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Implications of Exchange Rate Volatility on Agricultural Exports: The Case of Egypt

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ABSTRACT

Contributing to the empirical literature of exchange rate implications on foreign trade, the study analyzed the impact of Egyptian pound depreciation on the revenues from agricultural exports, using Engle-Granger approach and Error Correction Mechanism (ECM). The results indicated that the exchange rate has a vitally important role in boosting the value of agricultural exports. As regards the short term, the exchange rate positively affects agricultural exports returns. On the other hand, the results showed that the error correction term of the long-term impact is statistically-significant, and also has a negative sign, as well as, it reflects a high speed of adjustment (0.45). This implies that about 45% from the imbalance of the relationship between the exchange rate and the agricultural exports value are corrected within one year. Moreover, the results of diagnostic and stability tests showed that the estimated model is free from the problems of normality, serial correlation and heteroskedasticity, additionally, the stability of coefficients is proven over the study period, which proven the reliability of the study results. Finally, the study concluded with a set of recommendations which revolve around the necessity of taking the dynamics of Egyptian pound exchange rate into account when designing the trade polices in general.

Keywords: Exchange Rate, Agricultural Exports, Engle-Granger approach, Engle-Granger Causality, Error Correction Mechanism (ECM).

INTRODUCTION

Agriculture is a vital part of Egypt's economy, because of its contribution to food security and job creation. In addition, agriculture provides raw materials to the important manufacturing industry in Egypt (Suliman, 2019). According to the recent statistics, agriculture contributed up to 739.6 billion Egyptian pounds of Egypt's GDP in 2021, approximately employed 7.73 million of the labor force which is nearly 29.2% of all jobs in the same year (CAMPAS, 2022). Moreover, it is considered an essential source of foreign currency for Egypt, and its therefore absolutely necessary for the equilibrium of trade and payments balances (Sultan, 2020). The Agricultural sector in Egypt, however, suffer from a rung of risks and uncertainty which adversely affects its performance.

Foreign trade sector definitely plays a great role in achieving the economic development for all countries around the world (Shehata, & Abd Elftah, 2008). In fact, Egypt mainly relies on agricultural exports as an important source of its national income. In 2021, agricultural exports were contributed about 12.5% to the Egyptian GDP (CAMPAS, 2022). However, Egypt as an emerging county is still suffering from the increasing gap between food imports and exports. Accordingly, the Egyptian government strives constantly to reduce the widening gap in the trade balance by increasing exports and decreasing imports. To address this issue, agricultural exports is required to be risen by 20% annually from the current year to 2030.

In the light of economic and political contemporary changes that the world witness', the vast majority of countries around the world have shifted to the flexible regime of exchange rate (Olamide et. al, 2022). Some see that the exchange rate fluctuation is assumed to cause a negative effect on the international trade, which in turn leads to uncertainty in terms of profit, leads to risk for the exporters, subsequently causing them give up exporting (McKenzie, 1999). On other side, some researchers previously reached that exchange rate movements positively affect the international trade and especially the export volumes (Permana & Rifin, 2022). Thus, the issue of exchange rate change and its implications on the international trade has been drawn attention of many researchers, which points out the importance of the subject, and highlights the need to study it. Therefore, the idea of this study stems to address the conflict concerning the impacts of exchange rate on agricultural exports in Egypt.

Problem of the study:

Since 2011, Egypt has been facing a serious problem concerning the foreign currencies availability. The foreign reserve of Egypt declined from around (USD 36 billion) in 2010 to (USD 13.4 billion) in 2013. The problem has been greatly exaggerated by the presence of the "black market", which exercises further pressure on the Egyptian pound and gradually weakens its value.

