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Effect of the exchange rate change on the purchasing power of the consumer of agri –food by using (ARDL) model

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Abstract--In this paper, we studied of the impact of the exchange rate change on the (CPI) of Agri-food during the period (January 2019 - December 2021), to determine the extent of the exchange rate used as a tool for economic policy in Egypt, and to identify the extent to which the actual reality matches the economic theory that emphasizes that the high price of The exchange leads to a decrease in the purchasing power of money and then to the consumer. Statistical tests have been conducted to ensure the existence of a long-term equilibrium relationship between the changes that occur in the exchange rate on the (CPI) of Agri-food , using the Autoregressive Distributed lagged (ARDL) methodology, where it was found an inverse relationship Between the exchange rate and the (CPI) of Agri-food , a relationship that is consistent with the economic logic , there was an equilibrium relationship in the long run between the exchange rate and the purchasing power of the consumer of Agri-food represented in the (CPI) of Agri-food, as its estimated morale has been proven.

Keywords--exchange rate, CPI of agri, food, autoregressive, distributed lagged methodology (ARDL), partial correlation, stability.

Literature review

Over the past years, many studies utilized the impact of the exchange rate change on foreign trade, on the prices of agricultural crops, the relationship between the exchange rate and the purchasing power of the consumer. These section overviews the recent empirical analyses on the exchange rate change. The study of (AlZahraa 2011) confirmed the impact of exchange rate fluctuations on economic development, a case study of Algeria, where it was found that exchange rate changes affect economic development, imbalances in macro indicators, imbalances in the balance of payments and the state's general budget. (Khader 2012) studied the impact of the exchange rate on the overall indicators of the Palestinian economy (1994-2010), it targeted the effect of the exchange rate on inflation, and the impact of the exchange rate on the growth of the GDP. Where it was found that there is an inverse relationship between the real exchange rate and real GDP, direct relationship between the real exchange rate of exports and total exports, direct relationship between total imports and the real exchange rate of imports, that the inflation rate was affected by changes in the exchange rate, there is an inverse relationship between the nominal exchange rate, revenues and expenditures the public.

(Hajira 2012) studied the impact of exchange rate changes on the trade balance, a case study of Algeria, where it was found that there is a long-term relationship between changes in the exchange rate of the euro and the dollar, the balance of trade balance, there is no causal relationship between the exchange rate of the euro and the dollar and the balance of the trade balance. (ElSayed 2012) studied the impact of exchange rate fluctuations on exports in Egypt, using the autoregressive model and the error correction model. The study showed that exchange rate fluctuations negatively affect the growth of exports in the long and short term, as uncertainty leads to trade dealers preferring to trade in the local market over trade in the international market.

(Salma 2015) studied the impact of exchange rate fluctuations on the trade balance and ways to treat it "Algeria case study", the study showed that there is a direct relationship between exchange rate changes and the balance of trade balance, the lower the value of the local currency, the greater the balance of trade, and there is a relationship A direct correlation between changes in oil prices and the balance of trade balance, as the higher of oil prices led to higher the trade balance. (Helmy 2015) measured the impact of the depreciation of the exchange rate on the trade balance in the long and short term; it was shown the importance of reducing the inflation rate to benefit from the reduction of the nominal exchange rate to improve the trade balance. The study also showed the price inelasticity of demand for Egyptian imports. (Mostafa and ElBadry 2015) studied the impact of the exchange rate change on the retail prices of the most important vegetable crops in Egypt, using an unstructured autoregressive model (VAR) , analyzed the relationship between the exchange rate and the prices of vegetable crops in Egypt, where it was found that there is a direct relationship between the price of The exchange rate and the increase in the prices of vegetable crops, where an any shock in the exchange rate will have an increasing effect on the prices of vegetable crops.

