

What Determines Egypt's Demand for Foreign Reserves?

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Received: 20/7/2023

Revised: 28/8/2023

Accepted: 5/10/2023

Published: 1/1/2024

Citation: Elroukh, A. W. (2024).
What Determines Egypt's Demand
for Foreign Reserves?. *Jordan
Journal of Economic Sciences*, 11(1),
1-15.

<https://doi.org/10.35516/jjes.v11i1.1454>

Abstract

Objective: The main objective of this paper is to identify the determinants of the demand for foreign reserves in Egypt.

Methods: The buffer stock model, quarter-century data spanning over the past 20 years, and Auto-Regressive Distributed Lag (ARDL) regression are all employed to estimate Egypt's demand function for foreign reserves, assess its stability, and predict how swiftly it may change if the underlying Cointegrated connection is disturbed.

Results: The results reveal that exports and imports have elasticities of demand for foreign reserves of 1.16 and -3.69, respectively. Moreover, Egypt's foreign reserve assets have notably increased due to foreign direct investment and foreign portfolio investment growth. Lastly, the demand function for foreign reserves is steady, and in the event of a shock, it returns to its steady state in less than two years.

Conclusion: To improve Egypt's foreign reserve holdings, policymakers should concentrate on measures encouraging exports and attracting foreign investment.

Keywords: foreign reserves, demand, buffer stock, ARDL regression, bounds test.

st.

JEL Classification: C22, F30

ماذا يحدد طلب مصر على الاحتياطيات الأجنبية؟

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ملخص

الهدف: الهدف الرئيسي من هذه الورقة هو التعرف على محددات الطلب على الاحتياطيات الأجنبية في مصر. المنهجية: تم استخدام نموذج المخزون الاحتياطي، والبيانات ربع السنوية التي تغطي العشرين عاماً الماضية، ونموذج الانحدار الذاتي ذي الفجوات الزمنية الموزعة (ARDL) لتقدير دالة الطلب في مصر على الاحتياطيات الأجنبية، وتقييم استقرارها، والتنبؤ عن مدى سرعة تعديله في حالة الاضطراب في العلاقة الأساسية المدمجة. النتائج: تُظهر النتائج أنّ الصادرات والواردات تتمتع بمرونة طلب على الاحتياطيات الأجنبية تبلغ 1.16 و -3.69 على التوالي. بالإضافة إلى ذلك، زادت الأصول الاحتياطية الأجنبية في مصر بشكل كبير بسبب نمو الاستثمار الأجنبي المباشر واستثمارات المحافظ الأجنبية. وأخيراً، فإنّ دالة الطلب على الاحتياطيات الأجنبية ثابتة، وفي حالة حدوث صدمة، فإنها تعود إلى حالتها الثابتة في أقل من عامين.

خلاصة الدراسة: لتحسين احتياطيات مصر من الاحتياطي الأجنبي، يجب على صناعات السياسات التركيز على التدابير التي تشجع الصادرات وتجذب الاستثمار الأجنبي.

الكلمات الدالة: الاحتياطيات الأجنبية، الطلب، نموذج المخزون الاحتياطي، انحدار ARDL، اختبار الحدود.



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1. INTRODUCTION

IMF Managing Director Kristalina Georgieva urged Egypt to stop the loss of its foreign reserves in an interview with Al Sharq Bloomberg, describing Egypt's reserve position as "putting water in a bucket with holes".¹ She explained that this leakage was caused by the country's support for the Egyptian pound and the availability of multiple exchange rates, making it more important than ever to understand what drives Egypt's demand for foreign reserves.

Foreign reserves are financial assets representing liquid international purchasing power held by a country's central bank. These reserves comprise holdings of foreign currencies, gold, and Special Drawing Rights (SDRs) that central banks maintain for both transactional and precautionary purposes (Gandolfo, 2016). The transaction motive facilitates international transactions, addressing the asynchrony between international import payments and export receipts, while the precautionary motive enables central banks to address unforeseen events such as sudden stops in capital inflows or hot-money flight.

If a country adopts a pure floating exchange rate regime, its exchange rate is allowed to fluctuate until its balance of payments imbalances are resolved. Even if such a government doesn't necessarily need to hold foreign reserves, some countries may still choose to keep reserves as a precaution.

On the other hand, if a country adopts a fixed exchange rate, it can utilize its retained foreign reserves to purchase its own currency when experiencing a balance-of-payments deficit. In a managed float system, which lies between these two extreme regimes, a country maintains foreign reserves to intervene in foreign exchange markets and control its exchange rate when it experiences abrupt rises or falls (Bahmani-Oskooee and Brown, 2002). In conclusion, regardless of the exchange rate regime in place, central banks always have a demand for foreign reserves.

