is to use the minimum information criterion. According to log likelihood and Schwarz criterion (SC), we find the optimal lag order is two.

Table 3 illustrates the results of the Johansen cointegration procedure which determine the number of the cointegrating relationship between variables in the model. The results indicate that the null hypotheses from no cointegration through one cointegrating relationships (r = 0, 1) can be rejected at the 5% level, but the null of two cointegrating relationships (r = 2) cannot be rejected at the 5% and 1% level, so we have two cointegrating equation, and we use Vector Error Correction Model (VECM) to estimate the model.

Table-3. Results of the Johansen cointegration rank tests

	Eigenvalue	Likelihood ratio	5% critical values	1% critical values
H_0:r=0	0.81	103.66	68.52	76.07
H_0:r≤1	0.56	51.66	47.21	54.46
H_0:r≤2	0.32	26.07	29.68	35.65
H_0:r≤3	0.25	14.29	15.41	20.04

Source: Compiled by researcher from Johansen cointegration test depending on the program E-Views.

5.2. Results of Variance Decomposition

The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR model. Variance decomposition determines how much of the forecast error variance of each variable can be explained by exogenous shocks to the other variables (Lütkepohl, 2013; Mondi *et al.*, 2011).

Table (4) shows the results of Variance decomposition of the value of Egyptian rice exports to identify the most important factors that affect it. We find that more than 61% of the forecast errors explained by its shocks, then both Egyptian export prices and yield, contributing about 20%, 10%, respectively, in the interpretation of the forecast errors of the value of Egyptian rice exports for year two. But in the long run (year ten), We find that 35% of forecast errors explained by the Egyptian export price, then the value of rice exports, world export price, yield, contributing about 18%, 18%, 15%, respectively.

In other words, if we want to increase Egyptian rice exports, decision-maker should provide exports at a reasonable price less than the world price, and increase rice yield, through (R&D) that lead to innovate improved varieties which resistant to pests and less consumption for water**.**

Table-4. Variance Decomposition of The value of Egyptian rice exports (VEX)

Period	S.E	(ER)	(VEX)	(EXPE)	(EXPW)	(Y)
1	0.28	0.12	99.88	0.00	0.00	0.00
2	0.50	6.79	61.90	20.01	0.37	10.93
3	0.55	10.42	51.46	19.35	9.64	9.12
4	0.79	12.74	24.94	40.68	16.84	4.80
5	0.86	12.16	21.80	37.16	14.43	14.46
6	0.88	12.79	20.69	35.15	17.50	13.88
7	0.90	12.81	20.06	35.10	17.64	13.50
8	0.92	12.21	19.17	36.35	18.30	13.97
9	0.93	12.08	18.81	35.33	18.26	15.53
10	0.94	12.02	18.65	35.31	18.46	15.56

Table (5) shows the results of Variance decomposition of Egyptian export prices of rice, where we find about 50% of forecast errors explained by its shocks, then exchange rate, world export prices of rice, yield, contributing about 16%, 15%, 13%, respectively, in year ten.

Table-5. Variance Decomposition of Egyptian export price of rice (EXPE)

Period	S.E	(ER)	(VEX)	(EXPE)	(EXPW)	(Y)
1	0.17	9.08	3.78	87.14	0.00	0.00
2	0.20	12.17	3.06	69.41	9.17	6.18
3	0.21	11.86	4.42	64.80	8.87	10.05
4	0.21	11.20	4.87	60.95	11.87	11.10
5	0.24	13.95	3.83	58.22	14.95	9.06
6	0.26	14.34	4.36	54.12	15.44	11.74
7	0.26	14.06	4.31	52.63	15.51	13.49
8	0.27	15.46	4.31	52.02	15.211	12.10
9	0.27	15.95	4.32	50.69	15.88	13.16
10	0.28	16.21	4.38	50.17	15.47	13.77

Table (6) shows the results of Variance decomposition of world export prices of rice, where we find about 75% of forecast errors explained by its shocks, and the role of other variables is very small in both short and long run. Also table (7) illustrates that about 87% of forecast errors Variance decomposition of exchange rate explained by its shocks, in both short and long run.