In 2016, Central Bank of Egypt took a decision of liberalization of the Egyptian pound against foreign currencies, as an important step on the way of economic reform (Lemaire, Thibault, 2018). Many arguments have arisen about this step between supporters and opponents. The supporters of this decision considered it one of the necessary procedures to increase Egyptian exports, as it gives them a competitive price compared to other

commodities in the international markets (Ahmed, Elghafour, 2020). On the contrary, the opponents of this decision believe that there is no effect of exchange rate liberalization on the exports, and they realize that there are other variables that have a greater impact on exports volume rather than the exchange rate of the Egyptian pound. Based on that inconsistency of views between supporters and opponents, there is a need to a detailed study on that topic. Accordingly, the problem of this study can be summarized in answering the main following question:

To what extent does Egypt's agricultural exports value affected by the exchange rate of Egyptian pound ?

Objective of the study

In the light of the above problem, this study aims at identification the impact of Egyptian pound fluctuations on revenues from agricultural exports during the period (1985-2022), in order to come up with a set of recommendations which may help the policymakers on how to stimulate the agricultural exports and rise its contribution to the Egypt's economy.

Importance of the study

For Egypt particularly, the exchange rate dynamics should be taken into consideration, especially when designing trade policies. So the expected results of this study undoubtedly will help policymakers in drawing appropriate plans and policies to boost the agricultural exports and improve their competitiveness in the foreign markets, as well as, preparing for the expected long-term effects of the exchange rate on agricultural exports in Egypt.

MATERIALS AND METHODS

Methods and Data Analysis:

In order to achieve the objective of the study, both descriptive and quantitative methods were used. The study mainly used the method of cointegration depending on Engle-Granger approach and Error Correction Mechanism (ECM) (Engle, & Granger, 1987). Contrasting with Johansen (1988) approach and even with ARDL method, Engle-Granger approach is limited to only two variables (Niyimbanira, F., 2013). In general, the vast majority of macro economic variables are not stationary at their levels, but stationary at the first deference (Harris, R., 1995). Estimating regressing models between two or more non-stationary variables leads to so-called spurious regression. To avoid this problem and obtain accurate estimators, it is necessary to use cointegration methods like Engle-Granger. For this study, using Engle-Granger approach requires three main conditions (Kennedy, 1996), which are:

1- Examining the relationship between the two variables of the study.

2- The two variables should be cointegrated of the same order.

3- Making sure that the residuals generated from the regression of the two variables are stationary at the level e. i. I(0). Thus using the error correction mechanism (ECM) is one of the best choices.

The error correction model was initially used in 1984 (Sargan, j. Denis, et.al, 1984). According to this method, the disequilibrium relationship between two variables in the short term will be back towards the long term equilibrium by the error correction mechanism (speed of adjustment) (Etale & Ayunku, 2016). The general formula of the error correction model is expressed by the following equation:

$$\Delta \hat{Y}_t = A_1 + A_2 \Delta X_t - A_3 U_{t-1} + V_t$$

Where:

$\Delta \hat{Y}_t$: The estimated value of the first difference of dependent variable.

ΔX_t: The value of the first difference of independent variable.

U_{t-1}: The Error term (in t-1 period).

(A1, A2, A3): Model parameters.

Data Collection:

The study employed annual data that covers a period of 38 years (1985-2022) for each of Egyptian pound exchange rate (EXR) and Egyptian agricultural exports value (AEXP). The data on exchange rate were collected from the statistical bulletins and reports issued by the central bank of Egypt (CBE), and from the electronic yearbook of Central Agency for Public Mobilization and Statistics (CAPMAS). The value of Egyptian agricultural exports data were collected from the database of the Food and Agriculture Organization (FAOSTAT). Table 1 shows a brief description for the variables of this study, besides the source of data for each of them.

Table 1. Description of the study variables and the source of data

Variable	Description	Source of data
EXR	The formal exchange rate of Egyptian pound against US Dollar in the Central Bank of Egypt (1 USD/EGP).	CBE - CAPMAS
AEXP	The net value of the Egyptian agricultural exports (USD Billion).	FAOSTAT

Source: Prepared by the researcher.