Academics and practitioners agree that Egypt's *de facto* exchange rate regime is a managed float, despite the Central Bank of Egypt's announcement in 2003 that it would adopt a floating exchange rate regime. This underscores the significance of foreign reserves in maintaining Egypt's economic stability.

According to the buffer stock model, foreign exchange reserves act as a safety buffer to support a country's economic goals (Sula, 2011). If, for instance, a decline in currency demand harms the Egyptian economy, policymakers have three alternatives. The first, often known as an expenditure-reducing policy, is to raise domestic interest rates. While this contractionary policy can maintain exchange rate stability, it may lead to a recession in the Egyptian economy.

The second alternative is an expenditure-switching policy, in which Egypt either lowers the value of the Egyptian pound or imposes new trade restrictions such as tariffs or quotas. A devaluation of the EGP can reduce the balance of payments deficit by altering the relative pricing of Egyptian and foreign commodities, but it can also destabilize the financial system and increase domestic inflation. Trade barriers, though a misguided response to a current account deficit, have a significant negative impact on welfare.

The third alternative is a reserve policy, in which Egypt uses its foreign reserves to counteract the oversupply of the Egyptian pound. Although this strategy can help preserve a stable currency rate, the Egyptian government cannot implement it without a substantial foreign reserve buffer. Investigating the factors that influence a country's demand for reserves is essential.

Identifying the factors that determine "adequate" levels of foreign reserves and the factors that determine the "actual demand" for reserves are two distinct issues (Gandolfo, 2016). The former is a normative economics question, aiming to establish the ideal level of reserves, while the latter is a positive economics question, seeking to define objective criteria

¹ Interview date: June 20, 2023. Retrieved: July 20, 2023. URL: <https://shorturl.at/btEG7>

such as how much the Central Bank of Egypt's (CBE) holdings of foreign reserves would change if, for example, imports rose by 1%. The goal of this study is to answer the latter question; that is, to identify the determinants of Egypt's foreign exchange reserves by estimating the CBE's demand function for foreign reserves.

The objective of this paper is to empirically identify the determinants of Egypt's demand for foreign reserves, using quarterly data spanning the previous two decades and an ARDL model. This paper finds that the elasticity of foreign reserves with respect to exports and imports is 1.16 and -3.69, respectively, thus indicating that the trade balance plays a significant role in determining foreign reserves. Additionally, the capital account items have a positive and significant contribution to the growth of foreign reserves, despite the relatively small magnitude of their contribution.

Following this introduction, a review of theoretical and empirical literature is provided in the next section. Section 3 presents data and methodology. Empirical results are presented in Section 4. Section 5 concludes and provides policy recommendations.

2. RECENT DEVELOPMENTS IN EGYPT'S BALANCE OF PAYMENTS

To analyze changes in Egypt's foreign reserves, this section presents a summary of recent changes to its balance of payments (BOP).² Egypt's BOP showed an overall surplus of US\$523.5 million in the third quarter of 2022. Its current account deficit decreased by 20.2%, from US\$4.0 billion in the same quarter last year to US\$3.2 billion in the current quarter.

The improvement in tourism receipts, exports of goods, and Suez Canal receipts were the key drivers of the decline in the current account deficit. In particular, the non-oil trade deficit was reduced by \$2.0 billion, while the deficit in the oil trade balance stabilized. Egypt experienced an increase in visitor nights and arrivals, leading to a 43.5% rise in tourism revenue from \$2.8 billion to a record \$4.1 billion. Additionally, transportation revenue rose by 33.7%, from \$2.3 billion to \$3 billion, partly due to the increased revenue from the Suez Canal. However, the development of the current account was hampered by a 20.9% decrease in remittances from Egyptian employees, dropping from \$8.1 billion to \$6.4 billion.

Furthermore, the capital and financial account saw a net inflow of US\$4.4 billion as net FDI in Egypt grew to US\$3.3 billion. A US\$2.2 billion outflow occurred due to non-residents withdrawing their portfolio assets from Egypt at that time, primarily because of the Russian-Ukrainian crisis and the Federal Reserve's contractionary monetary policy.

To address its trade imbalance and attract foreign investment, the Egyptian government has implemented various programs. For instance, to mitigate the trade deficit, the Egyptian pound depreciated by over 100%, going from 15.7 EGP/USD in March 2022 to 30.9 EGP/USD in March 2023. The administration has also improved the business environment by modernizing the regulatory framework and providing incentives for foreign investment. In the medium to long term, these structural adjustments are expected to enhance Egypt's balance of payments. Nonetheless, certain issues, such as the significant trade deficit, still need resolution.

3. LITERATURE REVIEW

3.1 Theoretical literature

Three basic strands can be seen in the literature's analysis of the demand for foreign reserves: determining the factors influencing the demand for foreign reserves, examining the stability of the demand function, and gauging how quickly actual reserves adjust to desired levels.

