An Econometric Analysis of the Macroeconomic Determinants of External Debt in Egypt

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Abstract:

This paper examines the macroeconomic determinants of external debt in Egypt during 1977-2020 using Johansen cointegration test and a vector error correction model (VECM). It tries to fill the research gap due to the lack of empirical studies on the determinants of external debt accumulation in Egypt. The results of Johansen cointegration show that there is a long-run equilibrium relationship between the model variables. Furthermore, the long-run cointegrating equation reveals that there is a negative relationship between gross domestic savings and external debt accumulation in Egypt, whereas government final consumption expenditure, trade openness, and total external debt service are positively related to external debt accumulation in Egypt. Accordingly, some policy recommendations can be suggested to deal with the growth of Egypt's external debt such as boosting gross domestic savings rate through achieving higher growth rates, increasing government revenues through widening the tax base, directing the funds acquired from external borrowing to highly-productive projects that generate high rates of return in excess of interest payments on external debt, and

implementing an industrialization program that is complemented with an export promotion strategy that aims at increasing exports and hence, reducing the foreign exchange gap.

Keywords: Macroeconomic Determinants, External Debt, Egypt, Johansen Cointegration Test, Vector Error Correction Model

تحليل قياسي للمحددات الاقتصادية الكلية للدين الخارجي في مصر

الملخص :

تتناول هذه الورقة المحددات الاقتصادية الكلية للدين الخارجي في مصر خلال الفترة ما بين ١٩٧٧-٢٠٢٠ باستخدام اختبار جوهانسن للتكامل المشترك ونموذج متجه تصحيح الخطأ (VECM). وتسعى الورقة إلى سد الفجوة البحثية الناتجة عن عدم وجود دراسات تجريبية كافية حول محددات تراكم الدين الخارجي في مصر. وقد أظهرت نتائج اختبار جوهانسن للتكامل المشترك أن هناك علاقة توازن في الأجل الطويل ما بين متغيرات النموذج. وبالإضافة إلى ذلك، فقد أوضحت معادلة التكامل المشترك في الأجل الطويل أن هناك علاقة سلبية بين إجمالي المدخرات المحلية وتراكم الدين الخارجي في مصر، بينما يسهم كل من الإنفاق الاستهلاكي النهائي الحكومي، والانفتاح التجاري، وإجمالي خدمة الدين الخارجي بشكل إيجابي في تراكم الدين الخارجي في مصر. وبناء على تلك النتائج، يمكن اقتراح بعض التوصيات المتعلقة بكيفية التعامل مع نمو الدين الخارجي لمصر، مثل تعزيز معدل الادخار المحلي الإجمالي من خلال تحقيق معدلات نمو أعلى، وزيادة الإيرادات الحكومية من خلال توسيع القاعدة الضريبية، وتوجيه الأموال المكتسبة من الاقتراض الخارجي إلى مشروعات مرتفعة الإنتاجية تدر عوائد أعلى من مدفوعات الفائدة على الدين الخارجي، وتنفيذ برنامج للتصنيع يشتمل على استراتيجية لتشجيع الصادرات مما يسهم تقليص فجوة النقد الأجنبي.

الكلمات المفتاحية: المحددات الاقتصادية الكلية، الدين الخارجي، مصر، اختبار جوهانسن للتكامل المشترك، نموذج متجه تصحيح الخطأ

1. Introduction

Developing countries resort to external borrowing for both internal and external causes. On the one hand, internal causes of external borrowing include mainly macroeconomic determinants such as insufficient domestic resources, lack of foreign exchange, rising government budget deficit, excessive external debt payments, and reduction in total international reserves. Other internal causes include political instability and poor institutional quality. On the other hand, external causes include the exogenous sources of external borrowing such as wars, shocks in international commodity prices, and rising world interest rates (Tiruneh, 2004).

As a result of the international debt crisis in the early 1980s, there was a growing interest in investigating the sources of external indebtedness of developing countries, since several empirical studies have argued that external debt might have adverse impacts on economic growth. In this regard, Krugman (1988) proposed that excessive borrowing can result in the debt overhang problem, which means the presence of an existing inherited debt sufficiently large that creditors do not expect with confidence its full repayment. In such a case, creditors might lend debtors to recover part of their claims and extract some future country resources. However, since all future debtor's resources will be used to repay its creditors, this might reduce the incentives for saving and investment as well as the incentives for implementing policy

reforms by the debtor government, and hence, affects economic growth negatively (Imbs and Ranciere, 2005).

Consequently, time-series and panel-data studies on the determinants of external debt accumulation have increased since the 1990s and were based mainly on the theoretical framework provided by the two-gap model developed by Chenery and Strout (1966) that was then extended by the three-gap model introduced by Bacha (1990).

Meanwhile, the evolution of Egypt's external debt shows that external debt stock has witnessed a sharp rise since the mid-1970s after the launch of the Open Door Policy. Such rising external debt continued in the 1980s with the growing macroeconomic imbalances in the Egyptian economy and external debt stock reached $41.6 billion in 1988 compared to $4.8 billion in 1975 according to the World Bank, before showing a declining trend in the 1990s following the launch of the economic reform and structural adjustment program (ERSAP).

Although there was a slight rise in external debt stock and external debt as a percentage of GDP during 1997-2003, Egypt's external debt indicators improved during 2004-2007 after the launch of a package of economic reform measures. External debt then increased as a result of the political turmoil that followed the 2011 Arab Spring, before falling sharply in 2014 due to the grants received from the Gulf Cooperation Council (GCC) countries.

Nevertheless, the external debt stock increased significantly during 2015-2020 reaching $129.8 billion in 2020 as a result of the domestic currency devaluation in 2016 and the increased shift towards external borrowing after the IMF's extended fund facility in 2016 and its associated financing package from the World Bank and other partners. Such rising external debt with its associated increasing debt service burden raises concerns about Egypt's external debt growth, and thus increases the importance of investigating the main determinants of external debt in Egypt.