For the ease of interpretation of the findings and obtaining the estimations as elasticities, the data were transformed into logarithmic forms. The descriptive statistics of the study variables (on raw data) over the period (1985-2022) are summarized in table 1 in the appendix.

RESULTS AND DISCUSSION

Unit Root Tests:

For the majority of time series, the unit root test is frequently employed for testing stationarity (Ajewole & Jemilohun, 2020). As a matter of fact, there are different methods to check the data for stationary. In this study, Augmented Dickey-Fuller (ADF) (1979) and also Phillips-Perron (P.P.) (1988) which have been widely utilized were used. According to (ADF) and (P.P.) tests, the null hypothesis is that the given time series has a unit root. Table 2 of ADF and P.P tests shows that in the first deference of LEXR and LAEXP series', the calculated T-values is greater than critical values at 5% significant level, with P-value (Prob.) less than 0.05 (the level of significance), which indicates that LEXR and LAEXP series' are stationary at the first difference. In other words, the given time series' are I(1). With regard to the residuals that generated from the regression of LEXR and LAEXP (U $_t$), it is clear that the time series of the residuals is stationary at the level, which means that it is I(0). Accordingly, the conditions of using the error correction model (ECM) is confirmed, so we can proceed to the next step, which is determining the lag length of the model.

Table 2. Results of Unit Root Tests

Augmented Dick-Fuller Test (ADF)		Level			First Difference			Order of integration
		T-Stat	critical value (5%)	Prob.	T-Stat	critical value (5%)	Prob.	
L(EXR)	Intercept	- 0.996	- 2.943	0.745	- 4.342	- 2.945	0.001	
	Trend & intercept	- 2.009	- 3.537	0.577	- 4.270	- 3.540	0.009	I(1)
	None	2.008	- 1.950	0.988	- 3.560	- 1.950	0.000	
L(AEXP)	Intercept	- 0.520	- 2.943	0.876	- 5.559	- 2.945	0.000	
	Trend & intercept	- 2.065	- 3.527	0.547	- 5.545	-3.540	0.000	I(1)
	None	- 0.384	- 1.950	0.539	- 5.423	- 1.950	0.000	
U_t	None	- 4.907	1.950	0.000	-			I(0)
Phillips-Perron Test (P.P.)								
L(EXR)	Intercept	- 1.014	- 2.943	0.738	- 4.228	- 2.945	0.002	
	Trend & intercept	- 2.192	- 3.537	0.479	- 4.102	- 3.540	0.013	I(1)
	None	- 1.679	- 1.950	0.975	- 3.491	- 1.950	0.000	
L(AEXP)	Intercept	- 0.443	- 2.943	0.891	- 5.459	- 2.946	0.000	
	Trend & intercept	- 2.040	- 3.537	0.561	- 5.540	- 3.540	0.000	I(1)
	None	- 0.479	- 1.950	0.501	- 5.414	- 1.950	0.000	
U_t	None	- 4.968	- 1.950	0.000	-			I(0)

Source: EViews 12–outputs

Specifying Lag Structure

Error correction model is very sensitive for the lag length of the variables included (Kim, & W. Douglas, 2003). For determining the optimal lag length of Engle-Granger model, the study followed EViews package offers according to the evidence from the criterion (Akaike (AIC), Schwarz (SH), Hannan-Quinn (HQ), Final Prediction Error (FPE) and sequential modified LR test static). The results presented in table 3 indicate that according to (LR, FRE, AIC, SH, HQ, FPE) the optimal lag order are chosen to be one. Based on these results, the model is estimated using only first lag differences for each variable.