² Analysis in this section is based on Egypt's Balance of Payments in the third quarter of 2022 released by the Central Bank of Egypt (CBE, 2022).

3.1.1 Determinants of the demand for foreign reserves

The first strand of literature concerning the demand for foreign reserves identifies its determinants. Previous research suggests that scale factors, such as exports and imports, capital flows, and an opportunity cost measure, should be included in the demand function.

It has been shown that scale variables, such as imports and exports, are connected to the demand for foreign reserves. However, the literature disagrees on the direction of this association. Bahmani-Oskooee and Niroomand (1988) found evidence that the demand for reserves varied between developed countries with higher exports and less-developed countries with lower exports, contrary to the findings of Heller and Khan (1978) and Dooley et al., (1989), who found no significant effect of accounting for export volatility in the demand for foreign reserves function. Frenkel (1974) estimated a demand function for foreign reserves and reported a negative relationship between imports and the demand for foreign reserves. The literature has debated whether or not exports should be included in the demand for foreign reserves function.

Sula (2011) estimated the demand for foreign reserves in developing nations using a quantile regression approach and a dataset of 108 countries over a period of three decades. He found a positive association between capital inflows and the demand for foreign reserves and suggested that a measure of financial openness should be incorporated into the demand for reserves function to account for capital flow volatility.

When estimating the demand for reserves, the opportunity cost of preserving foreign reserves should be taken into consideration. Iyoha (1976) was the first to use an interest rate as an opportunity cost for holding reserves. Hipple (1979) observed that the interest on alternative investments, rather than the interest return on reserves, should be seen as the true opportunity cost of keeping reserves. Edwards (1985) used the difference between the domestic interest rate and the foreign interest rate that reserves earn to measure the true opportunity cost of holding reserves. Using data from 17 less-developed countries, he concluded that the demand for reserves decreases as this interest spread rises. Landell-Mills (1989), using data compiled from 24 countries, supported Edwards' conclusions.

In summary, the demand for foreign reserves function should take into account exports and imports, domestic and foreign interest rates, as well as capital flow measurements.

3.1.2 Stability of the demand for foreign reserves

The second strand of literature on the demand for foreign reserves looks at the stability of the demand function. According to Crockett (1978), the main empirical concern is whether the demand function is stable across various exchange-rate regimes. Taking into account the oil shocks of 1972, the majority of earlier research (e.g. Dooley et al. 1989; Edwards 1985; Frenkel 1974; Heller and Khan 1978) showed that the demand for foreign reserves is stable. Additionally, Huang (1995) found that the demand for foreign reserves in China remains stable, even after taking into account a number of structural breaks that occurred in the Chinese economy.

3.1.3 Speed of adjustment

Measuring the speed at which actual reserves converge to their desired levels is the third strand of literature on the demand for foreign reserves. Bilson and Frenkel (1979) estimated the speed of adjustment, if the level of reserves falls below its desired level, to be 0.54 for developed countries and 0.41 for less-developed countries. According to Dooley et al. (1989), the speed of adjustment slowed down in the 1980s compared to the 1970s. Elbadawi (1990) observed evidence in favor of a very slow speed of adjustment in Sudan, and Huang (1995), using an error-correction model, found a sluggish speed of adjustment in China.

3.2 Empirical literature

This subsection provides a brief review of empirical literature that has estimated the demand for foreign reserves in selected Middle Eastern and African countries.

Alnawaysa (2015) used an error-correction model to evaluate how changes in the trade balance affected the growth of foreign reserves from 1993 to 2014. He found that imports reduce foreign reserves, while exports boost them.

Using panel data from Gulf Cooperation Council countries between 1975 and 2013, Hendi (2014) estimated the demand for foreign reserves, with imports and transfers being the primary determinants.

To estimate the demand for foreign reserves function in Eswatini between 1990 and 2014, Khomo et al. (2018) employed an augmented buffer stock model, showing that changes in the current account significantly influence the levels of foreign reserves using the autoregressive distributed lag (ARDL) bounds testing cointegration approach.

Elgabory and Elkaddah (2019) examined how changes in the balance of payments in Iraq affected the growth of foreign reserves from 2000 to 2016, concluding that growth in foreign reserves is connected to a positive balance of payments.

Botokok (2020) investigated FDI, oil prices, and domestic factors including exports and imports as determinants of Algeria's accumulation of foreign reserves from 1990 to 2018, showing that fluctuations in FDI and oil price shocks could account for 88% of variations in foreign reserves and that the demand for reserves function could not be cointegrated over the long term. More recently, Assas (2022) utilized a Bayesian Vector Autoregression model to examine how international reserves responded to specific macroeconomic variables from 1994 to 2018 in Algeria, concluding that there is a one-directional relationship between shocks to oil prices and foreign reserves.