(AlYamna 2016) studied the impact of the exchange rate on foreign trade, case study of Algeria (1990-2014), where the study showed a positive relationship between the exchange rate and both exports and imports. (AlBandari 2016) studied the impact of differences in the exchange rate on the Egyptian economy, it was found that an increase in fluctuations in the exchange rate leads to an increase in the risks facing exporters and importers, and the study found an overvaluation of the Egyptian pound, a negative impact on the trade balance and the economic growth. (Youssef 2016) studied the relationship between the parallel exchange rate and purchasing power, a case study of Algeria, where the study used the Autoregressive Distributed Lagged Model (ARDL), and it was found that there was a relationship between the parallel exchange rate and the purchasing power of the consumer in the long run with a weak percentage Consumer goods are bought and financed at the official exchange rate. (ElBadry and Shabrawy 2017) studied the impact of the exchange rate change on the prices of the most important agricultural crops and food commodities in Egypt. The study showed that there was a positive relationship between agricultural exports and the exchange rate. If the exchange rate increases by 10%, it will lead to an increase in agricultural exports by 0.6%. There is an inverse relationship between agricultural imports and the exchange rate. If the exchange rate rises by 10%, it will lead to a 13% decrease in agricultural imports, and this is agreed with economic theory.

According to the weakness of the national economy to achieve rapid development processes due to the weak production structure on the one hand and the increase in the population on the other hand, a deficit in the Egyptian trade balance and a decrease in the state's foreign exchange earnings, and an increase in the value of imports to reach about 74.1 billion dollars in 2020 (CAPMAS 2022), in Exports remained limited, amounting to about 31.8 billion dollars, which led to an increase in the trade balance deficit to about 42.4 billion dollars, while the deficit in the Egyptian agricultural balance increased to about 2.2 billion dollars in 2020, which called on the state to take monetary policies to get out of the economic crisis into a market economy and give impetus to the national economy through the strategy of increasing exports and limiting the increase in imports to restore balance to the Egyptian trade and agricultural balance.

The Egyptian national economy is exposed to many economic shocks that lead to disturbances in the overall variables such as savings, investment, spending and the general level of prices, and the most important of these shocks is the shock resulting from the liberalization of the exchange rate, which leads to some market disturbances and high inflation rates, which reached about 23.9% in 2017, and the rise in the prices of consumer goods, especially local foodstuffs or imported from abroad, because the foreign product exported to the local market depends on the dollar to export. The liberalization of the exchange rate had a clear impact on the rise in the value of the dollar against the depreciation of the Egyptian pound, which made the burden of the decline in the value of the pound affect the increase in the value of imports of various from consumer and food commodities and the transfer of this burden in the form of rising prices of consumer and food commodities to be borne by the local consumer, which led The low level of real income of the consumer and his inability to provide many of his basic needs, which necessitated studying the impact of the exchange rate change on the

purchasing power of the food consumer through the food consumer price index in Egypt.

This research aims to study the impact of the exchange rate change on the purchasing power of the consumer of the Agri- food products through the standard estimation of the effect of the exchange rate change on the purchasing power of the food consumer represented in the general index of food consumer prices (CPMAS 2022), using Autoregressive Distributed lagged Methodology (ARDL) to ensure the existence of a long-term co-integration relationship between the exchange rate and the general food consumer price index, and to identify the extent to which the purchasing power of the food consumer changes with the exchange rate change through development of the exchange rate and the food consumer price index during the period , Developing a standard model to estimate the impact of the relationship between exchange rate change and the purchasing power of food consumers in Egypt. The research relied on the use of statistical and econometric analysis tools, where the Unit Root Test (AlSawai 2012) was used to ensure the stability of time series using the Augmented Dickey Fuller Test, Akaike Information Criterion (AIC) tests to compare between two types From estimates in a number of variables or landmarks, especially in determining the number of delay periods, Bounds test to identify the extent of co-integration between the model variables, Normality test, model stability test, Autoregressive Distributed lagged Methodology (ARDL). The research relied on a secondary data published in many official agencies such as the (MALR), foreign trade bulletins issued by the (CAPMS 2022), the website of (CAPMS 2022), the website of the (CBE 2022), some researches, letters, studies and books were also used. Scientific studies related to the research topic.

