Original Research Article

On The Impact of Exchange Rate Depreciation on bilateral Trade of Egypt and China: An ARDL Approach

ABSTRACT

The main purpose of this study is to examine the relationship of exchange rate depreciation with Egypt and China bilateral trade. The Autoregressive Distributed Lag (ARDL) approach to co-integration is employed to investigate the both long run and short run relationship between the real depreciation and bilateral Trade in the case of Egypt and China over the period of 1994 to 2019. Estimation results confirm the existence of the long-term impact of depreciation on Egypt's trade flows between the two countries. The results also revealed that growth in domestic income improved the Egypt's trade balance while growth in China income decreased the bilateral trade flows. Over time, the findings revealed that the J-curve phenomena hold in the long-run. Results suggest two main conclusions to policy makers. First, The improvement of the trade balance needs inclusive support of Egypt's export stimulus policies. Second, Second, China presents enormous opportunities for Egyptian exports to this growing market.

Keywords: Exchange Rate, bilateral Trade, Egypt , China, Depreciation, ARDL

1. INTRODUCTION

1.1. Background

Real exchange rate is related to balance of trade, where exchange rate is one of the factors for trade. Trade balance can be improved in two ways. One of the important ways affecting the surplus or deficit of such balance is improving productivity or industry level development so as to decrease the country's balance trade deficit. Another way is currency depreciation which increases competitiveness of the country's exports. Conventional economic theory disclosed that if the exchange rate depreciates, both trade balance and exports will increase and readjust to the time lag in the short run.

For Egypt, The Egyptian market has been gradually opening up, where trade represents 48% of GDP. Structurally, the Egyptian economy has many trade partners.In 2019; the Central bank of Egypt (CBE) reported that the statistics data has evidenced China as the main trade partner with Egypt (represents 6.8 percent of total foreign trade). Egypt has also signed other four trade partners includes the USA, Saudi Arabia, the UAE and Russia are constituting about 24 percent of total foreign trade. However, five partners include Italy, Germany, UK, Turkey and Switzerland are constituting about 13.5 percent of total foreign trade of Egypt in 2019. These countries combined constituted 51.8 percent of total foreign trade (Fig. 1).

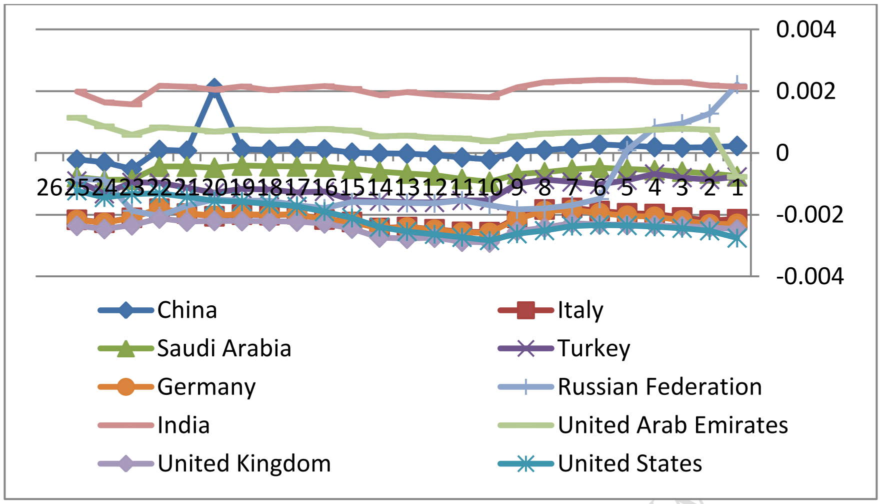

Fig. 1. Egypt trade partners during 1994-2019.
Source: Author's calculation using United Nations Comtrade Database (UN Comtrade)
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The country-specific effects depend on the destination of the country tradable goods front of trading partners, in addition to the composition of production and exports by type of good (merchandise goods and services). Structurally, the Egyptian economy has a continuous trade deficit during 1994-2019. **Figure 2. Illustrates Egypt's Exports and Imports values during 1994-2019**

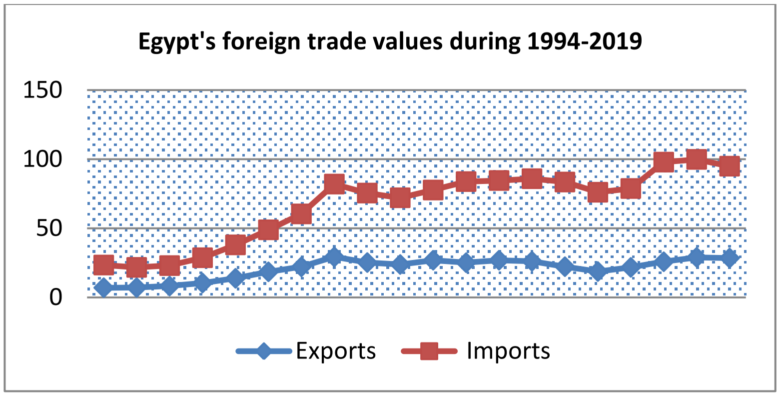


Fig 2. Egypt's Exports and Imports during 1994-2019
<u>Source</u>: Central Bank of Egypt, Annual report, Different Issues.

It is clear from the previous figure that, both exports and imports of Egyptian goods took an upward trend during 1994-2019. Particularly, Egypt's international trade market makes up a substantial part of its economy during 2010-2019. Egypt's total exports have increased from USD 4,693 billion in 2010 to USD 30,632 billion in 2019. Excluding services, imports increased to USD 78,657 billion in 2019 and Egypt's trade balance deficit declined to USD 48,024 billion in 2019.

