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An examination of the effect of exchange rates on food security: the case of Egypt (2000-2022)

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Abstract

Purpose: This paper addresses the effect of exchange rate on accessibility of sufficient nutritious food, or in other word, its effect on food security in Egypt without any moderator during the period (2000 – 2022).

Design/methodology/approach: The research has used Dicky Fuller test of stationarity, and the Autoregressive Distributed Lag (ARDL) bound testing framework, using the variables of exchange rate, per capita food supply variability, and some control variables, that shape the model like gross domestic product, inflation rate, unemployment rate and interest rate. Thus, to examine the hypothesis of the study which are as follows:

1. **Exchange rate fluctuations significantly affect food security in Egypt.**
2. **The weaker national currency negatively impacts food security in Egypt.**

Findings: The analysis reveals significant statistical effects of various factors on food security (PCFS) at the 5% significance level. Specifically, for every 1 unit increase in exchange rate (EXR), PCFS increases by 0.2603 units (p-value ≤ 0.05). Similarly, a 1 unit increase in inflation (INF) leads to a 0.0001 unit increase in PCFS (p-value ≤ 0.05). Conversely, an increase of 1 unit in interest rate (INT) results in a decrease of 0.001 units in PCFS (p-value ≤ 0.05), while a decrease of 1 unit in unemployment (UNEM) corresponds to a 0.364 unit decrease in PCFS (p-value ≤ 0.05). Finaly, an increase of 1 unit in gross domestic product (GDP) contributes to a 0.273 unit increase in PCFS (p-value ≤ 0.05).

Originality/value: There are many studies that investigate the influence of foreign exchange rate on the accessibility of sufficient healthy food, although some of them have attempted to figure out and determine this effect on food prices. So, this paper concerns this matter with a focus on the Egyptian economy. The paper is important as it put the shades on the impact of changing foreign exchange rates, that has government attention, on the national security of Egypt represented by food security, and it also suggests some policies that solve this problem like the policies that encourage local agricultural growth, and so forth.

Keywords: food production – exchange rate – food prices – sustainable development – inflation rates.

Study plan:

The theoretical framework

The methodology/ approach

Results & findings

Conclusion

Policies Implications

References

1.Introduction:

Countries around the world are starting a new era with the concern of international challenges and how to deal with them through setting number of developing goals achieved by 2030, known by the 17th sustainable development goals (SDGs). Food security and ending hunger are forming a part of these goals. That does not mean that food security is a new concept. The world knew this concept from 1970s, but it attracts more attention, especially through the country changing goals of SDGs. Food security is defined as "access by all people at all times to the food needed for an active and healthy life" in food and agriculture organization`s (FAO) viewpoint.

And Egypt is still an agricultural economy, but it ranked the 57th out of 121 countries with a hunger percentage of 14.4% of population (World food programme.2024). And wheat is the first strategic food crop in Egypt. Since, wheat is essential for daily food for most of the population. And the volume of Egypt's wheat production ranged between (8-9) million metric tons annually, while the volume of Egypt's wheat consumption is about 18 million metric tons, and the gap is imported, which is estimated by (9-10) million tons annually. Nevertheless, these results are fewer than the previous expectations. Since, the expectations of the Egyptian center for strategic studies indicates that Egypt's total consumption of wheat annually will rise to roughly 21 million metric tons for the year 2021/2022.

Egypt is the largest importer of wheat in the world, as the volume of its wheat imports during 2021 reached about 13.2 million metric tons of wheat, followed by Indonesia then Turkey with 10.7 and 10.2 respectively (Egyptian center for strategic studies.2024).

In addition to, Egypt has a considered poverty rate around 29.9%[3] of the population lived below 3.20$ daily according to the latest available statistics in 2019. On the other side, Egypt has 501,000 refugees and over

65,000 of them are assisted by world food production (WFP) through food and cash (World.Food.Programme. 2024). But even though there is an assistance of WFP, there is still a huge load on food security in the hosting country. Since Egypt has to provide enough healthy sufficient food with affordable prices for all whether they are citizens or not.

the UN World Food Program Report 2022 illustrated that undernourishment is an additional public health thread in Egypt, with a stunting rate around 22.3 %. As well as 7 % of children less than 5-year-old are underweight. Generally, Egypt ranked the 77th out of 113 countries in the food security index in 2022 (Global Food Security Index.2024). So, it can be said that Egypt is a food-insecure county. It is a logical result of the inadequate economic accessibility of the poor, which pointed out that poverty is a key factor of food insecurity. Since, around one-third of Egyptians live below 3.20$. The dependency on imported intermediate goods which is utilized for food production with lots of differentiation of their prices are additional causes of food insecurity in Egypt.