In this context, this paper adopts Johansen cointegration test and estimates a vector error correction model (VECM) in an attempt to uncover the macroeconomic determinants of external debt in Egypt using annual data for the time period through 1977 to 2020. The paper is trying to fill the research gap in examining the determinants of external debt accumulation in Egypt due to the lack of such studies.

The rest of the paper is organized as follows: section two reviews the theoretical and empirical literature on the determinants of external debt, then section three shows the evolution of Egypt's external debt while focusing on external debt indicators. Section four presents the econometric methodology adopted in this paper, whereas section five illustrates the results of econometric model. Finally, section six concludes and provides some policy recommendations on dealing with the rising external debt in Egypt.

2. Literature Review

The literature review will start with the theoretical framework for examining the sources of external indebtedness, particularly the gap models, followed by a review of the empirical evidence on the determinants of external debt accumulation.

2.1 Theoretical Framework

The theoretical framework for analyzing the sources of external debt accumulation is based mainly on the gap models, including the two-gap and three-gap models. These models are considered extensions for the seminal Harrod-Domar growth model. Harrod (1939) and Domar (1946) asserted that a country's desired growth rate depends on capital accumulation and the quantity of capital required per additional unit of output (capital-output ratio), given that capital accumulation is determined by a country's savings rate.

In this way, the Harrod-Domar growth model became in the 1950s the theoretical basis upon which countries determine their required savings rate to achieve the targeted growth rate, considering that savings include both domestic and foreign savings (Taylor, 1994). However, the Harrod-Domar model was then extended by Chenery and Strout (1966) to include a separate foreign exchange gap in addition to the savings-investment gap already included in Harrod-Domar's model. Furthermore, Bacha (1990) extended the two-gap by including a fiscal gap, and hence formulating the three-gap model.

According to Bacha (1990), countries demand foreign capital inflows including external borrowing to fill three gaps, which are the savings-investment gap, the foreign exchange gap, and the fiscal gap. These three gaps can be summarized by the following equation which identifies the different sources of financing the level of investment (I) required to achieve the desired economic growth rate.

$$I = \left(Y_p - C_p\right) + (T - G) + (M - X) \qquad (1)$$

In equation (1), $Y_p - C_p$ represents private savings where Y_p and C_p are private income and consumption respectively. In this regard, since domestic private savings are usually not sufficient for financing the desired level of investment in developing countries, the savings-investment gap is considered among the main sources of external indebtedness in developing countries.

Meanwhile, $T - G$ represents the domestic public savings or fiscal surplus where T and G are government revenues and expenditures respectively. The budget sector in most developing countries usually records a budget deficit with government expenditure exceeding government revenues, and thus external borrowing can be viewed as an alternative source for financing such government budget deficit.

Finally, $M - X$ represents the trade deficit where M and X are imports and exports respectively. In this context, the growth rate of developing countries is largely constrained by the foreign

exchange gap mainly resulting from trade deficits and the deterioration of these countries' terms of trade, since developing countries' exports are dominated by primary products that are characterized by low price-elasticity of demand as well as low income-elasticity of demand (Tiruneh, 2004).

2.2 Empirical Evidence

Based on the two-gap and three-gap models, several empirical studies focused on investigating the determinants of external debt accumulation in developing countries particularly after the international debt crisis of the 1980s. Such studies included time-series as well as panel-data studies and used different econometric techniques. Therefore, the review of empirical studies on the determinants of external debt accumulation will start with the time-series studies followed by the panel-data studies.

The time-series studies on the determinants of external indebtedness have grown largely since the 1990s due to the increased data availability. These studies adopted mainly cointegration techniques such as Johansen cointegration test and autoregressive distributed lag (ARDL) bound testing to deal with the non-stationarity of most economic variables over time.

Among the time-series studies that adopted Johansen Cointegration test and estimated a vector error correction model (VECM) were Bader and Magableh (2009); Awan et al. (2011); Imimole et al. (2014); Udoh and Rafik (2017); Adamu (2019).

For instance, Bader and Magableh (2009) found that government budget deficit, foreign aid, and real exchange rate were the main drivers of external debt accumulation in Jordan during 1980-2005. Meanwhile, Awan et al. (2011) concluded that domestic currency devaluation and fiscal deficit contributed positively to external debt growth in Pakistan during 1974-2008, whereas the terms of trade contributed negatively to external indebtedness implying that the deterioration in terms of trade was among the main sources of external indebtedness. Furthermore, the findings of Adamu (2019) revealed that government fiscal deficit, domestic currency devaluation, and debt relief were positively related to external debt accumulation in Nigeria during 1970-2017, while international oil price and gross domestic savings were negatively related to external indebtedness.

Alternatively, some time-series studies used ARDL cointegration technique to explore the sources of external debt accumulation. Among these studies were Al-Fawwaz (2016); Sa'ad et al. (2017); Ozata (2017); Beyene and Kustoz (2020); Mulugeta (2021). For example, Ozata (2017) asserted that domestic currency devaluation and government budget deficit were the main sources of long-run external debt accumulation in Turkey during 2000-2016, and interest rate as well as national savings were negatively related to external debt accumulation. Moreover, Beyene and Kustoz (2020) found that savings-investment gap, trade deficit, government budget deficit, and

debt service ratio to exports had a positive impact on external indebtedness in Ethiopia during 1981-2016, whereas trade openness, inflation rate, and real GDP growth contributed negatively to external debt accumulation.