The trade flows analysis tends to suggest that the volume of China's exports to Egypt is increasing, while that for Egypt's exports to China is declining. Particularly, the majority of trade deficit between the two countries over time is accounted for China's exports to Egypt resulting in a large trade surplus in favor of China .Hence, China is Egypt's largest trading partner. As noted China was considered as Egypt's largest importer with 20.4% shares of the total imports in 2019.

During the last few decades, Chinese exports into Egypt have shown relative stability. Fig. 3 Chinese exports to Egypt during (1994-2019). As noted the movement of exports followed an upward trend , the total exports increased from USD 194.4 million in 1994 to USD 4.4 billion in 2008, while total exports increased to USD 80.5 billion in 2014. Moreover, after 2016 Chinese exports to Egypt grown sharply, as they increased from USD 8.99 billion in 2016 to more than USD 12.04 billion in 2019.

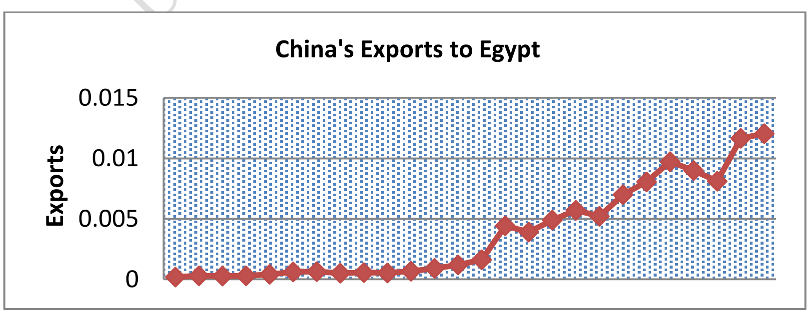


Fig. 3. China's Exports to Egypt trends
<u>Source</u>: Author's calculation using United Nations Comtrade Database (UN Comtrade)

As for Egyptian exports into China, the total exports increased from USD 10.6 million in 1994 to USD 342.5 million in 2008. However, over 2009-2014, exports from Egypt to China decreased from USD 975 million in 2009 to USD 330.5 million in 2014. Over 2017-2018, the Egyptian exports of goods and services increased from USD 680 million in 2017 to USD 1.045

billion in 2018. Then total exports followed a downward trend as the Egyptian exports into China decreased to USD 557 million in 2019.

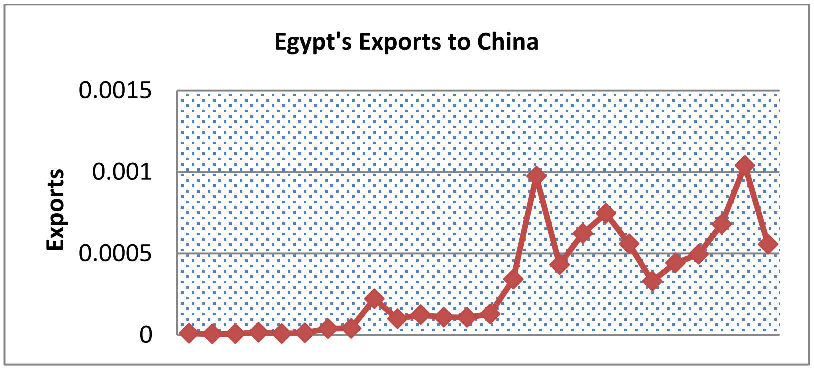


Fig. 4. Egypt 's Exports to China trends
Source: Author's calculation using United Nations Comtrade Database (UN Comtrade)

Several macroeconomic factors have affected the bilateral trade between Egypt and China. Floating the exchange rate policy in Egypt was one of these factors. Particularly in the last few years, the exchange rate policy in Egypt has been characterizing by sharp fluctuations. Starting from January 2001, the Central Bank of Egypt adopted a crawling peg exchange rate regime due to exchange rate crisis. In 2003 the Egyptian foreign exchange rate crisis was exacerbated again, thus Egyptian government decided to float the pound in January 2003. However, until December 2012 the CBE announced in its adoption for a managed floating exchange rate system. In 2014 the IMF classified the Egyptian regime as crawl-managed arrangement, while the IMF has classified the system as stabilized arrangement from 2015 to 2016.

Starting from 2016 Egypt began a period of economic instability this has negatively affected the value of the Egyptian pound. Since then, The central bank adopted new floating policies in November 2016. In 2017 the exchange rate regime in Egypt shifted to floating arrangement. Table 1 investigates different depreciations of exchange rate of Egypt during (1994-2019)

Table 1. Egypt's exchange rate regime's Classifications during (1994-2019)

Year	**classification of exchange rate regimes**
2017-2019	Flexible exchange rate
2016	Floating arrangement
2015	Stabilized arrangement

2014	*de jure* float
2013	Crawlling- Managed
2012	managed floating
2011	Crawlling- Managed
2007-2010	Managed Arrangement
2006	fixed arrangement
2003-2005	Managed floating
1999-2002	crawling peg
1994-1998	Fixed Peg

In the near past, different economic policies, strategies and reforms have been adopted to improve the Chinese currency and hence its trade balance. In August 2015 China's Yuan moved as a managed floating exchange rate regime resulted in rising effective Chinese Yuan equilibrium rate in the context of large external surpluses and productivity increases [1].Fig. 4 shows the Egyptian exchange rate and Chinese Yuan value from 1994 to 2019.