Not only poverty rate affecting food security in Egypt, but also population growth. Since according to the FAO`s point of view, food security refers to availability, accessibility, utilization, and stability of food. And countries should keep the balance between the growth of food and population to not rely mainly on the other countries. So, countries should pay attention to this factor that affects food security to keep this balance, or even prevent the gap between food growth and population growth from widening (FAO Agricultural & Development Economics Division. 2006).

One of the other main factors affecting food security is exchange rate, especially in Egypt. Since, it has had a lot of changes in the exchange rate through the last two decades. The foreign exchange rate in Egypt has been appreciated over the last two decades with a huge jump in the year of 2016 and 2022.

It is essential to understand the effect of exchange rate on food security in Egypt, as Egypt is an open importer economy. So once the foreign exchange rate fluctuates, it may affect food security. And for sure the poor are highly affected by this fluctuation to gain sufficient food. The raising of the foreign exchange rate negatively affects the level of output and the level of employment, which of course decreases food security. Since, Egypt is a lower middle income class country, and it is suffering for decades from a huge deficit in its trade balance, as its economy is dependent mainly on the foreign market for many imports whether they are for the final use, or for the domestic production as intermediate

products. This kind of imbalance in the balance of trade reduces the reserves of foreign currency (UNDP. 2024).

Not only the imbalance of the balance of trade that affects the reserves of foreign currency, but many other factors affect it, like the decrease in tourism, remittances, Suez Canal, etc. All these influences push the government to devalue the national currency against the US dollar. The devaluation of the national currency will increase the value of imports and decrease the value of exports with a high rate of inflation and a high cost of production, which appears clearly in the following figure.

Figure 1: the effect of increasing the exchange rate on the economy.

Source:https://www.undp.org/sites/g/files/zskgke326/files/migration/ss/WFP_UNDP_Analysis_of_the_Implications_of_foreign_exchange_reforms_on_food_prices_in_south_sudan.pdf. Access time 23rd of July 2024.

So, the increasing the exchange rate increases the cost of production including the cost of food production and decreases the ability to imports food production from abroad, may affect the food security in Egypt harmfully. So, this paper investigates the impact of foreign exchange rate on food security in Egypt, which is required to help the decisionmakers in forming the policies that enhances food security in Egypt.

1.1 The exchange rate: the trend and the effect: (Mahfouz, E. 2019 ,143):

The problem of foreign currency started in Egypt in 2001. When the foreign currency decreased gradually in its official channels from daily operations, it started to exist again in the black market. Because of the gradual decreasing of foreign exchange reserves because of decreasing of oil prices, tourism returns decreased.

In addition to the Luxor disaster that caused in a decreasing in foreign exchange reserves from 22 B$ in 1998 to be 14 B$ in 2001, which was so

insufficient to transfer the profit of foreign enterprises working in Egypt and to import the essential imports to Egypt. The depreciation of Egyptian pound has been occurred in 2001 to be 3.86 LE to US dollar then in august 2001 to be 4.15 L.E. And although the was a gap between interest rates between deposits in Egypt and USA, since the interest rate in Egypt was higher than in USA, this process did not success in reducing the fear of the threads of fluctuations at that time.

Above all that, September 11th, 2001, reduced the revenues of the tourism sector to 2B$. So, the national currency depreciated to be 4.51 L. E to a US dollar, and it was 5 L.E in the black market. Additionally, the value of exports could not even cover half of the value of imports. The value of exports was 6 B$ and the value of imports was 14B$. and all these consequences led to a transfer to the black market by 60 to 70%.

This means that the black market of foreign currency was one of the active business activities in Egypt. The censorship policy on the supply of the foreign currency was the first and the key reason for the existence of the black market. And the market was centralized in civil society. And the immigration in the wide range to the oil Arab countries sent a lot of foreign currencies to the geographic regions of the immigrants. So, this led to the enhancement of the black market of foreign currency.

This market was characterized with its efficiency and its effectiveness in sending information, in despite of the undeveloped ways of communication and transportation at that time in Egypt. As well as this market had a daily standard rate of a US dollar in all the Egyptian regions. This market focused on attraction more remittances from abroad beside the expenditure of the tourists inside Egypt to respond to the difference between the official rates and the rate in the black market. There were additional reasons that promoted the black like the changing the invoicing of foreign trade whether by over invoicing of the value of imports or the under invoicing of the value of exports.