The brief review of the literature in this section reveals three points: first, the quantitative and qualitative impact of each determinant of foreign reserves varies across countries; second, it is essential to estimate the demand for foreign reserves function in order to identify factors that increase or decrease foreign reserves levels; and third, no prior study has estimated the role of foreign reserve demand in Egypt.

This paper aims to fill this gap by estimating an Egyptian foreign reserves function. By doing so, the paper can offer both theoretical insights and useful policy advice. The study presents theoretical and empirical data on the elasticity of foreign reserves in relation to several macroeconomic factors, including exports, imports, and foreign investment. The paper will provide numerous policy recommendations to boost the total amount of foreign reserves acquired. The following section presents data, model specification, and econometric methodology.

4. DATA AND METHODOLOGY

4.1 Data

This study uses data primarily sourced from the Central Bank of Egypt (CBE) and the International Financial Statistics (IFS) of the IMF. In particular, data on Egypt's balance of payments are sourced from the CBE, while data about Egypt's international reserves, T-bills rate, and the US T-bills rate are sourced from the IFS. This study uses quarterly data from 2004Q3 to 2022Q4.³

4.2 Model specification

The stock buffer model, first developed by Deaton (1991), has been used to explain a variety of economic phenomena, such as the government's accumulation of foreign reserves (Chakravarty, 2009; Khomo et al., 2018). This model seeks to

³ Most of the time series data that the CBE publishes start from the third quarter of 2004.

explain how countries manage their foreign reserves in response to uncertain economic conditions. It assumes that countries have a target level of foreign reserves, or buffer stock, that they aim to maintain. This buffer stock serves as a cushion against unexpected economic shocks, such as a sudden decline in exports or a financial crisis. When economic conditions deteriorate, countries will draw down their buffer stock of foreign reserves to finance their current account deficit or to defend their currency. Conversely, when economic conditions improve, countries will add to their buffer stock of foreign reserves, as they want to build up a reserve for future shocks.

Using the buffer model as a theoretical framework and based on the reviewed theoretical literature in Section 3.1.1, the main determinants of foreign reserves can broadly be classified into scale variables and opportunity cost variables. Scale variables primarily include the components of the current account and financial account, while the opportunity cost variables consist of domestic and foreign interest rates.

In particular, the determinants of foreign reserves are as follows: first, the level of imports and exports since countries with high levels of imports and exports tend to hold more foreign reserves to finance their trade imbalances. Second, other current account components, such as service receipts, service payments, and transfers, as a current account deficit requires a country to draw down its foreign reserves to finance the deficit, and vice versa. Third, the components of the financial account, such as foreign direct investment and foreign portfolio investment, as a financial account surplus means that a country is receiving more foreign investment than its capital outflow, leading to an increase in foreign reserves. Finally, domestic and foreign interest rates serve as opportunity cost variables; a higher foreign interest rate encourages countries to hold more foreign reserves, whereas a higher domestic interest rate increases the opportunity cost of holding reserves, thus discouraging countries from holding more foreign reserves.

More formally, the functional form of the demand for reserves function adopted in this study is

$$R_t = \beta_0 + \beta_1 \ln E_t + \beta_2 \ln M_t + \beta_3 \ln SR_t + \beta_4 \ln SP_t + \beta_5 \ln T_t + \beta_6 FDI_t + \beta_7 FPI_t + \beta_8 i_t^{EG} + \beta_9 i_t^{US} + \epsilon_t \quad (1)$$

where R_t is the level of actual foreign reserves of Egypt, in US dollars, excluding gold, as it is commonly used in the literature (Sula, 2011); E_t is export proceeds, in US dollars; M_t is import payments, in US dollars; SR_t is service receipts, in US dollars; SP_t is service payments, in US dollars; T_t is transfers to Egypt, in US dollars; FDI_t is the net foreign direct investment in Egypt, in US dollars; FPI_t is the net foreign portfolio investment in Egypt, in US dollars; i_t^{EG} is the yield on short-term, 3-months, T-bills in Egypt; i_t^{US} is the yield on short-term, 3-months, T-bills in the United States; $\ln(\cdot)$ is the natural logarithm operator; t designates the corresponding quarter of the year; ϵ_t is a random error term.

Exports proceeds, services receipts, and net incoming transfers are expected to be positively related to the actual holdings of foreign reserves, whereas imports and services payments are expected to be negatively related to the actual holdings of reserves. Net capital inflows, whether foreign direct investment or foreign portfolio investment, are expected to be positively related to the actual holdings of foreign reserves. The opportunity cost measure of holding foreign reserves is expected to be negatively related to the actual holdings of reserves, although the previous literature has found mixed results on this (Edwards, 1985; Hipple, 1979; Iyoha, 1976; Landell-Mills, 1989)

4.3 Econometric methodology

A useful and effective technique for examining a variety of relationships among time series variables is the Autoregressive Distributed Lag (ARDL) model. The ARDL model can also be used to test for Cointegration and determine how Cointegrated the variables are over the long term. Compared to other time series models, such as those of Engle and Granger (1987) and Johansen and Juselius (1990), the ARDL model has a number of advantages. Specifically, while other

Cointegration methodology approaches require that all variables be integrated in the same order, the ARDL model can be used to analyze variables that are I(0), I(1), or mutually Cointegrated. This work applies the bounds test developed by Pesaran et al. (2001) to ascertain a long-run equilibrium relationship between variables. It is sufficient for the underlying variables to be stationary at the initial difference in order to apply the bounds test.