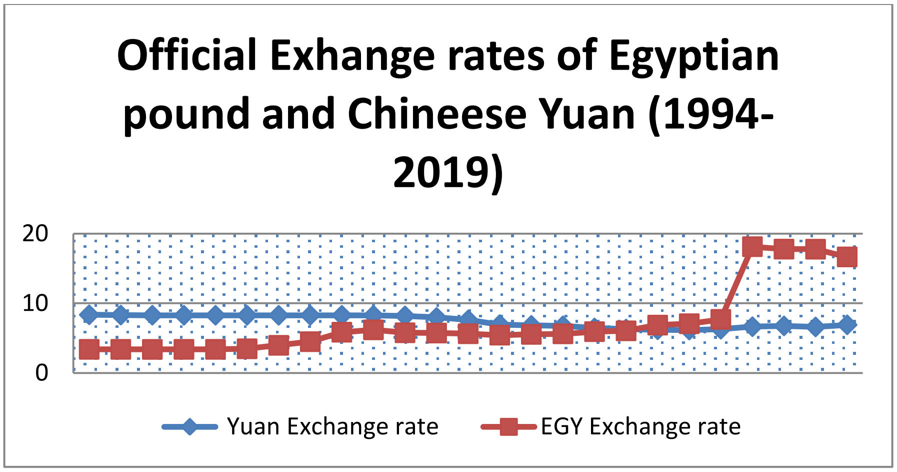


Fig. 5. Exchange rates of the Egyptian pound and Chinese Yuan

Source: Author's calculations based on International Financial Statistics (IFS) data.

It should be noted that for the actual short run in Egypt between 2011 and 2019, with a sharp depreciation of the local currency, the Egyptian pound loss about 18% of its value against Yuan since November 2016. According to Figure 5, despite the general downward trend during the period (2016-2019) the bilateral exchange rate between Egypt and China increased from 0.65 in 2016 to 2.28 by the year 2019.

1.2. Literature Review

Given the importance of the real exchange rate as a key economic indicator in any economy, there is a strong argument that depreciation decrease the deficit in trade balance [2,3].The economic theory suggests that when markets are free of misalignments, reduction in real exchange rate deteriorates the trade balance in the short term. Even though the deficit continues in long term but depreciation may have played a role to improve the trade balance [4,5].

1.2.1 The elasticity approach

The elasticity approach gives an important stylized fact regarding the development of the exchange rates effect on trade [6]. According to the elasticity approach, imported goods and the domestic competing ones are imperfect substitutes. The elasticity approach gives the evidence on the short-run response of the trade balance supporting that the demand for imports by domestic consumers and the demand for exports by foreigners and are elastic [7,8].

There are numerous studies have focused on the impact of the exchange rate devaluation on trade nexus. Theoretically, domestic currency depreciation/devaluation changes the relative prices of both exports and imports. Consequently, the price effect of currency depreciation can lead to a change in consumers' behavior. The reason for this is that depreciation decrease the elasticity for the demand of exports and imports as argued in the studies of [9,10].

1.2.2 The Marshall Lerner Condition

According to the Marshall Lerner Condition, balance of a country should be zero if the sum of the elasticities of export and import is greater than one. For this condition to be satisfied, currency depreciation improves the trade balance [11,12].

The assumptions of the Marshall-Lerner condition (MLC) encompass the perfect competition, one export commodity, and one import commodity, in addition to full employment.

The required condition for real devaluation to improve the balance of the current account is as follows:

$e_x + e_m > 1$

Where e_x is a country's elasticity of foreign demand for exports, while e_m represents the country's elasticity of import demand. The validity of this condition relies on the response of exports and imports to the real exchange rate.

1.2.3 The J-curve Effect

The J-curve phenomena assumes that a devaluation of domestic currency leads to an initial deterioration of the trade balance, subsequently followed by an improvement rate on trade balance, providing empirical evidence regarding the effect of the exchange rate which is negative in the short-run and becomes positive in the long-run. [13,14].

"the J-Curve" effect has some common assumptions. Initially, [15] explained that at the early stage of devaluation the trade balance is affected by the existing contracts which induced by the relative price (domestic versus foreign) changes; the matter that justifies the trade balance short run declining path post currency devaluation and depreciation[15,16,17]. However, over time, [16] explained the delayed effect of depreciating exchange rate on the trade balance in terms of five lags. These are the recognition lag of changed situation, decision lag to change real variables, delivery lag, replacement lag of inventories, and the production lag.

Hence, J-curve effect argued that contracts negotiated before the devaluation of the domestic currency may be responsible for the deterioration of the trade. In the medium-term, A country's trade balance is valued based on the demand of domestic goods as relative prices of domestic goods decrease, assuming elastic cross price elasticity between imported and exported goods. In the long term, domestic consumers decrease their consumption from foreign products and the volume of export of the country also increases. These two effects improve the trade balance of the devaluating country [18].

A large part of the literature focused on the J-curve effect. Recent studies conducting the J-curve approach include [19], [21], [23] among others.The most of these studies have compared the outcomes of the autoregressive distributed-lag ARDL analysis and have reported more evidence of J-curve effects.