Table-6. Variance Decomposition of World export price of rice (EXPW)

Period	S.E	(ER)	(VEX)	(EXPE)	(EXPW)	(Y)
1	0.13	1.42	7.37	3.73	87.48	0.00
2	0.15	1.06	9.89	3.37	77.96	7.72
3	0.15	1.95	9.31	4.73	76.06	7.96
4	0.17	2.33	9.66	3.82	77.17	7.03
5	0.18	2.02	10.35	3.40	76.75	7.49
6	0.20	2.38	10.11	4.38	75.91	7.21
7	0.21	2.59	9.95	4.23	75.91	7.32
8	0.22	2.45	10.26	3.88	75.84	7.56
9	0.23	2.44	10.42	3.80	75.82	7.52
10	0.24	2.57	10.27	3.94	75.87	7.36

Table-7. Variance Decomposition of Exchange rate (ER)

Period	S.E	(ER)	(VEX)	(EXPE)	(EXPW)	(Y)
1	0.05	100	0.00	0.00	0.00	0.00
2	0.07	94.75	0.00	0.10	5.04	0.11
3	0.09	87.10	1.01	7.47	4.33	0.09
4	0.10	85.72	0.81	9.95	3.39	0.13
5	0.11	86.07	0.68	9.20	3.88	0.17
6	0.12	87.08	0.81	8.18	3.50	0.43
7	0.13	86.80	0.69	8.77	3.327	0.42
8	0.14	86.32	0.61	8.99	3.69	0.38
9	0.15	86.74	0.59	8.65	3.54	0.48
10	0.16	87.23	0.56	8.43	3.32	0.45

While Table (8) shows the results of Variance decomposition of yield, where we find that more than 48% of forecast errors explained by Egyptian export prices of rice, and about 32% of forecast errors explained by its shocks in the long run (year ten).

Table-8. Variance Decomposition of Egyptian rice yield (Y)

Period	S.E	(ER)	(VEX)	(EXPE)	(EXPW)	(Y)
1	0.02	0.10	10.96	14.79	4.31	69.84
2	0.03	4.55	8.18	37.16	4.48	45.63
3	0.03	5.70	5.08	45.96	9.85	33.41
4	0.04	5.31	4.60	43.96	8.90	37.23
5	0.041	4.97	4.68	45.17	9.73	35.46
6	0.044	4.89	4.01	45.28	11.42	34.40
7	0.05	5.60	3.58	48.34	10.06	32.42
8	0.05	5.16	3.55	46.35	10.781	34.16
9	0.05	5.08	3.23	47.35	11.24	33.10
10	0.05	5.43	3.08	48.33	10.63	32.53

5.3. Forecast Values of The Model's Variables

Table (9) shows forecast values of the model's variables, we find that the exchange rate will continue to rise from 1US$ =7. 41 L.E in 2015 to its maximum value about 19.99 L.E in 2025. That indicates depreciation in Egyptian Pound against US$. That's reflected in the decline in Egyptian export price from 444.74 US$ in 2015 to 351.25 US$ in 2025. On the other hand, there is fluctuation in the world price, and it is higher than the Egyptian export price during all the forecast period. Also, we note that the yield of rice will increase as a result of innovating new improved varieties and that will lead to increase the Egyptian rice production and the quantity of rice exports.

The value of Egyptian rice exports is expected to increase during the forecast period due to the low Egyptian export price which will lead to rise the demand on Egyptian rice, then the value of rice exports. These Results indicated the possibility of improving the competitiveness of Egyptian exports of rice in global markets. But there are two main challenges should be considered:

1. The recent water policies in Egypt predicted a shortage in the national water supply and demand scenarios. This implies the necessity to introduce a water demand management (WDM) strategy in Egypt (Mohamed, 2000), so that government may decrease the land area used for rice production to preserve water (USDA FAS GAIN, 2016).
2. Implementation of export restraints in an attempt to ensure sufficient domestic rice supplies and keep domestic prices low through a high rice export tax, export license fees, or rice export ban (Baylis *et al.*, 2013; Durevall and Weide, 2017). That has not been conducive to improving Egypt’s export viability (USDA FAS GAIN, 2013).

Table-9. forecast values of the model's variables

year	The value of Egyptian rice exports (1000 US$)	Exchange rate for US$ in (LE)	Egyptian export price for rice (US$)	world export price for rice (US$)	Egyptian Rice yield (ton)
2015	27750.55	7.41	444.74	581.72	4.25
2016	70077.90	8.71	476.62	587.30	4.34
2017	95808.35	9.64	448.31	614.34	4.34
2018	46632.67	10.29	402.47	600.67	4.50
2019	61229.56	11.19	405.08	577.42	4.60
2020	77845.26	12.57	405.71	593.71	4.70
2021	74865.63	13.79	386.05	604.01	4.80
2022	79075.81	14.99	380.86	596.67	4.93
2023	83048.04	16.55	363.95	599.21	5.05
2024	87512.07	18.20	356.23	611.08	5.16
2025	94741.61	19.99	351.26	617.84	5.30

Source: Calculated by researcher depending on the program E-Views

6. Conclusion

The main objective of the study is to determine the main factors influencing Egypt's rice exports using Vector Autoregressive Model (VAR). This model can also be used to study the prospects of Egyptian rice exports during the period (2015: 2025)..The results of Variance decomposition confirm that the most important variables influence the value of Egyptian rice exports in the medium and long run is Egyptian export price of rice about 35% in year ten.while the Egyptian export prices of rice explained by its shocks about 50% of forecast errors, then exchange rate, world export prices of rice, yield, contributing about 16%, 15%, 13%, respectively, in year ten.