On the other side, several panel-data studies have investigated the sources of external indebtedness such as Tiruneh (2004); Waheed (2017); Azolibe (2021); Dawood et al. (2021). In this context, Azolibe (2021) examined the macroeconomic and socio-economic determinants of external debt accumulation for a panel of 39 heavily indebted poor countries (HIPCs) during 1996-2018 using both static-panel estimation and fully modified ordinary least squares method (FMOLS). The results of Azolibe (2021) showed that corruption, official development assistance (ODA), government expenditures, and unemployment were positively related to external debt accumulation, while international reserves and economic growth were negatively related to external debt accumulation. Furthermore, Dawood et al. (2021) concluded that government expenditures, trade deficit, and nominal exchange rate contributed positively to external debt growth during 1995-2019 for a panel of 39 developing and transitioning economies, whereas economic growth and inflation contributed negatively to external debt growth during the same time period for these countries.

Although there are several studies that have examined the impact of Egypt's external debt on economic growth, the review

of empirical studies on the determinants of external debt accumulation in Egypt shows that such studies are few. In this regard, the review shows that there are only three studies that investigated the drivers or determinants of debt accumulation in Egypt. Two of these studies, namely Alnashar (2019) and Abdu (2020), focused on the drivers of Egypt's public debt accumulation including both domestic and external debt, and hence did not consider the private external debt. Both studies concluded that the main drivers of Egypt's public debt were primary budget deficit and exchange rate depreciation, though Alnashar (2019) estimated a vector autoregression (VAR) model using quarterly data for 2004/05-2016/17 and Abdu (2020) estimated an ordinary least squares (OLS) model using annual data for 1999-2019.

Meanwhile, the third study by Ghaly (2023) focused mainly on investigating the two-way relationship between Egypt's external debt and inflation by using Johansen cointegration test and estimating a VECM. The results of Ghaly (2023) revealed that final consumption expenditure, gross capital formation, and net trade in goods and services contributed positively to external debt accumulation in Egypt, while inflation and broad money growth were negatively related to external debt accumulation.

Consequently, it appears that there is a lack of empirical studies on the determinants of external indebtedness in Egypt. Thus, the primary objective of this paper is to try to fill such

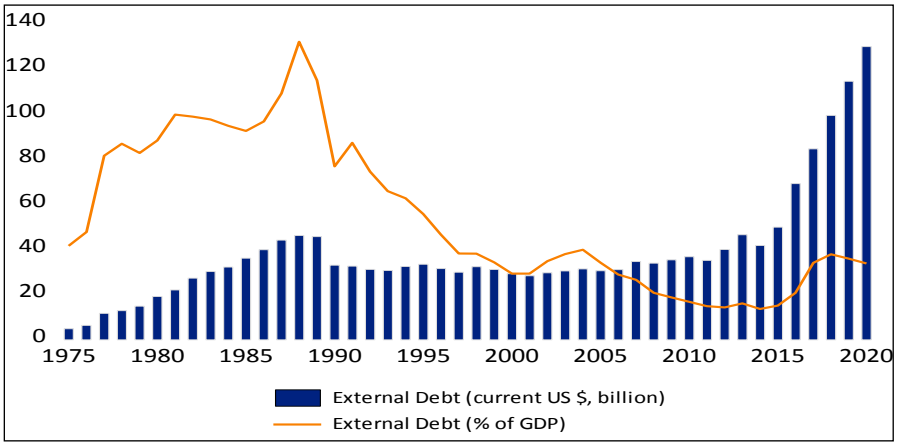
research gap by exploring the macroeconomic determinants of external debt accumulation in Egypt using an econometric model that is based on the two-gap and three-gap models.

3. Evolution of External Debt in Egypt

This paper adopts the World Bank's definition of external debt. According to the World Bank, external debt includes long-term public debt, publicly guaranteed debt, private non-guaranteed debt, IMF credit utilization, and short-term debt.

Although Egypt's history with external debt dates back to the 19th century, Egypt's external debt has witnessed a significant increase since the mid-1970s. This can be explained largely by launch of the Open-Door Policy in 1975, which opened up the Egyptian economy but without implementing an export-promotion strategy and an industrialization program (Sharaf, 2022). Accordingly, the industrial sector was negatively affected, and imports increased with a large share for imports of consumption goods resulting in chronic trade deficits in the second half of the 1970s, and hence a sharp rise in external debt stock and external debt to GDP ratio from $4.8 billion and 41.6% respectively in 1975 to $19.1 billion and 88.3% respectively in 1980 as depicted in figure (1) and table (1).

Figure (1) External Debt Stock and External Debt to GDP Ratio



Source: World Bank, World Development Indicators (WDI)

By the 1980s, the Egyptian economy became largely dependent on external sources of income and foreign exchange including the Suez Canal revenues, tourism revenues, oil export revenues, and Egyptian Workers' remittances from abroad. Nevertheless, the 1980s witnessed a sharp decline in revenues from the above-mentioned external sources due to the slowdown in the growth of the World economy after the large fall in international oil prices that was coupled with the international debt crisis (Helmy, 2021). Moreover, trade deficits and government budget deficits accumulated in the 1980s in addition to an increasing savings-investment gap. As a result of such negative shocks and macroeconomic imbalances in the 1980s, Egypt's external debt indicators worsened with the external

debt stock jumping to $46.1 billion in 1988 along with a high external debt to GDP ratio of 131.9% and an external debt service to exports ratio of 41%.