Table 2. Empirical literature survey

Author(s) and year published	Sample	Period	Data frequency	Methodology
Bahmani-Oskooee and Arize (2019)	U.S. with 20 African countries	2007-2017	quarterly	ARDL cointegration model
T Dogru, Cem Isik and E. Turk (2019)	(U.S.) bilateral tourism trade with Canada, Mexico, and the United Kingdom	2000-2018	yearly	(ARDL) cointegration

	(U.K.)			
Bahmani -Oskooee, Rahman and Kashem (2019)	Bangladesh bilateral TB with 11 trading partners	1985Q1 – 2015Q4	quarterly	ARDL cointegration model
Loredana Jitaru (2019)	China with the European Union (EU)	2001-2018	yearly	statistical analysis (the correlation)
Banna Banik, Chandan Kumar Roy (2020)	the South Asian Association for Regional Cooperation (SAARC)	2005 - 2018	yearly	Gravity model
Bahmani -Oskooee, Huseyin Karamelikli. (2021)	China-UK trade in 68 Industries	2010M1-2018M12	monthly	linear ARDL model
Ho Hoang Gia Bao and Hoang Phong Le (2021)	Vietnam's bilateral trade balance with EU-27 countries and the UK	2000Q1 –2018Q1	quarterly	NARDL model
Mohini Gupta and Sakshi Varshney (2021)	India-US	2002:09 to 2019:M06	monthly	ARDL, E-GARCH

The study by [19] assessed the effects of exchange rate changes on the trade balance of 20 African countries. The study applied the linear and nonlinear ARDL approaches, the results found support for the J-curve effect in short run in three partners from the linear models. However, nonlinear models support eight partners. Whereas in the long run the study found support for the J-curve effect in half of the partners. In Bangladesh, [20] undertook a study to empirically estimate the ARDL model for Bangladesh bilateral trade balance with 11 trading partners on the bilateral level using quarterly data over the period 1985Q1– 2015Q4. The empirical results revealed evidence for the J-curve effect with only 1 of 11 partners; however, the estimation results supported the J-curve effect in 3 partners including USA.

According to [21] the study investigated the impact of depreciations and appreciations of U.S. dollar in the terms of tourism trade with Canada, Mexico, and the United Kingdom (U.K.). The article utilized (ARDL) cointegration techniques to provide evidence supporting the J-curve. The estimation results supported the improvement of trade balance with all three trading partners. As for the appreciation, the results indicated that the U.S. dollar revaluation deteriorates the U.S. bilateral tourism trade balance with two partners and do not affect the U.S. bilateral tourism trade with Mexico.

In China, [22] explored the effect of Yuan depreciation on trade deficit of the EU in relation with China. For this purpose the correlation method was applied using yearly time-series data from March 2001 to December 2018. The study results implied that there is no evidence about the relation between trade deficit of the EU and depreciation of the Yuan.

In addition, [24] investigated the bilateral trade between Britain and China. The study evaluated the effect of Yuan-pound exchange rate changes on the trade balance of each of the 68 2-digit industries. The study utilized an ARDL approach using monthly data over the period 2010M1-2018M12 .The results found short-run effects in the trade balance of 45 industries. Respectively, the J-curve effect has significant impact in 17 (19) industries.

In Vietnam, [23] applied Error Correction Model (ECM) based on NARDL to evaluate short term and long term effects of Vietnam's bilateral trade balance with vehicle currency exchange rate in relation with EU-27 countries and the UK using monthly time-series data from 2000Q1 to 2018Q1. The results of the estimation supported the effect of US dollar as vehicle currency when more significant short-run and long-run coefficients are found. Accordingly, the study results explored that USD/VND movement affect both Vietnam-USA and also Vietnam-EU and UK trade balance.

The study by [25] used the modified gravity model to examine the effect of exchange rate volatility on the trade flows of SAARC members (includes eight members – Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka). The results suggested that exchange rate uncertainty lead to a reduction of trade flows in the eight countries of SAARC as a result of the negative implications of persistent trade deficits on the economic performance of these countries.

Empirically, [26] explored the effect and causality among real exchange rate volatility and control variables such as price of import, industrial production of India's import from the US at disaggregate level of 45 import commodities. The study used monthly data over the period from 2002:09 to 2019:M06.The results indicate the existence of real exchange rate volatility effect in one-third importing commodities.

As discussed the management of the exchange rate is a critical issue for trade balance, especially for a developing economy like Egypt. Empirically, and given the relevant situation of Egyptian economy, the further analysis of this study examines the interlinkage between real exchange rate and bilateral trade. Also, the research seeks to explore the existence of the effect of the (J) curve while large depreciations are passed to the trade balance in long run.

2. METHODOLOGY AND MODEL

Following [27] to estimate the short- and long-run dynamics of the bilateral trade relationship between Egypt and China, we set up the standard specifications of the exports and imports demand functions .The specifications of the reduced forms of the trade equations estimated by [27] are as follows.

$$\ln TB = a + a \ln REX + a \ln YW + a \ln YT + \varepsilon_t \quad (1)$$

The equation takes the linear-logarithmic form where the TB is a dependant variable. While the measure of the trade balance, TB is trade balance deficit; REX is bilateral exchange rate; YT is the gross domestic income of home country, YW is the gross domestic income of bilateral trade partner and ε_t is the random error term.

In order to test the application of J-curve phenomena, this paper apply the ARDL model (or bounds test co-integration approach proposed by [27] and [28] since these methodologies are well-known in literature.