And the results of Variance decomposition of yield show that more than 48% of forecast errors explained by Egyptian export prices, and about 32% of forecast errors explained by its shocks in the long run (year ten). While the results of Variance decomposition of world export prices of rice and exchange rate illustrate that about 75%, 87% of forecast errors explained by its shocks, and the role of other variables is very small in both short and long run.

Empirical results of Vector Error Correction Model (VECM) show that forecast values of exchange rate will continue to rise during all the forecast period. That indicates depreciation in Egyptian Pound against US$. That's reflected in the decline in Egyptian export price from 444.74 US$ in 2015 to 351.25 US$ in 2025. On the other hand, there is fluctuation in the world price, and it is higher than the Egyptian export price during all the forecast period. Also, we note that the yield of rice will increase as a result of innovating new improved varieties and that will lead to increase the Egyptian rice production and the quantity of rice exports. Considering the above facts the value of Egyptian rice exports is expected to increase.

These Results indicate the possibility of improving the competitiveness of Egyptian exports of rice in global markets. These results are also important for trade policy formulation to promote Egyptian rice exports to the world market. But there are two main challenges to improve the competitiveness of Egyptian rice should be considered: (i) reduction of land area used for rice production to preserve water, and (ii) implementation of export restraints to keep domestic prices low.

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Appendix

Table-1. Values of the model's variables during study period (1980:2014)

Year	The value of Egyptian rice exports (1000 US$	Exchange rate for US$ in (LE)	Egyptian export price for rice (US$)	World export price for rice (US$)	Egyptian Rice yield (Ton)
1980	35223	0.7	359.15	391.66	2.46
1981	42609	1.50	458.07	452.93	2.34
1982	11617	1.47	506.98	352.38	2.38
1983	7081	1.53	372.59	318.00	2.41
1984	22522	1.62	341.81	306.51	2.27
1985	5400	1.72	365.63	288.15	2.5
1986	16022	1.82	444.52	248.41	2.43
1987	39657	2.10	396.70	264.05	2.45
1988	17635	2.30	247.15	333.29	2.55
1989	8291	2.46	252.74	327.86	2.72
1990	18181	2.73	241.32	334.15	3.06
1991	38710	3.14	256.44	342.49	3.13
1992	57313	3.32	305.72	333.37	3.218
1993	40051	3.35	277.89	309.27	3.245
1994	78588	3.39	319.62	350.51	3.326
1995	56741	3.39	361.91	332.92	3.42
1996	117723	3.39	359.09	391.54	3.494
1997	71363	3.39	352.25	372.75	3.55
1998	135190	3.39	315.18	333.00	3.63
1999	87592	3.40	285.34	314.04	3.73
2000	112565	3.47	286.43	277.98	3.825
2001	133854	3.97	203.99	264.11	3.9
2002	105552	4.50	227.29	244.20	3.945
2003	149926	5.85	255.96	257.45	4.095

Continued

Year	The value of Egyptian rice exports (1000 US$)	Exchange rate for US$ in (LE)	Egyptian export price for rice (US$)	World export price for rice (US$)	Egyptian Rice yield (Ton)
2004	232164	6.20	277.55	310.32	4.133
2005	311031	5.78	279.83	327.00	4.197
2006	302130	5.73	307.43	345.61	4.234
2007	402612	5.64	329.11	409.63	4.106
2008	191110	5.43	622.84	672.63	4.091
2009	475933	5.54	733.67	639.35	4.031
2010	377850	5.62	630.03	599.20	3.959
2011	17102	5.93	427.85	637.67	4.021
2012	98498	6.06	670.65	594.72	4.007
2013	199318	6.87	593.61	648.05	4.029
2014	29995	7.08	365.74	624.61	4.031

Source: Food and Agriculture Organization Of United State (FAO), available at: http://www.fao.org/faostat/en/#data, Accessed January 2017

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Table-2. Results of Vector Error Correction Model (VECM)