Table (1) External Debt Indicators in Selected Years

Indicator	1975	1980	1988	1990	2000	2004	2010	2013	2014	2020
External Debt (current US $, billion)	4.8	19.1	46.1	33.0	29.2	31.4	36.8	46.5	41.7	129.8
External Debt (% of GDP)	41.6	88.3	131.9	76.8	29.3	39.9	16.8	16.1	13.7	33.8
External Debt Service (% of exports of goods and services)	14.5	18.7	41.0	35.1	11.4	9.8	6.6	7.0	13.8	28.8
Total international reserves (% of total external debt)	11.1	13.0	4.9	11.0	47.2	48.8	100.7	35.6	35.8	30.0
Short-term debt (% of total external debt)	23.2	21.1	14.9	13.5	14.0	5.5	8.6	6.1	8.0	9.2
Short-term debt (% of total international reserves)	210.1	162.4	303.9	122.9	29.8	11.2	8.5	17.0	22.2	30.7

Source: World Bank, World Development Indicators (WDI)

In the early 1990s, it was concluded that the Egyptian economy was facing several structural macroeconomic imbalances along with concerning external debt indicators. Thus, the Government of Egypt (GoE) started an economic reform and structural adjustment program (ERSAP) in 1991 supported by a stand-by arrangement from the International Monetary Fund (IMF) and a structural adjustment loan from the World Bank besides the bilateral debt forgiveness from the United States and

the Gulf Cooperation Council (GCC) countries (Mohieldin and Kouchouk, 2003). After the ERSAP, the macroeconomic stance and external debt indicators improved largely as the external debt to GDP ratio showed a declining trend in the 1990s reaching 29.3% in 2000 compared to 76.8% in 1990 as illustrated in figure (1). Furthermore, the percentage of total international reserves to total external debt increased to 47.2% in 2000 compared to 4.9% in 1990, whereas the external debt service to exports ratio declined from 35.1% in 1990 to 11.4% in 2000.

However, the ERSAP did not succeed in achieving a structural change towards the productive economic sectors, and hence Egypt's growth record was weak during the 1990s and the majority of domestic resources and funds from external borrowing was directed towards mega projects (Helmy, 2021). Meanwhile, the external sources of income and foreign exchange were negatively affected in the late 1990s by three main shocks which are the fall in international oil prices, the 1997 Asian financial crisis, and the 1997 Luxor terrorist attack (Mohieldin and Kouchouk, 2003). Consequently, the remaining trade deficits in the 1990s along with the declining foreign exchange inflows and the 2003 domestic currency devaluation have resulted in a rise in external debt stock and external debt to GDP ratio which reached $31.4 billion and 39.9% respectively in 2004.

As a result of the severe challenges that faced the Egyptian economy during 1997-2003, the GoE launched a package of

economic reform measures in 2004 with the aim of improving the economic growth record in addition to the fiscal stance and external sector performance. Following these reform measures, the performance of the budget sector and external sector improved during 2004-2007 which was marked by an increase in tax revenues, FDI inflows, tourism revenues, and export proceeds (El Mahdy et al., 2022). Accordingly, the external debt to GDP ratio declined to 26.5% in 2007. Nevertheless, the repercussions of the 2008-2009 global financial crisis have hindered the growth performance and caused a significant fall in foreign exchange inflows, and thus the external debt stock increased to $36.8 billion in 2010 but with an acceptable external debt to GDP ratio of 16.8%.

The second decade of the 2000s started with a rise in political instability following the 2011 Arab Spring, and such political turmoil resulted in a rise in trade deficit besides a fall in foreign exchange inflows, and thus a sharp decline in total international reserves as depicted by the percentage of total international reserves to total external debt which reached 35.6% in 2013 compared to 100.7% in 2010. This was followed by a significant rise in external debt stock to $46.5 billion in 2013 in an attempt to build the drying up total international reserves. But the external debt stock and external debt to GDP ratio declined to $41.7 billion and 13.7% respectively in 2014 as a result of the grants received from GCC countries (Sharaf, 2022).

Conversely, the external debt to GDP ratio started to rise since 2015 and reached 33.8% in 2020 after showing a declining trend since 2005 as depicted in figure (1). Moreover, the external debt stock increased largely during 2015-2020 reaching $129.8 billion in 2020. Such sharp increase in external debt stock can be explained by several factors including the drying up of total international reserves after the domestic currency devaluation in November 2016, the shift towards external borrowing after the IMF's extended fund facility in 2016 and its associated financing package from the World Bank, African Development Bank, and other bilateral partners such the GCC, in addition to the increase in the international Eurobond issuances by the GoE (Alnashar, 2019). However, it should be noticed that short-term debt as a percentage of total external debt was 9.2% implying that the maturity of Egypt's external debt remained in its favorable position even with such rising external debt stock.

In this way, the evolution of Egypt's external debt since the mid-1970s shows that there are main sources for external debt accumulation. Among these sources are the macroeconomic determinants such as savings-investment gap, trade deficit, government budget deficit, and total external debt service. Thus, this paper investigates the macroeconomic determinants of external debt accumulation in Egypt by specifying an econometric model that includes gross domestic savings,

government final consumption expenditure, trade openness, and total external debt service among the regressors.

4. Methodology

This paper adopts Johansen cointegration test and estimates a VECM to identify the macroeconomic determinants of external debt accumulation in Egypt using annual data covering the time period from 1977 to 2020.

4.1 Model Specification and Data

The review of theoretical literature and empirical evidence on the sources of external debt accumulation showed that there are several macroeconomic factors that affect external borrowing. Accordingly, the specified model for investigating the macroeconomic determinants of external debt accumulation takes the following form:

$$ED = f(SAV, GCE, OP, TDS) \qquad (2)$$

In the above model, ED is external debt to GDP ratio, SAV is gross domestic savings as a percentage of GDP, GCE is general government final consumption expenditure as a percentage of GDP, OP is trade openness proxied by trade as a percentage of GDP, and TDS is total external debt service as a ratio of exports of goods and services.

The source for the annual data of the model variables is the World Development Indicators (WDI) of the World Bank. All the variables are expressed in their natural logarithms, and hence the baseline regression equation can be represented as follows:

$$\ln ED_t = \alpha_0 + \alpha_1 \ln SAV_t + \alpha_2 \ln GCE_t + \alpha_3 \ln OP_t + \alpha_4 \ln TDS_t + \varepsilon_t \quad (3)$$

Where α_0 is the constant term, α_1 till α_4 are the coefficients of model variables, and ε_t is the white noise error term.