The (ARDL) approach to cointegration in estimating allows for the introduction of optimal lags of both the dependent and explanatory variables. The (ARDL) approach is considered an ideal technique for its ability to estimate models containing fractionally integrated variables, and to yield estimates of the parameters of the short-run and long-run relationships. From the initial assertion (ARDL) model is an ordinary least square (OLS) based model. **An ARDL representation of equation (1) is formulated as follows:**

$$\Delta \mathrm{LnTBE}_t = B_0 + B_1 \mathrm{LnTBE}_{t-1} + B_2 \mathrm{Ln\ YE}_{t-1} + B_3 \mathrm{Ln\ YC}_{t-1} + B_4 \mathrm{Ln\ RX}_{t-1} + \sum_{i=1}^{p} B_{5i} \Delta \mathrm{LogTBE}_{t-i} + \sum_{i=1}^{k} B_{6i} \Delta \mathrm{LogYE}_{t-i} + \sum_{i=1}^{m} B_{7i} \Delta \mathrm{LogYC}_{t-i} + \sum_{i=1}^{n} B_{8i} \Delta \mathrm{Log\ RX}_{t-i} + \varepsilon_t \quad (2)$$

Theoretically, changes in the exchange rate have two basic effects on the trade balance: price and volume effects. AS a result β_2 can be positive or negative relying on substitution effect of tradable goods. Similarly, β_3 can be positive or negative. Hence; β_4 is expected to be positive if the devaluation of the currency improves trade balance.

$$\mathrm{LnTBE}_t = B_0 + B_1 \mathrm{LnTBE}_{t-1} + B_2 \mathrm{Ln\ YE}_{t-1} + B_3 \mathrm{Ln\ YC}_{t-1} + B_4 \mathrm{Ln\ RX}_{t-1} + \sum_{i=1}^{p} B_{5i} \Delta \mathrm{LogTBE}_{t-i} + \sum_{i=1}^{k} B_{6i} \Delta \mathrm{LogYE}_{t-i} + \sum_{i=1}^{m} B_{7i} \Delta \mathrm{LogYC}_{t-i} + \sum_{i=1}^{n} B_{8i} \Delta \mathrm{Log\ RX}_{t-i} + \varepsilon_t \quad (3)$$

Empirically, the Autoregressive distributed lag (ARDL) approach and Error Correction model (ECM) model are used for our time series econometric modeling. The ARDL model consists of the dependent variable; and lagged dependent variable, vector of explanatory dynamic variables, vector of exogenous static variables and mean-zero uncorrelated error term as independent variables. To begin with, the ARDL approach was initially used by [27] to examine its use for the analysis of long-run relations when the underlying variables are I(1). Then, the approach was further developed by [28] to test for both the short run and the long run relationships between the dependent variable and set of independent variables.

For this an ARDL bound test is used to examine the existence of long-run relationship. [27], initiate the bounds tests in the unrestricted model or namely an ARDL model. If there was existed any co-integration among variables this means that the variables used in research topics move together in the long term Symmetry [28].ARDL long run model can be estimated Following the non-structural, partial reduced form model as follows:

To ensure the convergence of the dynamics to the long-term equilibrium Bounds test is performed while:

The null hypothesis: $\beta\beta 0=\beta\beta 1=\beta\beta 2= \beta\beta 3=\beta\beta 4$

The alternative hypothesis: $\beta\beta 0\neq\beta\beta 1\neq\beta\beta 2\neq \beta\beta 3\neq\beta\beta 4$

The ARDL model is selected for this study for its flexible properties and advantages over conventional co-integration testing. The standard co-integration analysis requires pretesting the variables to classify them into I(0) and I(1); however, the ARDL model can be applied irrespective of whether the underlying variables are I(0) and I(1) or a combination of both. But it does not allow for I(2) variables to be included in the model. Moreover, it also allows for fractionally-integrated series since it is difficult to assert the level of integration of the model variables with a reasonable degree of accuracy. Another important feature is that different variables can be assigned different lag lengths as they enter the model, which offers flexibility and avoids over fitting. It is also worth noting that the ARDL is featured as a dynamic single model equation, which allows for focusing on the variable of interest, facilitates its implementation and the interpretation of the results. To test for co-integration among the variables, the bounds test methodology of [27,28] is used, which is simpler in application and doesn't require certain assumptions about the existence of trends in data and in the co-integrating relationship itself. When co-integrating vectors are identified, the ARDL model is reparameterized into ECM and its results provide both short-run dynamics and long run relationship of the variables of a single model [30,31]. Accordingly, the model specification would be as follows:

$$\Delta \mathrm{LnTBE}_t = B_0 + B_1 \mathrm{LnTBE}_{t-1} + B_2 \mathrm{Ln\ YE}_{t-1} + B_3 \mathrm{Ln\ YC}_{t-1} + B_4 \mathrm{Ln\ RX}_{t-1} + \sum_{i=1}^{p} B_{5i} \Delta \mathrm{LogTBE}_{t-i} + \sum_{i=1}^{k} B_{6i} \Delta \mathrm{LogYE}_{t-i} + \sum_{i=1}^{m} B_{7i} \Delta \mathrm{LogYC}_{t-i} + \sum_{i=1}^{n} B_{8i} \Delta \mathrm{Log\ RX}_{t-i} + \alpha\ \mathrm{ECT}_{t-1} + \varepsilon_t \quad (4)$$

$$\Delta \text{LnYC}_t = B_0 + B_1\text{LnTBE}_{t-1} + B_2\text{Ln YE}_{t-1} + B_3\text{Ln YC}_{t-1} + B_4\text{Ln RX}_{t-1} + \sum_{i=1}^{p} B_{5i}\Delta\text{LogTBE}_{t-i} + \sum_{i=1}^{k} B_{6i}\Delta\text{LogYE}_{t-i} + \sum_{i=1}^{m} B_{7i}\Delta\text{LogYC}_{t-i} + \sum_{i=1}^{n} B_{8i}\Delta\text{Log RX}_{t-i} + \alpha\ \text{ECT}_{t-1} + \varepsilon_t \quad (5)$$