Material and Methods

The research uses the Autoregressive Distributed lagged Model (ARDL) (AlSawai 2012; AlYousef 2013), which developed by (Pesaran et. Al.2001) where the methodology does not require the time series to be integrated of the same degree, as Pesaran saw that the bounds test in the (ARDL) methodology can be applied if the time series are stable at the zero level $I(0)$ or integrated of the first degree $I(1)$, and the only condition for applying this test is that the time series must not be a second integral $I(2)$, it can be used in the case of short time series, compared to the co-integration test such as the Granger method (Engle-Granger 1987) or the Johansen cointegration test (Johannsen Contegration Test) in the (VAR) model. The (ARDL) method also can be applied in the case of small samples, in contrast to the co-integration test, which requires that the sample size be large. Both long- and short-term estimates can be obtained simultaneously in one equation. The best results are given for the parameters in the long term (Diagnostics tests) can be used to determine the validity of the estimated model. Therefore, the (ARDL) model can separate the short-term from the long-term effect, and determine the size of the effect of each of the independent variables on the dependent variable, and estimating the parameters of the independent variables in the long and short term.

To test the extent of the equilibrium relationship between the variables is achieved in the (ARDL) model, in the unconstrained error correction model

(UCEM), by the (Bounds test). The (ARDL) model includes testing a long-term equilibrium relationship between the variables of the model, where the null hypothesis tested were no co-integration between the model variables:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_n$$

Whereas the alternative hypothesis represented in the presence of co-integration between the model variables in the long run:

$$H_0: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_n$$

The (ARDL) summarized (AlSawai, K.M 2012; AlYousef, N.A.R.2013) in these steps as follows:

- To test the stability of time series by using the (Unit Root Test).
- Co-integration test by using (Bounds Test).
- Estimation of the long-term model by using (ARDL).
- Estimation of Error Correction Model (ECM).
- Estimation the Residuals Test.

Results and Discussion

A study of the development of the exchange rate shows that its minimum reached about 15.725 pounds/dollars in November 2020, while it's highest reached about 17,892 pounds/dollars in January 2019 - Table (1). By estimating the equation of the time trend of the exchange rate development during the period (January 2019 - December 2021), it was found that it took a statistically significant decreasing trend of about 0.047 pounds / dollar, representing about 0.3% of the average of about 16,172 pounds / dollar - Table (2). The study of the development of the (CPI) of Agri- food showed that its minimum reached about 95.9% in December 2019, while its maximum reached about 110.8% in October 2021. By estimating the equation of the time trend of the development of the (CPI) of Agri- food, it was found that it took an increasing trend, statistically significant amounted to about 0.202%, representing about 0.2% of the average of about 101.3% during the study period - Table (2).

Table 1
Development of the exchange rate and the (CPI) of Agri- food during the period
(January 2019 - December 2021)

Month	Exchange rate (pounds / dollars)	(CPI) of Agri- food 100=2019/2018
January 2019	17.892	96.9
February 2019	17.629	100.1
March 2019	17.434	101.6
April 2019	17.334	102.0
May 2019	17.072	103.3
June 2019	16.796	100.9
July 2019	16.667	101.4
August 2019	16.633	102.5

September 2019	16.460	100.3
October 2019	16.284	98.3
November 2019	16.189	96.7
December 2019	16.146	95.9
January 2020	15.941	97.9
February 2020	15.741	97.8
March 2020	15.784	98.6
April 2020	15.818	102.9
May 2020	15.843	103.0
June 2020	16.221	101.3
July 2020	16.058	99.9
August 2020	16.007	97.4
September 2020	15.836	96.8
October 2020	15.770	97.5
November 2020	15.725	100.6
December 2020	15.763	99.0
January 2021	15.769	97.7
February 2021	15.729	97.7
March 2021	15.780	99.5
April 2021	15.757	102.5
May 2021	15.741	103.9
June 2021	15.734	104.6
July 2021	15.757	105.3
August 2021	15.766	104.8
September 2021	15.775	109.4
October 2021	15.777	110.8
November 2021	15.778	109.9
December 2021	15.778	108.6
Average	16.172	101.3