The first step in establishing cointegration is to estimate the unrestricted error correction form of the demand for **foreign reserves function (equation 1) using OLS as follows. The unrestricted error correction form of the demand for foreign reserves (equation 1) is given as:**

$$\Delta LnR_t = C_0 + \sum_{j=1}^p \gamma_{1j} \Delta LnR_{t-j} + \sum_{j=1}^{q_1} \gamma_{2j} \Delta LnE_{t-j} + \sum_{j=1}^{q_2} \gamma_{3j} \Delta LnM_{t-j} + \sum_{j=1}^{q_3} \gamma_{4j} \Delta LnSR_{t-j} + \sum_{j=1}^{q_4} \gamma_{5j} \Delta LnSP_{t-j} + \sum_{j=1}^{q_5} \gamma_{6j} \Delta LnT_{t-j} + \sum_{j=1}^{q_6} \gamma_{7j} \Delta FDI_{t-j} + \sum_{j=1}^{q_7} \gamma_{8j} \Delta FPI_{t-j} + \sum_{j=1}^{q_8} \gamma_{9j} \Delta i_{t-j}^{EG} + \sum_{j=1}^{q_9} \gamma_{10j} \Delta i_{t-j}^{US} + \beta_1 LnR_{t-1} + \beta_2 LnE_t + \beta_3 LnM_t + \beta_4 LnSR_t + \beta_5 LnSP_t + \beta_6 LnT_t + \beta_7 FDI_t + \beta_8 i_t^{EG} + \beta_9 i_t^{US} + \epsilon_t \quad (2)$$

where Δ is the first difference operator, $\gamma_{1j}, \gamma_{2j}, \dots, \gamma_{10j}$ are the coefficients of short-run dynamics of the underlying corresponding variables, with lag length p, q_1, q_2, \dots, q_9 respectively, $\beta_1, \beta_2, \dots, \beta_9$ are the coefficients of the long-run relationship of the variables in the Cointegrating set, and ϵ_t is a white-noise error term.

The errors in equation 2 must be serially independent for the bounds test to be reliable (Pesaran et al., 2001). The error term of equation 2 can be tested for serial correlation and heteroskedasticity using the Breusch-Godfrey test and the Breusch-Pagan-Godfrey test, respectively. Serial correlation in the error term can invalidate the bounds test, while heteroskedastic errors can result in inefficient estimates. When the error term's white-noise assumption is met, the bounds test can be used to determine whether a long-term relationship exists.

The bounds test is a standard Wald test used to test the null hypothesis of no cointegration, i.e., $H_0: \beta_1 = \beta_2 = \dots = \beta_9 = 0$, against the alternative that at least one of them is not. The computed F-statistic is then compared to two critical values corresponding to cases of all variables being purely I(0) or purely I(1). If the test statistic is below the lower critical value, the null hypothesis of no cointegration cannot be rejected. If the test statistic is above the upper critical value, the null hypothesis of no cointegration is rejected and there is evidence of a long-run relationship among the underlying variables. The bounds test is inconclusive if the test statistic falls between the lower- and upper-critical values.

Once cointegration is established using the bounds test, the long-run equilibrium foreign reserves demand relationship can be estimated as follows.

$$LnR_t = C_0 + \beta_1 LnE_t + \beta_2 LnM_t + \beta_3 LnSR_t + \beta_4 LnSP_t + \beta_5 LnT_t + \beta_6 FDI_t + \beta_7 i_t^{EG} + \beta_8 i_t^{US} + \mu_t \quad (3)$$

where μ_t is an error term. Short-run dynamics could be captured by the restricted error correction model (ECM):

$$\Delta LnR_t = C_0 + \sum_{j=1}^p \gamma_{1j} \Delta LnR_{t-j} + \sum_{j=1}^{q_1} \gamma_{2j} \Delta LnE_{t-j} + \sum_{j=1}^{q_2} \gamma_{3j} \Delta LnM_{t-j} + \sum_{j=1}^{q_3} \gamma_{4j} \Delta LnSR_{t-j} + \sum_{j=1}^{q_4} \gamma_{5j} \Delta LnSP_{t-j} + \sum_{j=1}^{q_5} \gamma_{6j} \Delta LnT_{t-j} + \sum_{j=1}^{q_6} \gamma_{7j} \Delta FDI_{t-j} + \sum_{j=1}^{q_7} \gamma_{8j} \Delta FPI_{t-j} + \sum_{j=1}^{q_8} \gamma_{9j} \Delta i_{t-j}^{EG} + \sum_{j=1}^{q_9} \gamma_{10j} \Delta i_{t-j}^{US} + \psi EC_{t-1} + \mu_t \quad (4)$$

where ψ captures the speed of adjustment to long-run equilibrium, following a shock to the system.