On the other hand, the main source of demand for foreign currency in the black is importing goods and services whether it is for financing commodity smuggling or for financing import operations without currency conversion. Drug trade financing operations mainly depended on the black market of the currency. Besides there was a huge demand for the foreign currency, who want to buy financial assets with foreign currency to invest in the stock portfolio. At the beginning of February 2002, the Egyptian government applied a request for the donor countries to provide 2.5B$ as urgent aids to help Egypt in the significant economic deterioration after 11th of September.

After of all these consequences in 29 of Jan in 2003 Egypt announced the floating of the Egyptian pound and the deterioration of the national currency by 16% to be 5.40 LE for the US dollar to immigrate the negative effect of these consequences on the Egyptian economy. The black market depreciated the national currency to be 6 LE for the US dollar. And the gap between the official market and the black market of the foreign currency. Since the official rate was less than the unofficial one because of the expected consequences of the gulf war at that time plus the expected economic issues with high inflation rates in Egypt, which affected the debts with foreign currencies.

The government formed suitable monetary policies depending on raising interest rates to decrease the high inflation rates that occurred because of floating of the currency. The national bank of Egypt and Misr bank, which are responsible for 42% of the banking deposits in Egypt, issued certificates with a return of 12% with 2% increasing comparing with any other saving pot. This collected around 3B pounds in 3 weeks, which encouraged the other banks to issue similar certificates. Despite all these procedures the inflation rate continued to rise, and the depreciation of the national currency continued to increase to 6.3 LE for the US dollar in 2006.

After the revolution of 25th of Jan the foreign exchange rate collapsed to be 7.15 LE for the US dollar at the end of 2011 then 7.6 LE in 2013 according to the official rate in the banks that determined by the Egyptian central bank. Nevertheless, there was a huge support from the gulf countries to the Egyptian government to support the reserves of the foreign currencies, the foreign exchange rate continued to increase to be 8.8LE for the US dollar in the official market in March 2016, and it end up being 13 LE in the black market. Through the global fluctuations that affect almost all the open economies, countries decreasing of deciding to modify their policies to promote their economic capacity through improving economic growth rate. Hence, in 2016, Egypt made an important decision to enhance its economic growth (Mobarez, O. M., & Eldeen, A. S.2022,16)

So, at the end of 2016 precisely on the 3rd of November, Egypt floated its national currency against the US Dollar. Until the beginning of November 2016, the exchange rate witnessed a successive, but limited decline with a continuous increase in the trade deficit, since the ratio of exports covering imports is only 0.32. And the trade balance deficit was about 38.7B$, and at the same time the reserve eroded from 35 B$ to only about 20 B$ in June 2016.

And the exchange rate was followed by successive reductions as a condition of the International Monetary Fund to get the fund, since it reached 31 pounds. Besides the existence of a parallel market at a price that increased by about 20%. However, this period witnessed a steady rise in the money supply until it doubled from about 917 billion pounds in June 2010 to about 2095B pounds in June 2016, with a decline in the number of months covered by the cash reserve from 9 months in June 2010 to only about 5 months in 2022, with an unprecedented increase in external debt (Tealeb, K. A. 2023,72)

1.2 The effect of exchange rates through the literature review:

Some economic studies focus on the impact of the exchange rate on food security around the world. Some of these studies pointed that exchange rate affects food security such as the paper of Elgali, M. B., et al (2006), which used a multi-market model to evaluate the policy influence on the agriculture in Sudan. Since it is an open economy except millet products and sorghum. The findings illustrate that 23% of currency depreciation raises producer prices. And competitiveness influenced non-traded crops negatively, as a result, food security of Sudan gets worse (Elgali, M. B., Mustafa, R. H., & Bauer, S. 2006, 1).

In addition to the study of Dorosh, P., & Ahmed, H. (2009), that analysis foreign exchange rationing and food security in Ethiopia pointed that foreign exchange rationing hinders imports and, and raises wheat prices, decreases wheat consumption, and decreased welfare for its consumers. So, it negatively affects food security (Dorosh, P., & Ahmed, H.2009, 21) Besides, the work of Obiageli, I. A. (2020), who examined the impact of exchange rate on agricultural output using Dickey Fuller tests. And he pointed that exchange rate has harmful impact on the agricultural output, which weakens food security in Nigeria (Obiageli, I. A. 2020, 43)

And the study of Bjornlund, V, et al (2022), which ask the question of why food insecurity persists in sub-Saharan Africa (Bjornlund, V., Bjornlund, H., & van Rooyen, A.2022, 845)

the results illustrated that Africa is an exceptional case since increasing export production decreases a per capita food production. And African countries should prevent themselves from fluctuations in global currency, which crippled their ability to achieve food security.