Cointegrating Equation	**Cointegrating Equation 1**	**Cointegrating Equation2**			
DLOG(ER(-1))	1	0			
DLOG(VEX(-1))	0	1			
DLOG(EXPE(-1))	2.48 (1.51) (1.64)	-2.49 (1.34) (-1.86)			
DLOG(EXPW(-1))	-0.97 (0.81) (-1.2)	1.77 (0.72) (2.47)			
DLOG(Y(-1))	4.98 (3.87) (1.29)	-12.07 (3.44) (-3.51)			
C	-0.13	0.09			
Error correction	**D(DLOG(ER))**	**D(DLOG(VEX))**	**D(DLOG(EXPE))**	**D(DLOG(EXPW))**	**D(DLOG(Y))**
Cointegrating Eq1	-0.06 (0.08) (-0.72)	-1.24 (0.44) (-2.85)	-0.8 (0.27) (-2.99)	-0.20 (0.19) (-1.04)	-0.04 (0.03) (-1.26)
Cointegrating Eq2	0.02 (0.06) (0.32)	-2.64 (0.32) (-8.18)	-0.20 (0.2) (-1.02)	0.02 (0.14) (0.12)	0.03 (0.02) (1.28)
D(DLOG(ER(-1)))	-0.1 (0.21) (-0.45)	0.52 (1.2) (0.44)	-0.01 (0.74) (-0.01)	0.18 (0.54) (0.34)	0.08 (0.09) (0.87)
D(DLOG(ER(-2)))	-0.051 (0.10) (-0.51)	-1.23 (0.56) (-2.21)	0.20 (0.34) (0.59)	0.01 (0.25) (0.02)	0.05 (0.04) (1.16)
D(DLOG(VEX(-1)))	-0.01 (0.04) (-0.23)	0.71 (0.23) (3.13)	0.03 (0.14) (0.21)	-0.01 (0.10) (-0.14)	-0.01 (0.02) (-0.64)
D(DLOG(VEX(-2)))	-0.01 (0.02) (-0.27)	0.05 (0.11) (0.49)	-0.04 (0.07) (-0.61)	-0.02 (0.05) (-0.48)	-0.00 (0.01) (-0.15)
D(DLOG(EXPE(-1)))	0.21 (0.17) (1.25)	-1.63 (0.94) (-1.73)	0.46 (0.57) (0.80)	0.42 (0.42) (0.99)	0.09 (0.07) (1.35)
D(DLOG(EXPE(-2)))	0.016 (0.11) (0.14)	0.03 (0.63) (0.04)	0.46 (0.39) (1.19)	0.32 (0.28) (1.13)	-0.02 (0.05) (-0.46)
D(DLOG(EXPW(-1)))	-0.21 (0.12) (-1.75)	3.38 (0.68) (4.98)	0.20 (0.42) (0.47)	-0.70 (0.30) (-2.32)	-0.07 (0.05) (-1.37)
D(DLOG(EXPW(-2)))	-0.13 (0.11) (-1.20)	3.36 (0.62) (5.43)	0.02 (0.38) (0.06)	-0.53 (0.28) (-1.93)	0.03 (0.04) (0.70)

Continued

Error correction	**D(DLOG(ER))**	**D(DLOG (VEX))**	**D(DLOG (EXPE))**	**D(DLOG(EXPW))**	**D(DLOG(Y))**
D(DLOG(Y(-1)))	0.37 (0.61) (0.60)	-15.98 (3.42) (-4.67)	-1.35 (2.09) (-0.65)	-1.18 (1.53) (-0.77)	-0.33 (0.25) (-1.33)
D(DLOG(Y(-2)))	0.25 (0.47) (0.53)	-4.45 (2.65) (-1.68)	-0.54 (1.62) (-0.33)	-0.88 (1.18) (-0.74)	-0.12 (0.19) (-0.65)
c	0.00 (0.01) (0.19)	-0.15 (0.07) (-2.13)	-0.00 (0.04) (-0.05)	0.01 (0.03) (0.29)	0.00 (0.01) (0.57)
R-squared	0.45	0.97	0.68	0.41489	0.81
Adj. R-squared	0.08	0.94	0.47	0.052	0.68
Sum sq. resids	0.08	2.51	0.94	0.50	0.01
S.E. equation	0.07	0.37	0.23	0.17	0.03

F-statistic	1.21	43.17	3.21	1.14	6.24
Log likelihood	48.35	-5.03	10.21	20.03	76.67
Akaike AIC	-2.28	1.16	0.18	-0.45	-4.11
Schwarz SC	-1.68	1.76	0.78	0.15	-3.51
Mean dependent	-0.00	-0.05	-0.01	0.00	-0.00
S.D. dependent	0.07	1.58	0.31	0.17	0.05
Determinant Residual Covariance	0.00				
Log Likelihood	160.02				
Akaike Information Criteria	-5.48				
Schwarz Criteria	-2.03				

Standard errors & t-statistics in parentheses

Source: Calculated by researcher depending on the program E-Views.