4.2 Econometric Technique

Time-series regression usually starts with unit root tests and then follows to conducting cointegration tests or estimating vector autoregression (VAR) models in first differences if the variables are nonstationary. This paper follows the same methodology as illustrated in the following steps.

4.2.1 Unit Root Tests

Based on the econometric literature on empirical economic relationships that involve economic time series, it was realized that the time series should be stationary in order to apply standard inference procedures in studying such economic relationships (Dolado et al., 2003). However, most economic time series are characterized by being nonstationary. Such nonstationary time series have time varying means and variances, and hence will not reliable when used for the purpose of statistical forecasting (Lin and Brannigan, 2003).

More interestingly in this regard is that Granger and Newbold (1974) found that regressing nonstationary time series on each other might result in a significant statistical relationship as denoted by significant t-statistics and high coefficient of determination (R^2) even if these time series are unrelated in the

economic sense. This phenomenon was then known as spurious regression problem and has been thoroughly considered by econometricians since the mid-1970s. In this way, the econometric estimation of time series should start with the unit root tests that check the stationarity of the variables included in the model. Thus, the econometric estimation of the proposed model will start by checking the stationarity of all variables using two well-known unit root tests which are Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test.

4.2.2 Johansen Cointegration Test

In an attempt to deal with non-stationarity, the econometricians started to take differences of the time series to become stationary. Nevertheless, some econometricians criticized the estimation of dynamic models in differenced variables only, since differencing will ignore the deviations of model's variables from their long-run equilibrium relationship given that studying such deviations is important in several economic relationships that are characterized by a long-run equilibrium relationship (Dolado et al., 2003). In the light of the importance of such long-rum equilibrium relationships, Clyve Granger and Robert Engle devoted of much their attention in the 1980s to studying the concept of cointegration. According to Engle and Granger (1987), a vector of nonstationary variables could have one or more linear combinations that are stationary in levels, $I(0)$.

Consequently, Engle and Granger (1987) developed a cointegration test that is based on a two-step procedure for checking the stationarity of the residual series generated from the regression of the nonstationary time series on each other. Although the Engle-Granger cointegration test is easily implemented, it is not applicable when there is a possibility of detecting more than one cointegrating vector since it does not have a systematic procedure for separately estimating multiple cointegrating vectors (Enders, 2015).

Thus, Johansen (1988) introduced a cointegration test that can check for the existence of multiple cointegrating vectors for variables that are integrated of order 1, $I(1)$. The Johansen cointegration test is based on two likelihood ratio tests which are trace test and maximum eigenvalue test. Both likelihood ratio tests rely heavily on the relationship between the rank of cointegration matrix (π) and its characteristic roots, given that the rank (r) of the cointegration matrix is equal to the number of cointegrating vectors (Enders, 2015). Based on Johansen (1988) as well as Johansen and Juselius (1990), the test statistics for the two likelihood ratios can be calculated using the following equations:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1-\lambda_i) \qquad (4)$$

$$\lambda_{max}(r, r+1) = -T \ln(1-\lambda_{r+1}) \qquad (5)$$

where T is the number of observations, n is the number of variables, λ_i is the estimated values of the characteristic roots (also known as eigenvalues) obtained from the cointegration matrix, and r is the rank of the cointegration matrix.

The hypotheses for each of these tests are different. On the one hand, the trace test is testing the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of *n* cointegrating vectors. On the other hand, the maximum eigenvalue test is testing the null hypothesis of *r* cointegrating vectors against the alternative hypothesis of $r + 1$ cointegrating vectors.

Since the implementation of Johansen cointegration test requires the determination of the optimal lag length, an unrestricted VAR model of the model variables is firstly estimated and then the optimal lag length for Johansen cointegration test will be determined using the different information criterion.

4.2.3 Vector Error Correction Model (VECM)

According to Engle and Granger (1987), if cointegration was proved to exist between nonstationary time series, then an error correction model can be estimated to show the short-run and long-run dynamics of the model. In such an error correction model, the error correction term will show the speed with which the model variables converge towards their long-run equilibrium. In the context of the paper's specified model, there is a vector of variables, and thus a VECM will be estimated taking the form of

a VAR lagged first differences in addition to a lagged error correction term. This VECM will take the following form:

$$\Delta \ln ED_t = \alpha_0 + \alpha_1 \sum_{i=1}^{p} \Delta \ln ED_{t-i} + \alpha_2 \sum_{i=1}^{p} \Delta \ln SAV_{t-i} + \alpha_3 \sum_{i=1}^{p} \Delta \ln GCE_{t-i} + \alpha_4 \sum_{i=1}^{p} \Delta \ln OP_{t-i} + \alpha_5 \sum_{i=1}^{p} \Delta \ln TDS_{t-i} + \lambda_1 ECT_{t-1} + \varepsilon_t \quad (6)$$

Where Δ is the first difference operator, p is the lag length, α_0 is the constant term, α_1 till α_5 are the short-run coefficients, and ECT_{t-1} is the lagged error correction term. For convergence towards the long-run equilibrium to take place, ECT_{t-1} should be negative and statistically significant.