In addition to, the work of Rahman et al (2023) which uses tests of stationarity and the ARDL approach, and it points that raising the exchange rate is harmful for achieving food security in the long term in

Pakistan, because Pakistan is an importer (Rahman, I. U., Ali, W., Khattak, N., & Khan, J.2023,65)

However, the research of Yaqub, J. O. (2013) has a different opinion. since it examined the influence of changing exchange rate on the items of agricultural output by focusing on the responses of these items which are different for data from 1970-2008 in Nigeria. That pointed out that the exchange rate negatively impacts fishery output and crops, and it positively influences forestry and livestock. The result shows that the exchange rate affects the agricultural outputs differentially (Yaqub, J. O. 2013,75)

And for the other studies that investigate the impact of foreign exchange rate on food security, there is the study of UNDP and WFP that worked together to make a technical brief about the influence of foreign exchange rate on prices of food in South Sudan (2021). It is found that the increasing foreign exchange rate increases prices, especially imported agricultural goods (UNDP and WFP.2021,9)

And that could be supported by lots of papers, such as the paper of Umar, U. A., and Umar, A. (2022). By using the non-linear ARDL model with data from 2008 to 2020, the impact of the exchange rate on food prices is investigated. The results show that there is a direct relationship between food prices and exchange rates in the short and long term in Nigeria (Umar, U. A., & Umar, A.2022,15)

And these findings are illustrated clearly through lots of studies, like, for example, the paper of Khodeir, A. N. (2012), which analyzes the effect of the exchange rate on the inflation rate from 1990 to 2008 depending on the Granger causality test, which pointed out that there is a strong direct relationship between the exchange rate and the inflation rate. And the inflation rate is represented by two indicators, which showed that the wholesale price index responds more sufficiently to changes in the exchange rate than the consumer price index. The findings showed that the exchange rate is one of the main factors that controls the inflation rate in Egypt (Khodeir, A. N.2012, 325)

Additionally, the paper by Ahmed El Refaay (2023) examines the influence of some macroeconomic variables (exchange rate, investment, lending interest rates, and monetary supply,), representing the supply and demand sides of inflation, on the inflation rate in Egypt from 1990 until 2022. According to the results of Nonlinear Autoregressive Distributed Lag, the exchange rate has an impact on the inflation rate in the short run and in the long run (Ahmed El Refaay.2023, 295)

To make this point clear, the relationship between the exchange rate and inflation rate, particularly food prices, then the effect of food prices on food security should be explained. The exchange rate changes affect food prices and, accordingly, food accessibility. In case of national currency depreciates to the USD, the prices of food imports will increase, and subsequently, an increase in prices of domestic food for imported components and, through replacement of these components with cheaper items and shifting consumption, to raise prices of domestic food in general. And parallelly, food exports will be more competitive.

Developing export demand also increases domestic food prices. Furthermore, if a national currency quickly depreciates, keeping food products stocks can be considered as a store of value for savings rather than holding local currency, which consequently decreases the availability of food in the market. So, finally depreciation of currency decreases the food security[1].(World food programme.2019, 1)

2. Methodology:

2.1 Data Sources and methodology:

This paper focuses on the impact of the exchange rate on food security in Egypt to test the study hypothesis that assumes that firstly, exchange rate fluctuations significantly affect food security in Egypt, and secondly, the weaker national currency negatively impacts food security in Egypt. This is an attempt to figure out the effect of exchange rates beside some macroeconomic control variables on food security. So, the study will investigate that effect using per capita food supply variability (kcal/cap/day) as a dependent variable and real GDP, inflation rate, and unemployment rate as control variables and official exchange rate as independent variable for the time span of (2000 – 2022) using data, collected mainly from the World Bank and food and agriculture organization. These variables of the study have been derived from the paper of Obiageli, I. A. (2020) which is about the Effects of exchange rate on agricultural sector output in Nigeria (1987-2019). Since the study of Obiageli, I. A used the variables of interest rate, inflation rate, nominal exchange rate and food security in his work.

Table (I) shows a description of all the indicators used in the model as follows:

[1] World food programme. (2019). Exchange rate monitoring Guidance note. World food programme. Guidance Note - Exchange Rate Monitoring, July 2019 | World Food Programme (wfp.org) Access time: 7th of March 2024.