Source: Collected and calculated from: The website of the (CPMAS) www.capmas.gov.eg, The website of the Central Bank: www.cbe.org.eg

Table 2
Equations of the trend of the study variables during the period (January 2019 - December 2021)

Equation	Variable	Average	Growth Rate	R ²	F
Exchange rate (pounds / dollars)	$\hat{Y}_t = 17.002 - 0.047 T$ (-8.25)**	16.172	-0.3	0.667	68.1**
(CPI) of Agri- food (%)	$\hat{Y}_t = 97.78 + 0.202 T$ (3.75)**	101.3	0.2	0.293	14.0**

Source: Collected and calculated from the data of table (1).

**Significance at 0.01 probability level. *Significant at the 0.05 probability level.

Estimating an impact of the exchange rate on the (CPI) of Agri- food by using (ARDL) Model

Where the model consists of a dependent variable represented in (CPI) of Agri-food (Y), an independent variable represented in (Exchange rate) (X). In order to

estimate the exchange rate impact model on the (CPI) of Agri- food by using (ARDL) Methodology, the conditions for the stability of the time series must be met (Augmented Dickey Fuller test) (Tawil Assia et al. 2021; Zahra and Shoman 2013), which was shown by conducting a Corrologram test for the exchange rate And the consumer price index is that it suffers from the problem of instability at the zero level - Figures (3,1), but it becomes stable after making the first difference - Figures (4,2), and then the results of the stability study indicate that there is a long-term relationship between the variables, so the (ARDL) method and co-integration tests will be conducted to test the existence of a long-term equilibrium relationship between the model variables.

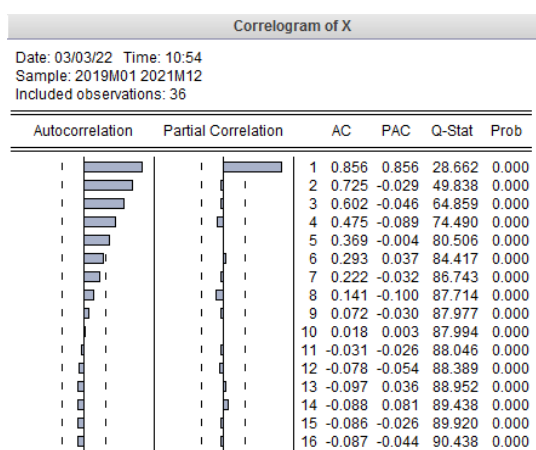


Fig. 1. Correlations and partial correlations of the exchange rate at zero difference

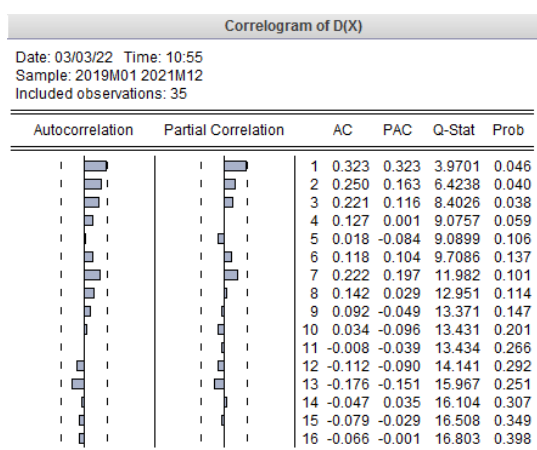


Fig. 2. Correlations and partial correlations of the exchange rate at first difference