$$\Delta \text{LnRX}_t = B_0 + B_1\text{LnTBE}_{t-1} + B_2\text{Ln YE}_{t-1} + B_3\text{Ln YC}_{t-1} + B_4\text{Ln RX}_{t-1} + \sum_{i=1}^{p} B_{5i}\Delta\text{LogTBE}_{t-i} + \sum_{i=1}^{k} B_{6i}\Delta\text{LogYE}_{t-i} + \sum_{i=1}^{m} B_{7i}\Delta\text{LogYC}_{t-i} + \sum_{i=1}^{n} B_{8i}\Delta\text{Log RX}_{t-i} + \alpha\ \text{ECT}_{t-1} + \varepsilon_t \quad (6)$$

Where the significant ECT provides evidence of causality. We further proceed the estimation of the long-run coefficients associated with the error correction term (α) that should be negative and statistically significant.

3 Data Testing and Interpretations

Since the largest trading partner of Egypt regarding exports and imports is China, this study attempted an empirical test for the impact of exchange rate depreciation on the bilateral trade flows between Egypt and China. In fact Egypt has become more reliant on imports from China, the relation between Egypt and China is one of the most important bilateral relationships in North Africa.

Hence, the purpose of this section is to test, both of short and long run effects of changes in the real exchange rate of the Egyptian pound on the bilateral trade with China. For this purpose, the bounds testing approach to cointegration model autoregressive distributed lag (ARDL) framework is used for the estimation within a symmetric and asymmetric effects. The ARDL approach is applied for its benefits in the estimates, first; it has the capability to estimate the variables which integrated of order zero I (0) and integrated of order one I (1) at the time. second; bound F-test can also be utilized without identifying the order of integration.

3.1 Data and Time Series Characteristics

For empirical analysis, Current study assumed the existence of J-curve effect of Egypt's bilateral trade China. This hypothesis is incurred by using exchange rate of Egyptian pound in terms of Chinese Yuan. This study used China’s gross domestic income and gross domestic income of Egypt as control variables. Data for Trade balance is collected from (UN Comtrade), and the other variables data are collected from many sources such as World Development Indicators (WDI, 2021) of the World Bank.

A great challenge for an economy facing the negative trade balance like Egypt over the time is to formulate the appropriate degree of foreign exchange rate flexibility. Therefore, the recent exchange rate depreciation of Egyptian pound towards the foreign currencies especially the Chinese Yuan is very controversial issue [32]. Moreover, Time series data in this study spanning the period of 1994 and 2019 to empirically analyze bilateral trade between Egypt and China during fixed exchange rate regime in 1994 and floating exchange rate regime in 2019.

3.2 Descriptive Results

To analyze the foreign trade relationship over specific period of time the study is considering the stationarity of long-run coefficients in the relationship of Egyptian bilateral trade with China from year 1994 to year 2019 using the autoregressive distributed lag approach, **Descriptive statistics of Egypt – China bilateral trade model reported in Table 3:**

Table 3. Descriptive statistics of TBE

Variable	TBE	YC	YE	RX
Mean	0.100584	2926073	102625.4	0.610610
Median	0.092809	2455409	97688.54	0.595245
Maximum	0.234841	6148251	149133.0	0.779828
Minimum	0.013166	958039.5	61117.07	0.502475
Std. Dev.	0.058958	1677922	28516.62	0.076636
Skewness	0.494232	0.531866	0.134999	0.697788
Kurtosis	2.567635	1.930654	1.609849	2.862861
Probability	0.586548	0.352494	0.398858	0.406048
Sum	2.212852	64373608	2257758	13.43343
Sum Sq. Dev.	0.072996	64373608	1.71E+10	0.123333

Source: *Author's compilation from E-Views 11*

3.3 Testing the Stationarity Results of the Estimators

There are alternative methods that are used to test for stationarity in the time series. The traditional methods include the standard Elliott-Rothenberg-test (Stock DF-GLS) which is considered the most appropriate test to check the order of integration of the variables under investigation. Since the series are of the same order, cointegration methodology could be applied, as required by the long-run bilateral trade model. Moreover, this technique is suitable if the variables are I (0) & I (1). Based on the results of (Stock DF-GLS) test, the variables included for both domestic income and foreign income were stationary without taking the first difference while both trade balance (TBE) and real exchange rate (RX) are stationary at first difference (I(1)) in level form with an intercept and trend and this confirms the suitability to use ARDL model. **The (Stock DF-GLS) test results are reported in Table 4:**

Table 4. The (Stock DF-GLS) test results

Variable	DF-GLS Test in Level	DF-GLS Test in First Difference
Ln TBE	- 2.806300	-7.012806

LnYE	- 3.403435	-2.307461
LnYC	- 3.516193	-1.553834
Ln RX	- 2.418419	-2.968398

Source: *Author's compilation from E-Views 11*

Note. The test is carried out at 5% level of significance.