Table (I): Description of the variables

Variables Type	Variables	Symbol
Control variables	Gross Domestic Product	GDP
	Unemployment rate	UNEM
	Inflation rate	INF
	Interest rate	INT
Independent Variables	Official Exchange Rate	EXR
Dependent Variables	Per Capita food supply variability	PCFS

Source: prepared by the researcher

To achieve the purpose of the paper, the researcher used Autoregressive Distributed Lag (ARDL) bound testing by utilizing analysis of the information for Egypt and T time intervals (which could be yearly, biannual, quarterly, or monthly to enhance the number of observations for analysis, if necessary) as demonstrated in the statistical review below. The Error Correction Mechanism (ECM). The ARDL model incorporates both lagged values of the dependent and independent factors as autoregressive, and distributed lag respectively as explanatory factors. ARDL is employed to determine if a long-term equilibrium relationship exists among the examined variables, particularly when the indicators are integrated at order zero I(0) plus order one I(1). According to Pesaran et al. (2001), the ARDL method for cointegration is represented in Equation (I).

$$\Delta(PCFS)_t=\beta 0+\beta_1\Delta(EXR)_t+\beta_2\Delta(UNEM)_t+\beta_3\Delta(INF)_t+\beta_4\Delta(INT)_t+\beta_5\Delta(GDP)_t+\beta_6\Delta(EXR)_{t-1}+\beta_7\Delta(UNEM)_{t-1}+\beta_8\Delta(INF)_{t-1}+\beta_9\Delta(INT)_{t-1}+\beta_{10}\Delta(GDP)_{t-1}+ECTt-1 \quad (1)$$

Where:

Δ(x)t :1st difference of the variable during year t.

Δ(x)t-1 :1st difference of the variable during year t-1.

e_t: Error from long-run model during year t.

e_{t-1}: Error correction model (ECM), lagged error.

In this context, p represents number of lags, Δ denotes the first difference operator, and ECT_{t-1} stands for the error correction, while all other variables still unchanged. tests are performed on the coefficients of the unrestricted ECT factors to calculate F-statistics, which are utilized to assess the presence of a long-term relationship. The distribution of the F-test is non-standard and is influenced by whether the variables in the model are I(0) or I(1), the count of regressors, and

whether the econometric model includes an intercept and/or a time trend. The F-statistics are then compared against a critical value at a significant level of 5%. This testing procedure incorporates asymptotic critical value bounds, according to whether the indicators are I(0), I(1), or a combination of both.

The upper and the lower bound critical values are derived from I(1) and I(0) series, separately. The null hypothesis that suggests there is no cointegration among the indicators should be rejected. leading us to point out that there is a long-term relationship among them, regardless of their order of integration. Conversely, if the statistic is below the lower bound, there is a cointegration, and if it is among the bounds, the outcome is indeterminate. Once it is determined that the indicators are cointegrated (indicating a long-term or equilibrium relationship), there may still be short-term imbalances. The error correction mechanism is employed to address this disequilibrium. The short-term dynamics can be estimated by calculating the Error Correction Term (ECT) with the indicated lags, as outlined in Equation (2).

$$\Delta PCFS_t = \beta 0 + \sum_{i=1}^{p} \beta 1\ \Delta PCFSt - i + \sum_{i=1}^{p} \beta 2\ \Delta EXRt - i + \sum_{i=1}^{p} \beta 3\ \Delta UNEMt - i + \sum_{i=1}^{p} \beta 4\ \Delta IMFt - i + \sum_{i=1}^{p} \beta 5\ \Delta INTt - i + \sum_{i=1}^{p} \beta 6\ \Delta GDPt - i + \beta 7\ \Delta ECTt - 1 \quad (2)$$

Since βk+1 indicates the speediness of adjustment.

2.2 Descriptive statistics:

Table (II) shows descriptive statistics for the variables using minimum value, maximum value, mean and standard deviation. And it illustrates that the food security in Egypt is a dependent variable, and it hypothetically depends on the remaining variables, which are illustrated as follows:

Table (II): Descriptive Statistics

	PCFS	EXR	INT	INF	GDP	UNEM
Mean	1.769986	2.051489	2.066734	2.101993	1.409143	2.305713
Median	1.757858	1.801059	2.039053	2.248099	1.469404	2.303585
Maximum	2.140066	3.206803	2.510953	3.384614	1.967991	2.576726
Minimum	1.568616	1.244745	1.794533	0.819673	0.567908	1.993884
Std.Dev.	0.153165	0.550884	0.205377	0.634982	0.403224	0.187743

Source: prepared by the researcher according to the outputs of E-views

2.3 Time Series Stationarity test:

To examine the stationarity for the time series, unit root test like Augmented Dicky-Fuller (ADF) will be utilized. Table (III) illustrates

the unit root test for the indicators at (the level), and at the first difference.