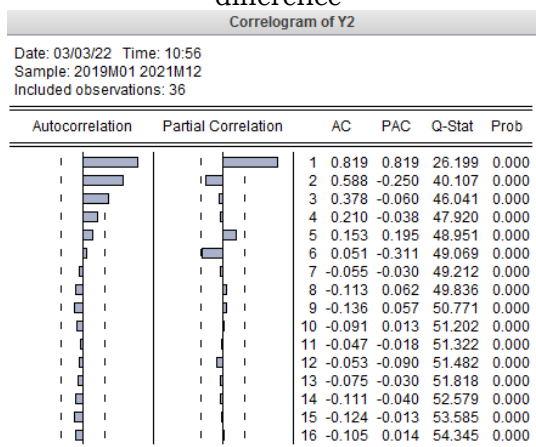


Figure 3. Correlations and partial correlations CPI at zero difference

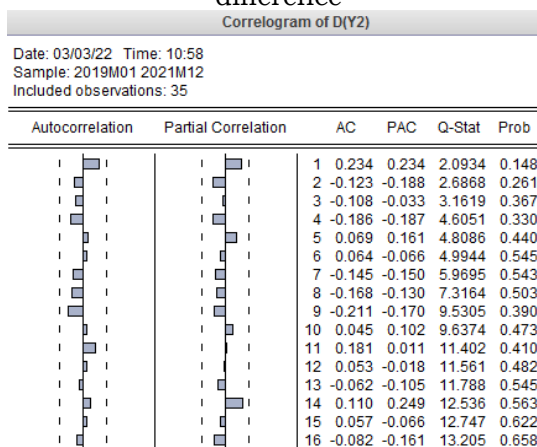


Figure 4. Correlations and partial correlations CPI at first difference

In order to estimate the exchange rate impact model on the (CPI) of Agri- food by using (ARDL) Model, it is necessary to meet the conditions for the stability of the time series, whether they are stable at the zero level $I(0)$ or integrated of the first

degree I(1), and to ensure the stability of the series In time, the Unit Root Test was conducted using the Augmented Dickey Fuller Test, where it was found that the exchange rate is stable at the zero level with a degree of 95% confidence in it and does not have a unit root (ElBadry 2017), while it was found that the (CPI) of Agri- food It is not stable at the zero level and has unit roots, so the first difference was taken, as it was found after taking the first difference that the calculated value (t) is greater than its tabular value at the level of significance 0.05, which means that there is no unit root and the stability of the time series, which calls (ARDL) Methodology which presented by (Pesaran, et. Al. 2001) - Table (3).

Table 3
Results of Augmented Dickey Fuller Test (ADF)

Variable	Difference	constant	constant and trend	without constant and trend	Degree of Integration
Exchange rate	Level	-4.966**	-2.632	-3.056**	I(0)
	Differ.1	-4.212**	-5.195**	-3.859**	
(CPI) of Agri- food	Level	-1.029	-2.118	1.014	I(1)
	Differ.1	-4.543**	-4.583**	-4.588**	

Source: Collected and calculated from the data of table (1) by using E-views 10.

**Significance at 0.01 probability level. *Significant at the 0.05 probability level.

After ensuring the stability and integration of the time series, whether at the zero degree or the first degree, the ARDL model is estimated through the following steps: Bounds Test, (Dickey, D.A., Fuller W.A. 1979) : The limits test was conducted to identify the extent of co-integration between the model variables or not, and it was found from the results of the limits test that the calculated (F) value amounted to about 7.3 which is greater than the upper limit of the critical values of the limits, which means rejecting the null hypothesis and accepting the alternative hypothesis with the presence of A long-term equilibrium relationship between the model variables at the 5% level of significance - Table (4).

Table 4
Results of (F Bounds) Test

F	Sign.F	Min Level I(0)	Max Level I(1)
7.3	1%	4.94	5.58
	5%	3.62	4.16
	10%	3.02	3.51

Source: Collected and calculated from the data of table (1) by using E-views 10.

Estimating the equilibrium relationship in the long run (Darwish and Abdel 2013): It was found that there is a long-term relationship between the variables of the study, and the maximum number of deceleration periods (10 periods) was determined, and therefore the (ARDL) model (10,9) was chosen to estimate the long-term equilibrium relationship. The results of estimating the impact of the exchange rate model on the (CPI) of Agri- food by using (ARDL) during the period (January 2019 - December 2021) revealed a long-term inverse relationship

between the dependent variable (CPI) of Agri- food and the independent variable (Exchange rate). That is, a decrease in the pound exchange rate by 1% leads to an increase in the (CPI) of Agri- food by about 16.9%, and this is consistent with economic theory.