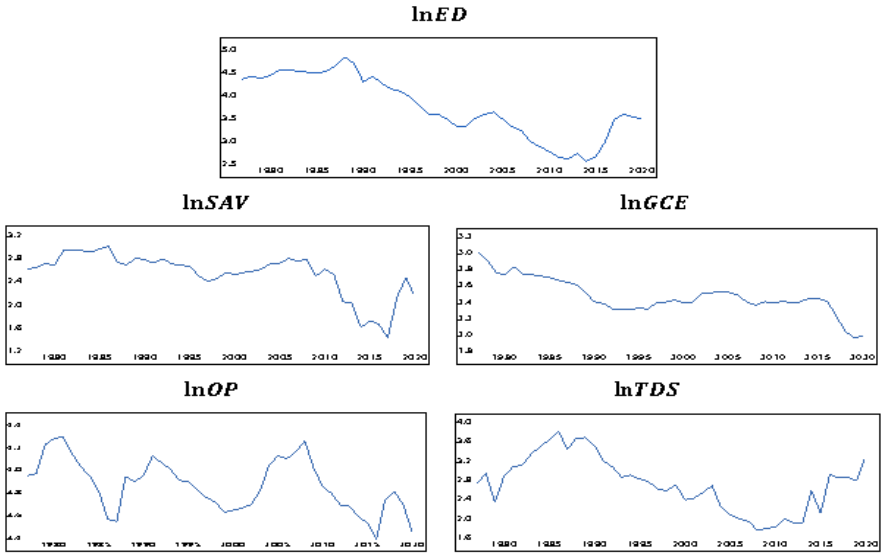
Finally, the diagnostic tests of the VECM should be conducted by checking the model's residuals against serial correlation, non-normality, and heteroskedasticity. Furthermore, the stability of the VECM is tested using the plots of recursive residuals known as cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ).

5. Results

The econometric estimation starts with detecting whether the time series are stationary over time firstly by plotting the different time series during 1977-2020 as depicted in figure (2).

The graphs of time series indicate that all variables have an intercept but without a trend. Hence, ADF and PP unit root tests are conducted, while assuming that all time series have an intercept. The results of unit root tests are obtained from EViews 12 and summarized in table (2).

Figure (2) Graphs of Model Variables



The results of ADF and PP unit root tests show that all the model variables are nonstationary, since the null hypothesis of a unit root was not rejected for all the variables in level, whereas all the variables become stationary in their first difference implying that all the model variables are integrated of order one, $I(1)$ as illustrated in table (2).

Table (2) Results of Unit Root tests

Variable	ADF		PP		Order of Integration
	Level	First Difference	Level	First Difference	
lnED	-1.336	-4.198***	-1.129	-4.235***	$I(1)$
lnSAV	-1.509	-6.509***	-1.571	-6.508***	$I(1)$
lnGCE	-1.469	-4.139***	-1.503	-4.115***	$I(1)$
lnOP	-1.651	-4.879 ***	-1.929	-4.798***	$I(1)$
lnTDS	-0.981	-8.844***	-1.351	-8.508***	$I(1)$

*** Significant at 1%, ** Significant at 5%, * Significant at 10%
Null Hypothesis: The series contains a unit root
Reported values represent the t-statistics
Lag length for ADF test is automatically selected using Schwarz Information Criterion

Since all the model variables are $I(1)$, then the next step is detecting whether the time series are cointegrated using Johansen cointegration test. However, an unrestricted VAR model of the specified variables is firstly estimated to determine the optimal lag length for Johansen cointegration test using different information criterion. The findings of VAR lag order selection criteria indicate that one year lag is the optimal lag as shown in table (3). Thus, Johansen cointegration test was conducted with one lag and the results of both trace and maximum eigenvalue tests are summarized in table (4).

Table (3) VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-16.322	NA	1.81e-06	0.969	1.172	1.044
1	167.826	318.074*	1.32e-09*	-6.265*	-5.048*	-5.814*
2	188.398	30.858	1.69e-09	-6.063	-3.833	-5.236
3	206.664	23.247	2.59e-09	-5.757	-2.513	-4.554

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table (4) Results of Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)			
Hypothesized No. of Cointegrating Equations	Eigenvalue	Trace Statistic	0.05 Critical Value
None *	0.561	69.974	69.819
At most 1	0.349	33.717	47.856
At most 2	0.243	14.835	29.798
At most 3	0.051	2.588	15.495
At most 4	0.007	0.304	3.841
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)			
Hypothesized No. of Cointegrating Equations	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value
None *	0.561	36.257	33.877
At most 1	0.349	18.882	27.584
At most 2	0.243	12.247	21.132
At most 3	0.051	2.284	14.265
At most 4	0.007	0.304	3.841

Both trace and max-eigenvalue tests indicate 1 cointegrating equation at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The results of both trace and maximum eigenvalue tests reveal that there is one cointegrating equation. This implies that Egypt's external debt, gross domestic savings, general government consumption expenditure, trade openness, and total debt service have a long-run equilibrium relationship. Accordingly, the cointegrating vector is normalized by external debt and the normalized cointegrating coefficients are represented in table (5).

Table (5) Normalized Cointegrating Coefficients

lnED	Constant	lnSAV	lnGCE	lnOP	lnTDS
1.000	7.089	0.979	-1.477	-1.603	-1.253
		(0.234)	(0.264)	(0.339)	(0.109)
		[4.187]***	[-5.592]***	[-4.723]***	[-11.436]***

Figures in brackets and square brackets are standard errors and *t*-statistics respectively

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Based on the normalized cointegrating coefficients, the long-run cointegrating equation can be represented by equation (7), given that the signs of normalized cointegrating coefficients were reversed to estimate the long-run cointegrating equation.

$$\ln ED_t = -7.089 - 0.979 \ln SAV_t + 1.477 \ln GCE_t + 1.603 \ln OP_t + 1.253 \ln TDS_t \quad (7)$$

[4.187] [-5.592] [-4.723] [-11.436]

Long-run cointegrating equation shows that the coefficients of all regressors are statistically significant at 1% and this confirms the existence of a long-run equilibrium relationship between the model variables. On the one hand, the results reveal

a negative relationship between gross domestic savings and external debt accumulation, given that a 1% increase in gross domestic savings results in about 0.98% decrease in external debt. This indicates that when gross domestic savings increase, the savings-investment gap will be reduced resulting in less dependence on external borrowing. Such negative relation between gross domestic savings and external debt accumulation is consistent with the findings of some empirical studies such as Ozata (2017) and Adamu (2019).