3.4 BOUNDS TESTING ESTIMATION RESULTS

Following [21], the determination of lag length is meant to inform the number of lags to be included. In selecting the preferred models, we utilize the Akaike Information Criterion (AIC) as the lag selection criterion and the order of the model was selected to be ARDL (1,3,3,1). **The results are given in the next Table which summarizes Optimal Lag Length Selection with Unrestricted Error Correction Model (UECM).**

Table 5. Optimal Lag Length Selection with Unrestricted Error Correction Model (UECM)

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	20,41418	20,4141	-0,414393	8,459501	-12.0361	0.0449
1	0,267291	0,26729	1.149406	0,307225	-14.7988	-0,3002
2	0,069334	0,06933	-5,520408	-0,38275	-20.3965	0,3028
3	0,103784	0,10378	-2,746798	-0,285073	-15.7405	0,3026

Source: *Author's compilation from E-Views 11*

The results of the ARDL bounds test for cointegration, indicates the presence of a significant asymmetric long run relationship between trade balance, and exchange rate, these results suggest that the ARDL model combining both the short and long run asymmetry is suitable for this study.

Having defined the lag selection criterion. The *F* test proposed by [27] can be used to determine whether a long-run relationship exists through testing the significance of the lagged levels of the variables. **Table 6 summarizes Error Correction model Bounds Test**

Table 6: Error Correction model Bounds Test

Calculated F	Critical values	
	Lower value	Upper value
12.89	2.79	3.67

Source: *Author's compilation from E-Views 11*

The calculated F-statistic is 12.89, which is above the upper bound critical value at 5% level of significance. This means that there is a long-term relation between variables. The results ensure that the time series data provide the sample representative of the phenomenon under study.

3.5 ARDL Long-Run DYNAMICS and Short-Run DYNAMICS

The steps of the study applied are as follows: 1) Estimating export and import response equation to the real exchange rate of Egypt using the Ordinary Least Squares Method (OLS), The bounds testing approach to cointegration model within a symmetric and asymmetric autoregressive distributed lag (ARDL) framework is used for the estimation.. 2) Estimating the real trade balance elasticities from steps (1).

Based on the results of the bounds test for the time series described previously, which showed that the series are stable when taking the first difference, the next step is to test the existence of a long-term equilibrium relationship between the trade balance and exchange rate, the analysis further looked at the responsiveness of trade balance of Egypt (TBE) to gross domestic income in the both of Egypt and China. **Table 7 illustrates the estimation results for long-term coefficients:**

Table 7. Coefficient estimates of long-term TBE model (ARDL (1,3,3,1)

Variable	Coefficient*	Standard error	E - Statistic	Prob
C	-161.7435	1.9294	5.4013	0.0267
LnYC	-16.75792	0.10695	0.94773	0.0260
LnYE	35.54680	0.300311	-8.2177	0.0124
LnRX	2.624486	0.13340	-5.7705	0.0245

Source: *Author's compilation from E-Views 11*

Note. ARDL (1,3,3,1) is selected using (AIC) criterion.

Considering the long-run coefficients in Table 7, the signs of the coefficients of the gross domestic income variables support the expectation from economic theory. Result shows that China income (YC) has negative impact on the trade balance of Egypt in the long run. As for the coefficients of income in Egypt (YE), the variable is statistically significant and positively related to trade balance. Based on the equation of trade balance, the growth of domestic income leads to an improvement of the trade balance. The estimated elasticity of income in Egypt is 35.54%. The results implying that a 1% increase in domestic income leads to a 35.54% increase in trade balance. As for the estimated elasticity of income in China the results suggest that a 1% increase in domestic income in China would lead to a 16.7% reduction in trade balance of Egypt.

To verify the existence of the effect of the (J) curve empirically in the case of the Egyptian economy, there is a necessary and sufficient condition that must be fulfilled, which is that the sign of the coefficient of the exchange rate variable be positive and statistically significant, and that it be the value of the coefficient that measures the elasticity of the total exports and imports are greater than the correct one and to make sure there is an effect (J) curve, this hypothesis distinguish that the value of the exchange rate coefficient is firstly negative and statistically significant in the short term, the value of the coefficient becomes positive and greater than the integer one and is statistically significant in the long term .

Based on the results of table. 7, the variable of exchange rate appears to be statistically significant indicating the existence of long-run relationships. Result shows that exchange rate change yields a positive impact on Egypt's bilateral trade with China. The estimated coefficient of exchange rate accounted for 2.6%, which means that the real depreciation of 1% causes an improvement of 2.6% in the trade balance. Resulting cointegration equation, ARDL model shows the positive impact of real depreciation and income on the trade balance. This result indicates the J-curve hypothesis in the long run.

It was also important to assess the short-run relationships between the explanatory variables depending on co-integrating relation between the variables and an error correction model (ECM) to estimate the short run dynamics of the adjustment process. The results from the short run ARDL model presented in Table 8,

Table 8. Short run Coefficient estimates of TBE lags in TBE model

Dependent variable: TBE		
Variable	**Coefficient**	**Probability**
ARDL →	**ARDL (1,3,3,1)**	
Dlog (YC)	-8.680300	-7.012806
Dlog (YC (-1))	- 3.403435	-2.307461
Dlog (YC (-2))	- 3.516193	-1.553834
Dlog (YE)	-0.5590	-2.968398

Dlog (YE(-1))	- 2.418419	0.0982
Dlog (YE(-2))	-17.71124	0.0041
Dlog (RX)	0.890648	0.2254
Coint Eq. (-1)	-1.121958	
R^2	0.930756	
Adj. R^2	0.8556	
DW-Sta.	1.9343	

Source: *Author's compilation from E-Views 11*

The results in table 8 show that the exchange rate has no affect on trade balance in the short run as the coefficient of exchange rate is positive but non-significant. Other variables, Egypt's income, the coefficient has negative sign, which means that holding constant for other variables, a one percentage point increase in the income of Egypt will decrease the total Egyptian trade by about 2.41-9 percentage point. As for partner country income, the coefficient has negative and significant effect on the trade balance, indicating that Egypt’s total trade decrease to about 3.40e-5 percentage point with the increase in China’s income.