Table 3. The results of lag order selection

Lag	LR	FPE	AIC	SC	HQ
0	NA	0.003549	0.034538	0.125236	0.065055
1	134.8012*	0.002459*	- 4.216411*	- 3.944319*	- 4.124860*
2	3.612317	0.005949	- 4.102998	- 3.649511	- 3.950413
3	5.537086	0.007149	- 4.073539	- 3.438657	- 3.859920
4	5.865792	0.008349	- 4.075522	- 3.259245	- 3.800870
5	2.811677	0.009549	- 3.960902	- 2.963230	- 3.625215

* indicates lag length suggested by the criterion (LR, FPE, AIC, SC, HQ)
Source: EViews 12–outputs

Testing for Granger Causality:

In 1988, Granger introduced an important method for testing causality between two variables, e.g. (y and x). According to this method, when the changes in the variable X occur before the changes in the variable Y, then X could be a cause of Y or vice versa (Pindyck. et. al., 1998).

Granger causality test results of the study variables are given in table 4. Unambiguously, there is a clear-cut evident of two-way Granger causality between LEXR and LAEXP. Apart from the value of F-statistic, P-value of 0.0071 (which less than 0.05) suggest that LEXR Granger-causes LAEXP. Similarly, since the P-value 0.010 less than 0.05, we conclude that LAEXP Granger-causes LEXR. These results in fact are totally consistent with the economic theory, and also with numerous of previous studies. With regard to interpretation for the result of (LEXR Granger Cause LAEXP), depreciation in a country's currency is expected to attract the exporters towards the agricultural exports of this country, as a result of its lower prices in compared with other trading partners, which in turn encourage agricultural exports and promote their competitiveness. In contrast, logically, the appreciation of country's currency could make the agricultural exports of this country more expensive compared with the exports of competitors, and thus discourage agricultural exports, as well as, negatively affects their competitiveness. In relation to the interpretation for the result of (LAEXP Granger Cause LEXR), a change by increase or decrease in the agricultural exports could be reflected in the foreign reserves, which in turn affect the value of national currency.

Table 4. The results of Granger Causality test between the study variables

Null Hypothesis	F-Statistic	Prob.
LEXR does not Granger Cause LAEXP	4.24438	0.0071
LAEXP does not Granger Cause LEXR	3.93162	0.0101

Source: EViews 12–outputs

Error Correction Model (ECM)

Based on above, it is clear that the conditions of Error Correction Model (ECM) is proven. So the model was estimated considering that agricultural exports value is the dependant variable, whereas the independent variable is the exchange rate. Table 5 reports the results of (ECM), which are also given in equation (1). With respect to these results, the exchange rate has a positive and statistically-significant effect (in the short term) on the value of agricultural exports. R-squared is estimated at 0.678, which implies that 67.8% of the changes in the value of agricultural exports is mainly attributed to the changes in the exchange rate. An appreciation in Egyptian pound by 1% rises the value of agricultural exports by 0.287%. Furthermore, the results show that the coefficient of the error correction is statistically-significant at the level significance of 5%, besides it has the expected negative sign, with a relatively fast speed of adjustment 0.45. This implies that about 45% of the imbalance in the relationship between the study variables (EXR and AEXP) is corrected within one year.

Table 5. The results of Error Correction Model Estimates

Variables	Coefficient	T-Statistic	Prob.	F-Statistic	R-Squared
C	0.507	5.722	0.0000		
DLEXR	0.287	7.017	0.0000	36.855	0.678
U_{t-1}	- 0.452	- 3.170	0.0033		

Source: EViews 12–outputs

$$D(LAEXP)\hat{}_t = 0.507 + 0.287\ DLEXR_t - 0.45\ U_{t-1} \qquad (1)$$

Where:
AEXP: The total value of Egyptian agricultural exports (USD Billion) in the year (t) (the dependant variable).
EXR: Egyptian pound exchange rate against the USD (1 USD/EGP) in the year t (the dependant variable).
U_{t-1}: Error term in the year (t-1) (the speed of adjustment)
D: The first-deference.
L: Decimal logarithm.
Diagnostics tests:

Table 6 shows the results of diagnostics tests that utilized to assess the quality of ECM model. These tests are carried out at 5% level of significance. Jargue-Bera test indicates that the residuals of the model are normally distributed, because the p-value (0.653) is greater than 0.05 (the level of significance). With relation to serial correlation, Breusch-Godfrey test shows that the model is free from serial correlation, because the p-value (0.495) is greater than 0.05.