On the other hand, the results indicate that external debt accumulation is positively related to government final consumption expenditure, trade openness, and total external debt service. The results show that a 1% increase in government final consumption expenditure leads to about 1.5% increase in external debt. This positive relationship between external debt accumulation and government final consumption expenditure implies that the increase in government expenditures fuels government budget deficit given the insufficient government revenues, and this results in more dependence on external borrowing for financing such budget deficits. This finding is supported by other empirical studies like Waheed (2017) and Azolibe (2021).

Furthermore, a 1% increase in trade openness results in about 1.6% increase in external debt and this positive relationship between trade openness and external debt accumulation can be explained by the dependence on external borrowing to finance

the trade deficits that accumulated since the mid-1970s in Egypt due to the lack of an industrial development program that is complemented with an export-promotion strategy. Such result is complying with the findings of some empirical studies such as Awan et al. (2015) and Dawood et al. (2021).

Finally, a 1% increase in total external debt service leads to about 1.2% increase in external debt which indicates that the rise in external debt burden can result in future external borrowing, and this in turn, might induce a vicious cycle between external debt and debt service payments. This conclusion is consistent with the results of Imimole et al. (2014) and Beyene and Kustoz (2020).

The results of the vector error correction model (VECM) are represented in table (6). The coefficient of the lagged error correction term (ECT_{t-1}) is negative and statistically significant, which implies that there is a convergence by the model variables towards their long-run equilibrium relationship. Moreover, the lagged error correction term is -0.218 and this indicates that about 22% of previous year's disequilibrium from long-run equilibrium is adjusted in current year, and thus it takes about 5 years for the model variables to converge towards their long-run equilibrium relationship.

Table (6) Results of Vector Error Correction Model

Dependent Variable: $\Delta\ln ED_t$

Variable	Coefficient	Standard Error	t-statistic
ECT_{t-1}	-0.218***	0.069	-3.181
$\Delta\ln ED_{t-1}$	0.405**	0.151	2.674
$\Delta\ln SAV_{t-1}$	0.004	0.129	0.034
$\Delta\ln GCE_{t-1}$	0.056	0.395	0.143
$\Delta\ln OP_{t-1}$	-0.517***	0.183	-2.819
$\Delta\ln TDS_{t-1}$	-0.213**	0.105	-2.034
$Constant$	-0.007	0.024	-0.301

$R^2 = 0.437$ Adjusted $R^2 = 0.346$ F-statistic = 4.79

Prob(F-statistic) = 0.001 DW = 2.09

*** Significant at 1%, ** Significant at 5%, * Significant at 10%

Furthermore, the findings of the diagnostic tests for the VECM's residual are summarized in table (7). Since the null hypotheses are rejected for all tests, it can be concluded that the model's residual is normally distributed with no serial correlation and heteroskedasticity problems.

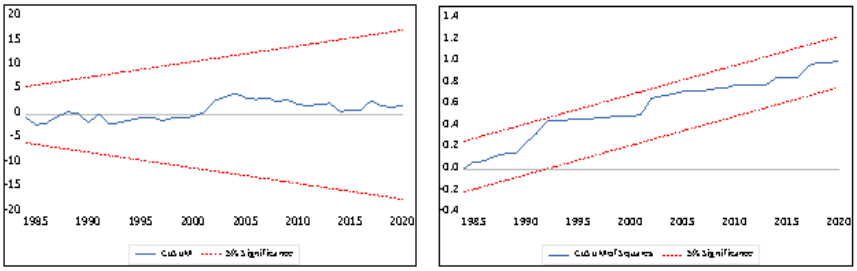
Table (7) Results of Diagnostic Tests

Test	Test Statistic	p-value
LM Serial Correlation Test	LRE* stat = 23.087 Rao F-stat = 0.921	0.572 0.577
Jarque-Bera Test for Normality	Jarque-Bera = 9.230	0.510
White Heteroskedasticity Test	Chi-square = 190.279	0.285

In addition, the stability of the model is checked using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ)

as depicted in figure (3). The VECM satisfies the stability condition since the plots of CUSUM and CUSUMSQ lie between the upper and lower bounds indicating that that there is no root lying outside the significance level of 5%.

Figure (3) CUSUM and CUSUMSQ Plots



6. Conclusion

The evolution of Egypt's external debt since the mid-1970s shows that external debt stock has grown largely in most of the years, though external debt has shown a declining trend in the 1990s and during 2004-2007. Recently, there are rising concerns regarding external debt growth given that the external debt stock has grown largely since 2016 reaching $129.8 billion in 2020. However, the review of empirical studies implies that the studies on the determinants of external debt accumulation in Egypt are few. Thus, this paper adopts Johansen cointegration and estimates a VECM to identify the macroeconomic determinants of external debt in Egypt during 1977-2020.

The results of Johansen cointegration test reveal that there is a long-run equilibrium relationship between the model variables. In this regard, the long-run cointegrating equation implies that gross domestic savings are negatively related to external debt accumulation in Egypt, whereas government final consumption expenditure, trade openness, and total external debt service contribute positively to external debt accumulation in Egypt.

Based on the above results, there are some policy recommendations that can be suggested to deal with the growth of Egypt's external debt. Among these recommendations is devoting more efforts towards achieving higher economic growth rates and saving more from such generated income to reduce the savings-investment gap and hence, reduce the dependence on external borrowing. Meanwhile, the GoE should try to increase its revenues by providing support for private sector investment to generate more income, and thus widen the tax base. In addition, the funds acquired from external borrowing should be diverted to investment in highly-productive projects that generate higher rates of return in excess of the interest on external debt, which in turn, will decrease the external debt service burden and help the government avoid a vicious cycle between external debt and debt service payments.