A graph of the fitted values, obtained by deducting the estimated error correction (EC_{t-1}) term from the dependent variable, is also provided, along with the adjusted R^2 as a measure of goodness-of-fit.

5. RESULTS

The empirical findings of the econometric model are presented in this section.

5.1 Stationarity tests

The first step in the analysis is to ensure that none of the included series is integrated of order 2 or higher. To do so, I run the Augmented Dickey-Fuller (1981) unit-root test on each series at the level. If the null hypothesis of the existence of a unit root is rejected, no further testing is conducted. However, if the null hypothesis of the existence of a unit root cannot be rejected, I rerun the same test on the first difference of the series. Table 1 reports the estimates of the ADF test. The estimates of the ADF test statistics, presented in Table 1, show that the included series is a mix of I(0) and I(1), and, more importantly, none of the included series is integrated of order 2.

Table 1: Results of the Augmented Dickey-Fuller unit-root test.

	Level		1 st difference	
	ADF	specification	ADF	specification
ln (reserves)	-1.68	C	-6.34***	none
ln (exports)	-2.59	C	-9.88***	none
ln (imports)	-3.34*	C, T		
ln (services receipts)	-3.35*	C		
ln (services payments)	-4.90***	C, T		
ln (transfers)	-1.43	none	-12.95***	C
FDI (net)	-5.39***	C		
FPI (net)	-5.59***	none		
T-bills (Egypt)	-3.15	C, T	-6.13***	none
T-bills (US)	-1.83	none	-2.4**	none

Notes: ***, **, and * indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10%, respectively. C and T indicate whether the included constant and/or trend, respectively, are statistically significant. "None" designates that neither constant nor trend are statistically significant.

5.2 Deterministic specifications

The order of lags to be included in the regression is determined by the Akaike Information Criterion (AIC), as the Schwarz Bayesian Criterion (SBC) tends to under fit the estimated model in pursuit of producing a more parsimonious specification. Based on the AIC, the number of lags (p, q1, q2, ..., q9) to be included in the ARDL regression is (2, 0, 1, 0, 0, 0, 3, 4, 2, 0). Additionally, a constant has been included in the Cointegrating equation, as the foreign reserves series is not centered around zero.

5.3 Diagnostic testing

The LM test statistic of the Breusch-Godfrey test of no serial correlation in the error term of equation 2 is 1.17, with a p-value of 0.16, suggesting that there is no evidence of serial correlation. The F statistic of the Breusch-Pagan-Godfrey test of homoskedasticity is 1.47, with a p-value of 0.13, suggesting that there is no evidence of heteroskedasticity. Since the error term of the unrestricted error correction form of the foreign reserves demand function is well-behaved, the bounds test can be applied next.

5.4 The bounds test for cointegration

The F-statistic of the Pesaran et al. (2001) co-integration bounds test is 4.95, which is greater than the upper bound critical value of 3.68 at a 1% level of significance. Therefore, I conclude that there exists a long-run co-integration relationship between foreign reserves and the included explanatory variables: exports of goods, imports of goods, services receipts, services payments, transfers, FDI, FPI, Egypt T-bill rate, and US T-bill rate.

5.5 Estimation of LR relationship

Table (2) reports the estimated long-run coefficients for the demand for foreign reserves function in Egypt over the period 2004Q3 to 2022Q4.

The coefficient of log exports is positive and significant (1.16), indicating that a 1% increase in exports of goods proceeds will result in an increase in Egypt's holdings of foreign reserves by 1.16. The coefficient of log imports is negative and significant (-3.69), indicating that a 1% increase in imports of goods payments will decrease Egypt's holdings of foreign reserves by 3.69. The estimates of trade balance items are consistent with prior expectations.

However, the estimates of the services balance are inconsistent with prior expectations; a 1% increase in services payments will increase holdings of foreign reserves by 1.26, while an increase in services receipts has an insignificant effect on Egypt's holdings of foreign reserves. Additionally, net transfers have no significant effect on holdings of foreign reserves, which could be attributed to the fact that almost all transfers to Egypt are private transfers in the form of remittances for workers abroad. This might signal that the recipients of these remittances prefer to hoard them instead of depositing them in the Egyptian banking sector.