Additionally, the results of (Breusch-Pagan-Godfrey test) donates that the residuals are homoskedastic, the F-statistic p-value of 0.231 exceeds the level of significance (5%).

In relation to stability testing, the results of both CUSUM and CUSUMQS tests indicate that the estimated coefficients of ECM are stable over the study period, because both of CUSUM and CUSUMQS plots fall within the critical limits at the level significance of 5% (Figure 1 and 2 in the appendix).

Thus, given the results of diagnostic and stability tests, it is evident that EC model has no problem with normality, nor in serial correlation and heteroskedasticity, as well as the stability of coefficients is proven over the study period. Therefore, we conclude that the obtained results have a high degree of reliability.

Table 6. Results of diagnostic tests (Normality, Serial Correlation and Heteroskedasticity)

Test	Null hypothesis	p-value	Conclusion
Jarque-Bera	Ho: Residuals are normally distributed	0.653	Since (PV > 0.05): We accept Ho
Breusch-Godfrey	Ho: There is no serial correlation	0.495	Since (PV > 0.05): We accept Ho
Breusch-Pagan-Godfrey	Ho: The residuals are homoscedastic	0.231	Since (PV > 0.05): We accept Ho

Source: EViews 12–outputs

CONCLUSION AND RECOMMENDATIONS

As an attempt to contribute to the debate concerning the most recent depreciations of Egypt's currency and its implication on the agricultural trade, this study was conducted to estimate the likely effects of exchange rate fluctuations on the agricultural exports of Egypt. To achieve this goal, the study used Engle-Granger approach and Error Correction Mechanism (ECM), depending on the annual data that cover the period (1985-2022) for each of exchange rate and agricultural exports value.

The results of Error Correction Model (ECM) indicated that exchange rate of Egyptian pound has a short an long term impacts on agricultural exports value. The changes in the exchange rate positively affected the agricultural exports value in the short term. With respect to the long term, it was found that the error correction term has a negative sign, as well as, it is statistically significant, with a relatively fast speed of adjustment estimated at 0.45, which implies that the relationship between the two variables is highly important. The estimated (ECM) passed all of the diagnostic and stability tests, implying that it does not has problems with (normality, serial correlation, heteroskedasticity). Furthermore, the stability of coefficients is proven throughout the study period, which means that the results of the current study are very reliable. On the basis of these findings, the study concluded with a set of recommendations, that represent in the following:

1- The exchange rate changes and its implications on the agricultural trade in particular, and on the agriculture sector in general, should be the center of attention for the Egyptian policy-makers. Hence therefore, the exchange rate movements should be taken take into account when designing the policies related to agricultural exports stimulation.

2- Egyptian exporters should utilize the current depreciation of Egyptian currency in increasing the agricultural exports, by focusing mainly on the products quality.

3- For future studies, the researcher suggest that there is a need to evaluate the implications of Egyptian currency depreciation on the agricultural sector as a whole.