Table (III): Stationarity tests

Variables	Stationarity	Augmented Dicky-Fuller test	
		Test-value	*p-value*
EXCH	Level	-3.01	0.96
	1st Diff	-3.00	0.065
INT	Level	-3.02	0.14
	1st Diff	-3.02	0.0067
UNEMP	Level	-3.00	0.14
	1st Diff	-3.64	0.058
GDP	Level	-3.00	0.131
	1st Diff	-3.01	0.003
INF	Level	-3.01	0.085
	1st Diff	-3.01	0.0022
PCFS	Level	-3.02	0.9837
	1st Diff	-3.67	0.0370

Source: prepared by the researcher according to the outputs of E-views

From the above table all indicators are stationary at the first difference, whereas *p*- value < α = 0.05. So, the ARDL method was estimated as the proper approach for this model.

2.4 Correlation Matrix

Table (IV) illustrates a correlation coefficient matrix between each variable and the others applying Pearson's correlation coefficient.

Table (IV): Correlation matrix

Variables	Corr	PCFS	EXR	INT	INF	UNEM	GDP
PCFS	Corr	1	0.946335	0.318662	0.39093	-0.19888	0.09692
	P-value		0.000000	0.13830	0.06510	0.36290	0.66000
EXR	Corr	0.946335	1	0-43915	0.48250	-0.29104	0.14282
	P-value	0.000000		0.03600	0.01970	0.17790	0.51560
INT	Corr	0.318662	0.439159	1	-0.03412	-0.08015	-0.02118
	P-value	0.13830	0.03600		0.87720	0.71620	0.92360

INF	Corr	0.390932	0.482506	-0.03412	1	0.16270	0.25212
	P-value	0.06510	0.01970	0.87720		0.45820	0.24580
UNEM	Corr	-0.19888	-0.291046	-0.08015	0.16270	1	-0.5216
	P-value	0.36290	0.17790	0.71620	0.45820		0.01070
GDP	Corr	0.09692	0.142823	-0.02118	0.25212	-0.52162	1
	P-value	0.66000	0.515600	0.92360	0.24580	0.01070	

Source: prepared by the researcher according to the outputs of E-views

From the above table, it is pointed out that:

A. There is a statistically significant relationship between PCFS and EXR at a significant level of 5%, whereas p-value α < or = 0.05.

B. There is a statistically significant relationship between PCFS and INF at a significant level of 10%, whereas p-value α < or = 0.10.

C. There is no statistically significant relationship between PCFS and INT, UNEM, and GDP at a significant level of 5%, whereas p-value α < or = 0.05.

D. There is a statistically significant relationship between EXR, INT, and INF respectively at a significant level of 5%, whereas p-value α < or = 0.05.

E. There is no statistically significant relationship between EXR and UNEM, GDP respectively at a significant level of 5%, whereas p-value α < or = 0.05.

2.5 Testing the effect of the exchange rate on food security:

The ARDL model has been utilized to examine this effect. Hence, the optimum lag length for PCFS, EX, and GDP is one; and for INT, INF, and UNEM is zero; (ARDL (1,0,1,0,0,1). In the Bounds test, the calculated F-statistic is 5.135492, which is greater than the upper bound critical value (3.38) at the significant level of 5%. So, a long-run relationship among all variables does exist. Since, the null hypothesis (H_0) states that no cointegration among the variables should be declined.

Now the next step is using Error correction model (ECM) for correcting the deviations from the long-term equilibrium. The ECM helps to understand how variables adjust over time towards their long-term relationship. Noting that the optimum lag length for variables is one. The ECM short-run model is estimated as illustrated in Table (V).

Table (V): ECM short-run model

Variables	Short – run Model				
	Coefficients		*t*-test		*VIF*
	value	S.E	*t*	*(p-value)*	
Constant	-1.019	0.0228	-10.8	0.0001	0.0091
$\Delta(EXR)_t$	0.2603	0.0208	11.40	0.0001	0.0023
$\Delta(INT)_t$	-0.001	0.0208	0.020	-0.089	0.0033
$\Delta(INF)_t$	0.0001	0.0000	0.000	0.000	0.0004
$\Delta(GDP)_t$	0.0273	0.0097	2.795	0.038	0.0008
$\Delta(UNEM)_t$	-0.364	0.0371	-9.80	0.0002	0.0776
e_{t-1}	0.1970	0.0217	7.738	0.0000	0.0054
R2	0.9784				
S.E	0.009335				
F.test (p-value)	7.545 (0.050)				
JB. Test (p-value)	0.120(0.9413)				
Breusch-Godfrey test (p-value)	0.2847 (0.105)				
Breusch–Pagan-Godfrey	*0.2014(0.6093)*				

Source: prepared by the researcher according to the outputs of E-views

From the above ECM table, it is pointed out that:

A. **There is statistically significant positive effect of EXR on PCFS at 5% significance level, whereas ∆(EXR) is positive (0.2603) and p–value ≤ 0.05.**
B. **There is statistically significant negative effect of INT on the PCFS at 10% significance level, whereas ∆(INT) is negative (-0.001) and p–value ≤ 0.10.**
C. **There is statistically significant positive effect of INF on PCFS at 5% significance level, whereas ∆(INF) is positive (0.000) and p–value ≤ 0.05.**
D. **There is statistically significant positive effect of GDP on PCFS at 5% significance level, whereas ∆(GDP) is positive (0.0273) and p–value ≤ 0.05.**
E. **There is statistically significant negative effect of UNEM on the PCFS at 10% significance level, whereas ∆(UNEM) is negative (-0.364) and p–value ≤ 0.10.**
F. **Although, the model performs well in terms of goodness of fit: R^2 = 0.9784; meaning that the variables forming the model can explain (97.8%) of the changes in PCFS.**
G. **Additionally, the error term (residuals) is normally distributed whereas the probability value of Jarque-Bera test is greater 5% (JB = 0.120),p-value = 0.9413 > 0.05).**

H. **Also, there is no heteroskedasticity problem whereas the probability value of Breusch–Pagan-Godfrey is greater than 5% (F(5,12) = 0.2014, p-value = 0.6093 > 0.05).**

I. **In addition, there is no serial correlation whereas the probability value of Breusch–Godfrey serial correlation LM test is greater than 5% (F(2,11) = 0.2847, p-value = 0.105> 0.05).**

2.6 Summary of statistical analyses:

Based on the provided results and the specified hypotheses of the study regarding food security in Egypt, here is an evaluation of each hypothesis, including whether they are accepted or rejected:

A. **Hypothesis 1: "Exchange rate fluctuations significantly affect food security in Egypt."**

Result: Accepted. The analysis reveals a statistically significant positive effect of exchange rate fluctuations on food security, with a 1-unit increase in the exchange rate leading to an increase in food security by 0.2603 units and a p-value ≤ 0.05. This supports the notion that exchange rate fluctuations play a significant role in affecting food security.

B. **Hypothesis 2: "The weaker national currency negatively impacts food security in Egypt."**

Result: Rejected: The finding that an increase in the exchange rate positively affects food security suggests that a weaker national currency (which corresponds to an increase in the exchange rate) does not negatively impact food security.

3. Results and findings:

A. **There is a statistically significant positive effect of EXR on PCFS at the 5% significance level, whereas an increase of EXR by 1-unit results in an increase of 0.2603 units of PCFS and a p-value ≤ 0.05. Since a positive exchange rate can improve food security. Since then, agricultural products have become cheaper for foreign buyers. This can boost exports as international markets find the products more attractive pricewise. Increased agricultural exports can lead to higher income for farmers, enabling them to invest more in production, thus enhancing food security through increased availability.**

And imported goods become more expensive; this encourages local farmers to produce more food domestically, leading to greater self-sufficiency and a diversified food supply. And this also makes a country more attractive to foreign investors, particularly in agriculture and related sectors. Increased foreign investment can lead to improved agricultural practices, technology transfer, and

infrastructure development, which collectively strengthen food security.

B. There is a statistically significant positive effect of INF on PCFS at the 5% significance level, whereas an increase of INF by 1-unit results in an increase of 0.0001 unit of PCFS and a p-value ≤ 0.05.

Since moderate inflation can have positive effects in certain contexts, higher agricultural product prices may encourage farmers to invest in their operations, boosting productivity and food availability. Inflation can also relieve the real burden of debt for farmers with fixed-rate loans, enabling greater financial stability. Moreover, mild inflation may encourage immediate food consumption, reducing waste. Finally, government responses to inflation can include support for food production, enhancing supply stability. Overall, when managed well, moderate inflation can stimulate economic activity and contribute positively to food security.

C. There is a statistically significant negative effect of INT on PCFS at the 5% significance level, whereas an increase of INT by 1 unit leads to a decrease by 0.001 unit of PCFS and a p-value ≤ 0.05.

Since high interest rates can negatively impact food security by increasing borrowing costs for farmers, reducing investments in agriculture, restricting access to credit, and potentially causing broader economic slowdowns. These factors together can create a challenging environment for food availability and accessibility.

D. There is a statistically significant positive effect of GDP on PCFS at the 5% significance level, whereas an increase of GDP by 1-unit results in an increase of 0.0.273 units of PCFS and a p-value ≤ 0.05. Since growing GDP positively affects food security by increasing national income, fostering agricultural investment, improving infrastructure, supporting social programs, diversifying food sources, creating job opportunities, and encouraging research and development. These factors collectively contribute to greater food availability, accessibility, and nutritional quality for the population.