Both (net) FDI and (net) FPI enter the long-run equation without logarithm transformation, as they can take either positive or negative values depending on the direction of capital flows. Therefore, coefficients on either of them represent semi-elasticities, and must be multiplied by 100 to obtain elasticities of the demand for foreign reserves with respect to FDI and FPI. A 1% increase in foreign inflows of net direct investment will increase Egypt's holdings of foreign reserves by 0.01%, and a 1% increase in foreign inflows of net portfolio investment will increase Egypt's holdings of foreign reserves by 0.002%. Although these elasticities have the expected sign and are significant, their magnitudes are very small. This could be due to the fact that both FDI and FPI are volatile, and their impact on the long-run decision of foreign reserves holdings is minimal.

The coefficient on the yield of Egyptian T-bills is insignificant, which is justified as the decision of monetary authorities to hoard foreign reserves is irrelevant to the domestic interest rate that is paid in Egyptian pounds. The sign of the coefficient on the yield of the US T-bills is a little puzzling; however, the literature has also found mixed results on the same coefficient, as explained in the theoretical framework section.

In summary, the most important determinants of Egypt's holdings of foreign reserves are export proceeds and import payments, i.e., the trade account items.

Table 2: Results for the long-run relationship of the ARDL regression.

Dependent: ln (reserves)	Long-run form coefficients
ln (exports)	1.16* (1.99)
ln (imports)	-3.69* (-1.83)
ln (services receipts)	-0.43 (-1.15)
ln (services payments)	1.26* (1.84)
ln (transfers)	0.44 (0.69)
FDI (net)	0.00096*** (3.54)
FPI (net)	0.00024*** (4.29)
T-bills (Egypt)	0.04 (1.43)
T-bills (US)	-0.19* (-1.97)
Constant	23.22** (2.48)
R^2	0.96
Durbin-Watson Statistic	2.07
Serial correlation ¹	1.71
Heteroskedasticity ²	1.47
F-statistics ³	4.95

Notes: t-statistics are in parentheses. Newey and West (1987) standard errors are used. ***, **, and * indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10%, respectively.

¹ The LM test statistic of the Breusch-Godfrey test of no serial correlation.

² The F-statistic of the Breusch-Pagan-Godfrey test of homoskedasticity.

³ The F-statistic of the bounds test.

5.6 Estimation of short-term dynamics

The results of short-term dynamics are presented in Table 3. If disturbed by changes in one of its explanatory variables, the error-correction (EC) coefficient measures the speed of adjustment of long-run foreign reserves. The estimated EC coefficient, -0.13, is negative, less than one, and statistically significant. Its interpretation is that it takes less than eight quarters for the Cointegrating relationship to converge to its steady-state equilibrium if a shock occurs, providing extra support for the existence of a long-run relationship between foreign reserves and the included explanatory variables. Additionally, the magnitude of the speed of adjustment is close to prior suggestions by Bilson and Frenkel (1979), who suggested a magnitude of -0.41, and Dooley et al. (1989), who suggested that this magnitude declines as countries move towards floating exchange rate regimes.

Table 3: Error correction representation of estimated ARDL models

Dependent: ln (reserves)	ECM Regression coefficients
$\Delta \ln reserves (-1)$	-0.16 (-1.56)
$\Delta \ln imports$	-0.13 (-1.09)
ΔFDI	0.00029*** (2.78)
$\Delta FDI (-1)$	-0.00058*** (-4.21)
$\Delta FDI (-2)$	-0.00045*** (-3.90)
ΔFPI	0.00011*** (4.68)
$\Delta FPI (-1)$	-0.00015*** (-3.84)
$\Delta FPI (-2)$	-0.00012*** (-3.59)
$\Delta FPI (-3)$	-0.00093*** (-2.94)
$\Delta T - bills, Egypt$	0.00039 (0.04)
$\Delta T - bills, Egypt (-1)$	0.02*** (2.24)
$EC (-1)$	-0.13 (-8.11)

Notes: t-statistics are in parentheses. Newey and West (1987) standard errors are used. ***, **, and * indicate that the estimated coefficient is statistically significant at the 1%, 5%, and 10%, respectively.

5.7 Stability of the long-run relationship

To test the stability of the estimated long-run relations, Figure 1 depicts the Brown et al. (1975) CUSUM and CUSUM2 tests. Since the plots of the CUSUM and CUSUM2 do not cross the two 5% significance level critical lines, I conclude that the coefficients of the long-run foreign reserves regression are stable.