$$Y = -16.915X + 366.3$$

(9.85)** (-7.19)**

It was also found that the coefficient of determination reached about 0.994, which means that the estimated model variables explain about 99.4% of the fluctuations in the (CPI) of Agri- food due to the change in the exchange rate, while the remaining percentage of fluctuations are due to other factors that were not included in the model. As shown by the calculated F value it reached about 38.3 at the level of significance of 0.01, which means the estimated model is significance and this means acceptance of the model from a statistical point of view. The significance of the error correction coefficient and its negative sign, which reached (-1.95) at the level of significance 0.01, indicates the existence of a co-integration relationship between the exchange rate and (CPI) of Agri- food, that is, when the (CPI) of Agri- food deviates from the equilibrium value during the short term, it quickly returns to its equilibrium value in the long term , about 195% of the imbalance is corrected during period (t) until it reaches equilibrium again .

Diagnostic Tests (Mariam and Asma 2019) : Diagnostic tests are used to judge the suitability of the model used in measuring the estimated elasticities in the long term, to ensure the quality of the model used in the analysis and not include measurement errors and problems: The self-correlation test between errors (LM Test) (Salami and Salami 2020) : This test is used to detect the possibility of a sequential correlation between errors, in order to know the possibility of accepting the null hypothesis that there is no sequential autocorrelation problem between the parameters of the estimated model. Therefore, the null hypothesis was accepted that there is no sequential autocorrelation problem between the errors of the parameters of the estimated model - Table (5).

Table 5

Results of the residuals examining to the exchange rate impact model on the (CPI) of Agri- food during the period (January 2019 - December 2021)

Jarque-Bera Test	ARCH Test	LM Test Breusch-Godfrey Serial Correlation
Jarque-Bera = 0.258 Prob.= 0.879	F = 2.71 Prob.(1,23)= 0.11	F = 1.101 Prob.(2,3)= 0.44

Source: Collected and calculated from the data of table (1) by using E-views 10.

Autoregressive Condition Heteroskedasticity Testing (ARCH Test) (Mostafa, and Elbadry 2015) : This test is used to detect the problem of the instability of the variance of the error term as it depends on the Lagrang- multiplier LM, where it was found that the significance of the (F) value reached about 0.11, which is greater than the level of significance of 0.05, and therefore we reject the null

hypothesis and accept the alternative hypothesis that there is no problem of the variance instability Error boundary for the parameters of the estimated model - Table (5).

Test of the normal distribution of residuals (AlYousef 2013): This test is used to reveal the normal distribution of the residuals of the estimated model, as it depends on the Jarque-Bera test statistic, as it was shown from table (5) that the Jarque-Bera statistic is less than the tabular value of the chi-distribution, where it is equal to 0.258 with 28 d.f, and that The critical probability ratio is greater than the significance ratio of 0.05, i.e. we accept the null hypothesis H_0 which says that the residuals are distributed normally, in addition to that the skewness coefficient is about -0.244, where its value is limited between $[-3, +3]$, so the probability distribution of the residuals of the estimated model is moderate, which It indicates the symmetry and normality distribution of the residuals of the estimated model, as it was found that the probability distribution curve of the estimated model is negative, that is, it is slightly skewed to the left - Figure (5).