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APPENDIX

Table 1. Descriptive statistics of the study variables during (1985-2021)

Variables	Mean	Median	Maximum	Minimum	Std. dev	Skewness	Kurtosis
EXR	6.46	5.36	24.68	0.70	5.62	1.666	2.326
AEXP	1.50	0.89	3.30	0.32	1.12	0.444	- 1.696

Source: EViews 12–outputs
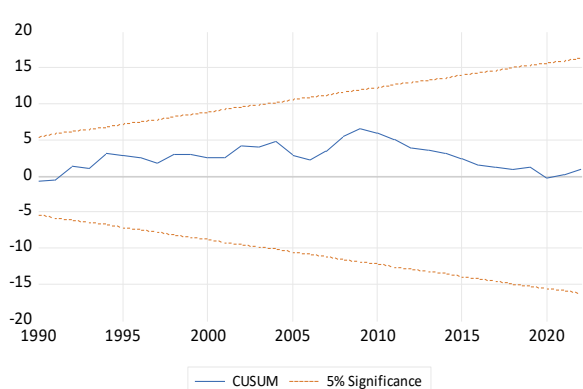

Figure 1. Plot of CUSUM test.
Source: EViews 12–outputs
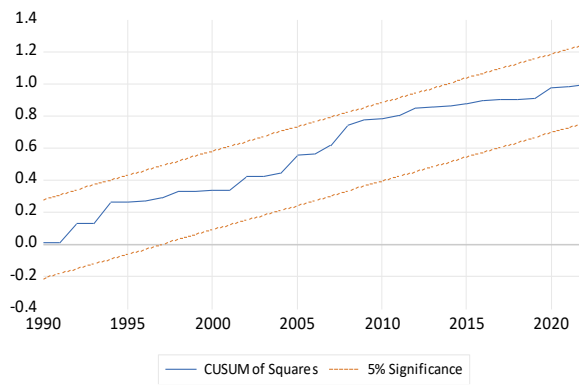

Figure 2. Plot of CUSUMSQ test
Source: EViews 12–outputs.

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أثر تقلبات سعر الصرف على الصادرات الزراعية: دراسة حالة في مصر

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الملخص

في محاولة للوقوف على الغموض والجدل المتعلق بالآثار المترتبة على تقلبات سعر صرف الجنيه المصري في الفترة الحالية وانعكاسه على التجارة الزراعية المصرية، سعت هذه الدراسة إلى استخدام منهجية انجل-جرانجر لتقدير العلاقة بين سعر صرف الجنيه المصري مقابل الدولار الأمريكي كمتغير مستقل وقيمة الصادرات الزراعية المصرية كمتغير تابع، وذلك خلال الفترة (1985-2022). وقد استخدمت الدراسة أسلوبي التحليل الوصفي والكمي، وذلك بالاعتماد على البيانات الثانوية المنشورة الصادرة عن كل من منظمة التغذية والزراعة (الفاو) التابعة للأمم المتحدة والبنك المركزي المصري. وأوضحت نتائج الدراسة بأن سعر الصرف يلعب دورا حيويا وايجابيا في التأثير على قيمة الصادرات الزراعية في المدى القصير والطويل على حد سواء. كما أظهرت النتائج بأن قيمة المعلمة المتعلقة بحد تصحيح الخطأ للعلاقة بين سعر صرف الجنيه المصري وقيمة الصادرات الزراعية بالمدى الطويل جاءت بإشارة سالبة وذات دلالة إحصائية مرتفعة، كما أنها تعكس سرعة تعديل عالية قدرت بحوالي 0.45، وهذا يعني بأن نحو 45% من الاختلال في العلاقة بين سعر صرف الجنيه المصري وقيمة الصادرات الزراعية في المدى القصير يتم تصحيحها خلال عام واحد فقط. كما أظهرت نتائج الاختبارات التشخيصية لنموج تصحيح الخطأ المقدر خلوه من جميع مشاكل القياس المتعلقة بالارتباط الذاتي والتوزيع الطبيعي لحد الخطأ. وقد خلصت الدراسة إلى مجموعة من التوصيات التي تدور في مجملها حول ضرورة مراعاة تحركات سعر صرف الجنيه المصري عند رسم السياسات الزراعية المتعلقة بالتجارة الخارجية.

الكلمات الداله:سعر الصرف – قيمة الصادرات الزراعية – نموذج تصحيح الخطأ – منهجية انجل-جرانجر

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