E. There is a statistically significant negative effect of UNEM on PCFS at the 5% significance level, whereas for a decrease of UNEM by 1 unit, there is a decrease by 0.364 unit of PCFS and a p-value ≤ 0.05. Since high unemployment rates negatively impact food security by reducing household income and increasing poverty, affecting local economies, diminishing consumption, and increasing competition for food resources. Together, these factors can lead to increased food insecurity and malnutrition among affected populations.

F. **Although the variables forming the model can explain (97.8%) of the changes in food security (PCFS).**

4. Policies Implications:

Based on the above results, several policy implications can be drawn regarding food security that can be illustrated as follows:

A. **Exchange Rate Management: implement policies that stabilize and promote a favorable exchange rate. This could include diplomatic measures to enhance trade relationships and engage in financial contracts that reduce exchange rate volatility. Since a positive exchange rate significantly increases food security by encouraging agricultural investment, maintaining a stable exchange rate will support food availability and diversification.**

B. **Inflation Control and Agricultural Support: develop and implement inflation-targeting frameworks that allow for control inflation rates while simultaneously offering support for the agricultural sector, such as subsidized inputs and**

C. **incentives to boost productivity. Since policies should focus on creating an environment where inflation can stimulate economic activity without spiraling out of control, ensuring that these positive effects on food security are maximized.**

D. **Interest Rate Regulation: formulate monetary policies that keep interest rates at manageable levels for farmers and agricultural investments, potentially providing targeted subsidies or low-interest loans specifically for the agricultural sector. Since high interest rates negatively affect food security by increasing the financial burden on farmers, it thus shrinks investment in essential agricultural operations.**

E. **Economic Growth and Investment in Food Security: encourage economic growth strategies that increase GDP while investing a portion of the gains back into agricultural infrastructure and research and development in food security initiatives. Since, the positive relationship between GDP and food security emphasizes the need for policies that stimulate economic growth and boost agricultural capacity to enhance food availability and accessibility.**

F. **Unemployment Reduction Strategies: implement robust employment programs to increase household incomes and improve food security. Since the negative correlation between unemployment and food security points to the need for immediate policy interventions in labor markets. Reducing unemployment will**

enhance local economies, consumer spending, and ultimately food security.

G. Integrated Food Security Policy Framework: develop an integrated food security strategy that considers all these variables (EXR, INF, INT, GDP, UNEM) collectively rather than in isolation. Stakeholders across different sectors should collaborate to create a holistic approach to food security. Given that the model can explain 97.8% of the changes in food security, it is essential to acknowledge the interplay between these factors and to ensure that policy interventions are coordinated to maximize their effectiveness.

By adopting these recommendations, policymakers can address the underlying economic factors influencing food security and aim for a comprehensive improvement in food security for their populations.

5. Conclusion:

This study has examined the impact of exchange rate on food security in Egypt during the period of 2000–2022, using other control variables like unemployment rate, inflation rate, interest rate, and gross domestic product, illustrating their impact on food security. The study employed the Dickey-Fuller test, the Zivot-Andrews test for stationarity, and the Autoregressive Distributed Lag (ARDL) bounds testing framework. The analysis identified that an increase in the exchange rate and GDP positively contributes to enhancing food security, while the inflation rate, when managed appropriately, can also have beneficial effects.

Conversely, the findings highlight the negative influence of high interest rates and unemployment rates on food security, illustrating the multifaceted challenges that threaten food security in Egypt. The results demonstrate that a favorable exchange rate can improve access to food and promote agricultural investments, thereby fostering a diverse food supply that meets nutritional needs. Moreover, moderate inflation may encourage farmers to expand their operations, contributing to greater food availability. However, the negative consequences of high interest rates present a critical barrier to investment in agriculture, reducing the capacity for production and sustainability in the sector.

Additionally, the correlation between unemployment and diminished food security underscores the urgent need for interventions that enhance income stability for households. Considering these findings, policymakers should focus on stabilizing exchange rates, managing inflation effectively, regulating interest rates, fostering economic growth, and creating employment opportunities. Such comprehensive

strategies will help ensure improved food security outcomes for populations.

As food security remains a pressing global challenge, the insights gleaned from this research can inform future efforts and guide policymaking toward holistic solutions that support the agricultural sector and food accessibility in a rapidly changing economic landscape. Further research is recommended to explore and assess the effectiveness of implemented policies in promoting sustainable food security.

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