Through Table 8 , The results found out that only the long run estimates of exchange rate supported the J-curve effect, while the estimation results do not support the evidence of the short-run worsening of trade balance suggested by the J-curve hypothesis. This result implies that although the exchange rate policy has no effect in the short run, the deficits in trade balance should be corrected through policies related to growth rates, government expenditure and money supply. That is, such problems could be corrected through fiscal and monetary policies rather than exchange rate policy.

3.6 DIAGNOSTIC TESTS OF THE ARDL MODEL

Different tests were conducted to ensure the goodness of fit and stability of the estimated ARDL model. (Table 9 reveals the results of the diagnostic tests). For this purpose we perform Breusch-Godfrey test for serial correlation, Ramsey RESET test for model specification and CUSUMQ tests of parameter stability.

Table 9. Diagnostic tests On the ECM

CALCULATED F	***CHI SQUARE****
BREUSCH-GODFREY	0.1577
HETEROSKEDASTICITY BREUSCH-PAGAN-GODFREY	0.1862
RAMSEY RESET	0.7854

Source: *Author's compilation from E-Views 11*

Note.* Diagnostic tests show that all classic assumptions are significant at 5%.

As outlined in Table 9 exchange rate is yielded sufficient evidence of stability of the model in terms of serial correlation, normality and heteroscedasticity. Table 9 shows a correlation coefficient of 0.1577 which means that there is no serial correlation. The table also shows ramsey test coefficient of 0.7854 whereby the model guaranteed the long run relationship.

After the Error Correction model is tested according to the ARDL, there are several criteria to test the quality of the model. Results reported in table 10 indicate the existence of one single cointegrating vector, where (Coint Eq. (-1), -1.121958) represents the long run equilibrium.

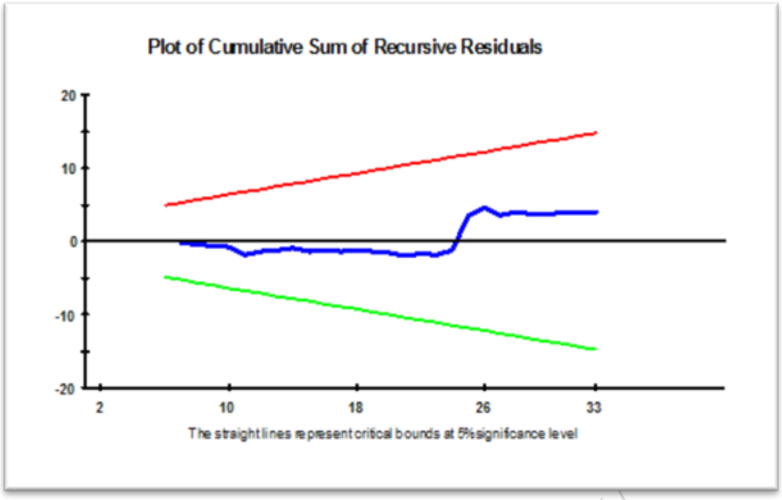
Table 10. Jarque-Bera test

Statistics	Estimated Value	Probability
Functional Form	2,0966	1,1147
Normality	2,2171	0,140
Cusum		Stable
Cusuma		Stable

***Source*:** *Author's compilation from E-Views 11*

Through Table No. 10, the results reveals that the cumulative sum of the squares of the residuals lies within the limits, this means that the model has no problems related to the the difference in variance and fulfills the condition of the normal distribution, as it is to determine what- If the regression equations were stable throughout the study period, both of Cusum and Cusuma tests confirmed that the regression equation was stable. In addition residuals are normally distributed with estimated Value 2,2171 and probability of 0,140, as outlined in Table 10 **.The following figure shows the structural stability test of the ARDL model estimated for the long-term and short-term relationship**

Fig 6. Plot of Cumulative Sum of Recursive Residuals for TBE ARDL Model (5% significance).



***Source*:** *Author's computation using E-Views 11*

4. CONCLUSION

The current study assesses the behavior of real exchange rate depreciation on Egypt and China bilateral trade using aggregate trade data for the period 1994 to 2019. The methodology is based on the most recent development in asymmetry cointegration using ARDL model. Based on the resulting cointegration equation, ARDL model indicates that the real exchange rate carries a negative sign and is statistically significant. The estimated or calculated elasticity for exchange rate was reported at 2.6%, which indicates that the real depreciation of 1% causes an improvement of 2.6% in the trade balance.

The analysis further looked at the responsiveness of trade balance of Egypt to gross domestic income in both of Egypt and China. The variables appear to be statistically significant with signs consistent with economic theory. Results shows that growth in foreign income tend to worsen the trade balance, while growth in domestic income improved the Egypt's trade balance, in the long run China income has negative impact on the trade balance of Egypt. The coefficients of income in Egypt is statistically significant and positivity related to trade balance in the case of Egypt-China bilateral trade. The results suggest that a 1% increase in domestic income lead to a 35.54% increase in trade balance. As for the estimated coefficient of income in China the results suggest that a 1% increase in domestic income in China lead to a 16.7% decrease in trade balance of Egypt**.**

The empirical results indicate that asymmetry cointegration yields support for the new definition of the J-curve in Egypt-China bilateral trade as the long-term real depreciation leads to an improvement of the trade balance. Although the short-run result shows evidence for positive values as the lag length increases, the coefficient is non-significant. Therefore the results do not find support for the J-curve phenomenon in the short-run.

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