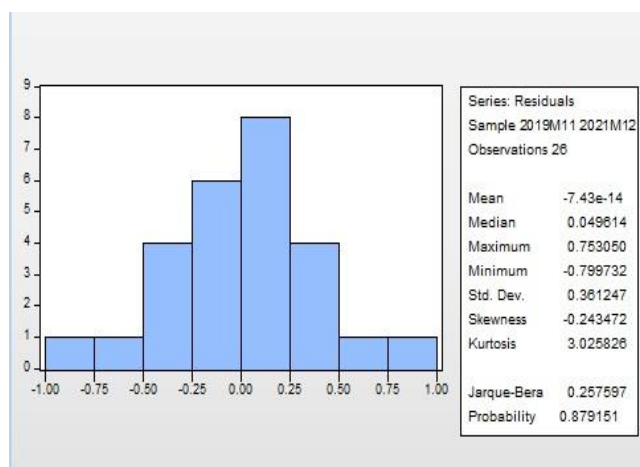


Fig 5. Normal Distribution test to the residuals of the ARDL Model

Stability Test (AlSawai 2012; Dickey, D.A., W.A. Fuller 1979): The Cumulative Sum Squares (Cusum of Squares) test is using to detect the presence of any structural changes and to show the stability and consistency of the long-term parameters of the model with the short-term parameters, to verify the structural stability of the estimated error-correcting coefficients of the (ARDL) Model. If the graph falls within the critical limits at the significance level of 0.05, it means that the model parameters are stable throughout the study period - Figure (7,6). It was found from the two figures that the estimated parameters of the model are structurally stable throughout the study period, and we note the consistency of the model between the results of error correction in the long and short term, where the graph fell within the critical limits at the level of significance of 0.05.

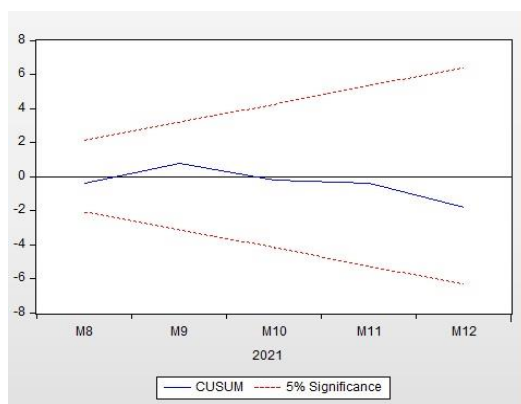


Fig. 6. Model Stability test
(cumulative sum of residuals)

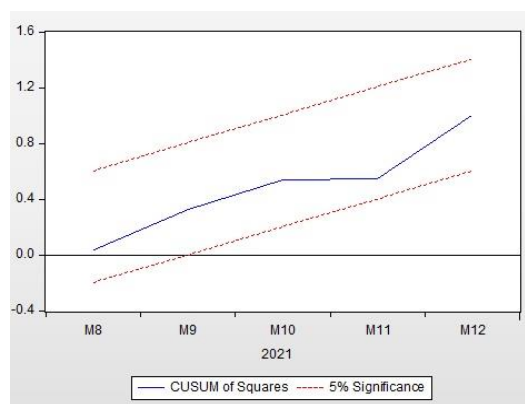


Fig. 7. Model Stability test
(Cumulative sum squares of residuals)

Conclusion

The results obtained for the (ARDL) methodology, an inverse relationship between the exchange rate and the purchasing power of the consumer of Agri- food. The results obtained an equilibrium relationship in the long run between the exchange rate and the purchasing power of the consumer of Agri-food represented in the general index of food consumer prices, as its estimated morale has been proven, which is in line with other studies (Youssef 2016). The results obtained the value of the error correction coefficient is about (-1.95), which indicates that when the Agri-food consumer price index deviated from the equilibrium value during the short term, the speed of its return to the equilibrium value in the long term is about 195% of the imbalance, until to reaches equilibrium about two months after returning to the long-term equilibrium position, which is in line with other studies, (ElSayed 2012; Mostafa and ElBadry 2015). The results obtained a negative impact of the increase in the exchange rate led to the increase in the general level of Agri-food consumer prices in the long term, that is, a decrease in the exchange rate of about 1% leads to an increase in the general level of prices Agri-Food to about 16.9%, which is consistent with economic theory, which is in line with other studies (AlZahraa 2011; Youssef 2016). As a future direction of research, we intend to devaluate of the pound for a long time so that the burden of depreciation is not transferred to the local consumer. Search for the reasons that led to the increase in the Agri imports. Develop the production policies to increase agricultural production to reduce the gap between consumer supply and demand to reduce the agricultural imports. Establish contractionary monetary policies to limit price increases to reduce the total spending and limit the money supply. Establish financial policies to stability the exchange rate, especially with the impact of food commodity prices on the increase in the exchange rate. Control the general level of prices as where affect the exchange rate.

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