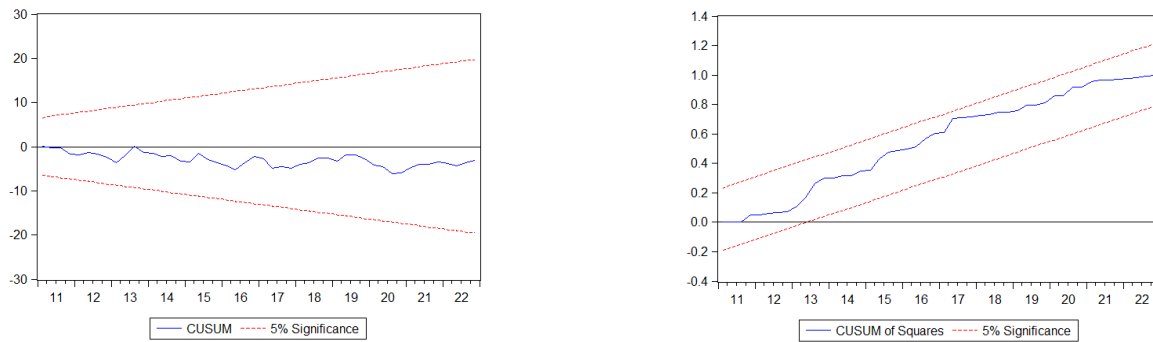


Figure 1: Plots of CUSUM and CUSUMSQ statistics for coefficient stability.

5.8 Goodness of fit

The adjusted R^2 for the estimated ARDL regression is 0.96 suggesting a good fit of the estimated model. Moreover, since the Durbin-Watson statistic is 2.07 which is greater than the adjusted R^2 , a case of spurious regression can be ruled out (Granger & Newbold, 1974). Additionally, observed versus fitted values for foreign reserves, along with the residuals, are depicted in Figure 2; thus, I conclude that my estimated model fits the data very well.

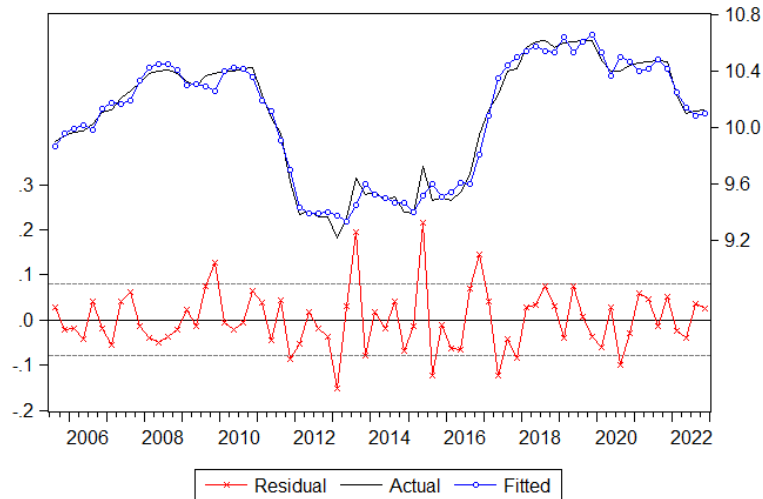


Figure 2: Actual vs fitted foreign reserves, along with residuals.

6. CONCLUSION AND POLICY RECOMMENDATIONS

This paper utilizes quarterly data over the last two decades and an Auto-Regressive Distributed Lag (ARDL) regression method to estimate a demand function for foreign reserves. The primary goal is to identify the determinants of Egypt's foreign reserves.

The results reveal that Egypt's demand for foreign reserves is mainly influenced by components of the trade balance,

with foreign reserve elasticity to exports and imports being 1.16 and -3.69, respectively. Additionally, Foreign Direct Investment (FDI) and Foreign Portfolio Investment (FPI) are highlighted as significant determinants of foreign reserves. The demand function for foreign reserves in Egypt is proven to be stable, and any shock disturbing the long-term Cointegrating relationship is shown to revert to its steady state in less than two years.

The findings of this paper hold significant policy implications. Since the estimated demand function for foreign reserves suggests that exports and foreign investments are key determinants of foreign reserves, policymakers should implement policies that aim to bolster Egypt's exports and entice inflows of foreign investment.

To achieve this, the paper suggests the following policies to boost Egypt's exports: First, reducing trade barriers, particularly tariffs on raw materials and intermediate goods used in manufacturing, which will lower production costs and make Egyptian exports more competitively priced. Second, supporting research and development of new, exportable products. Additionally, implementing quality control standards for Egyptian exports will enhance the quality of these goods. Third, fortifying the manufacturing sector by offering tax reductions to manufacturers that export their products. Fourth, targeting new export markets, and creating strategies to penetrate these markets.

The paper also proposes the following policies to increase the inflow of foreign investments into Egypt: First, cultivating a stable and predictable business environment by formulating a clear and transparent regulatory framework for businesses. This can include improving the investment climate by providing incentives such as tax breaks for foreign investors, simplifying the licensing process, and reducing the number of permits required to start a business. Second, establishing and enforcing a robust intellectual property rights regime that protects the rights of inventors, which will incentivize foreign investors to bring their technology and expertise to Egypt. Third, implementing antitrust laws, as increased competition will help attract foreign investors to invest in sectors previously closed to them.

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