Moreover, it appears that there is a need for designing and implementing an effective industrialization program with an export promotion strategy to reduce the foreign exchange gap and the dependence on external debt. In addition, the GoE should maintain

the current favorable maturity structure of external debt in which the short-term debt represents a small percentage of total external debt, so that to ensure the sustainability of Egypt's external debt.

Finally, although this paper is trying to fill the research gap in investigating the determinants of Egypt's external debt, it still has some limitations. Mainly, the paper is restricted to macroeconomic determinants of external debt, future research can extend the analysis by including other factors such as political instability, institutional quality, and external factors like shocks in international commodity prices. Furthermore, the econometric model is estimated using annual data, and thus future research can depend on quarterly data while uncovering the determinants of external debt in Egypt.

References:

Abdu, M. I. (2020). Egypt Public Debt Dynamic and its' Trajectory Projection. *Global Journal of Management and Business Research*, *20*(7), 14-29.

Adamu, I. M. (2019). Re-visiting the Drivers for Increasing External Debt. *Journal of Contemporary Issues and Thought*, *9*, 40-53.

Al-Fawwaz, T. M. (2016). Determinants of external debt in Jordan: An empirical study (1990–2014). *International Business Research*, *9*(7), 116-123.

Alnashar, S. B. (2019, December). *What are the Drivers of Egypt's Government Debt?*. Economic Research Forum (ERF), 1376.

Awan, A., Asghar, N., & Rehman, H. U. (2011). The Impact of Exchange Rate, Fiscal Deficit and Terms of Trade on External Debt of Pakistan. *Australian Journal of Business and Management Research*, *1*(3), 10.

Awan, R. U., Anjum, A., & Rahim, S. (2015). An Econometric Analysis of Determinants of External Debt in Pakistan. *British Journal of Economics, Management & Trade*, *5*(4), 382-391.

Azolibe, C. B. (2021). Determinants of External Indebtedness in Heavily Indebted Poor Countries: What Macroeconomic and Socio-Economic Factors Matter?. *The American Economist*, *66*(2), 249-264.

Bacha, E. L. (1990). A Three-Gap Model of Foreign Transfers and the GDP Growth Rate in Developing Countries. *Journal of Development economics*, *32*(2), 279-296.

Bader, M., & Magableh, I. K. (2009). An Enquiry into the Main Determinants of Public Debt in Jordan: An Econometric Study. *Dirasat Administrative Science, 36*(1), 181-190.

Beyene, S. D., & Kotosz, B. (2020). Macroeconomic Determinants of External Indebtedness of Ethiopia: ARDL Approach to Co-integration. *Society and Economy*, *42*(3), 313-332.

Chenery, H. B., & Strout, A. M. (1966). Foreign Assistance and Economic Development. *The American Economic Review*, *56*(4), 679–733.

Dawood, M., Baidoo, S. T., & Shah, S. M. R. (2021). An Empirical Investigation into the Determinants of External Debt in Asian Developing and Transitioning Economies. *Development Studies Research*, *8*(1), 253-263.

Dolado, J., J. Gonzalo, and F. Marmol (2003). *Cointegration*. In Baltagi, B. H. (Ed.), A Companion to Theoretical Econometrics. Blackwell Publishing, 634-654.

Domar, E. D. (1946). Capital Expansion, Rate of Growth, and Employment. *Econometrica*, *14*(2), 137–147.

El Mahdy, A., Toraeh, N., & Mohamed, R. O. (2022). External Debt and Economic Growth in Egypt. *Scientific Journal for Research and Business Studies*, *36*(4), 153-177.

Enders, W. (2015). *Applied Econometric Time Series* (4th ed). Wiley.

Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, *55*(2), 251–276.

Ghaly, S. B. (2023). External Debt in Time of Inflation in Egypt: A Vector Error Correction Model. *Scientific Journal for Financial and Commercial Studies and Research*, *4*(1), 661-701.

Granger, C. W., & Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics*, *2*(2), 111-120.

Harrod, R. F. (1939). An Essay in Dynamic Theory. *The Economic Journal*, *49*(193), 14–33.

Helmy, H. E. (2022). The External Debt-Inflation Nexus in Egypt. *Journal of Public Affairs*, *22*, e2802.

Imbs, J., & Ranciere, R. (2005). *The Overhang Hangover*. World Bank Policy Research Working Papers, 3673.

Imimole, B., Imoughele, L. E., & Okhuese, M. A. (2014). Determinants and Sustainability of External Debt in a Deregulated Economy: A Co-integration Analysis from Nigeria (1986–2010). *American International Journal of Contemporary Research 4*(6): 201–214.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control*, *12*(2-3), 231-254.

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169-210.

Krugman, P. (1988). Financing vs. Forgiving a Debt Overhang. *Journal of Development Economics*, *29*(3), 253-268.

Lin, Z., & Brannigan, A. (2003). Advances in the Analysis of Non-stationary Time Series: An Illustration of Cointegration and Error Correction Methods in Research on Crime and Immigration. *Quality and Quantity*, *37*, 151-168.

Mohieldin, M. & Kouchouk, A. (2003*). On Exchange Rate Policy: The Case of Egypt 1970-2001*. Economic Research Forum (ERF), 0312.

Mulugeta, E.T. (2021). Macroeconomic Determinants of External Debt Accumulation in Ethiopia: An ARDL Bound Testing Approach. *African Journal of Economics and Sustainable Development*, *4*(2), 1-28.

Özata, E. (2017). Determinants of External Debt Accumulation in Turkey: Evidence from an ARDL Bound Test Approach, *4*(4), 134-143.

Sa'ad, S. A., Umar, A. T., Waziri, S. I., & Maniam, G. S. (2017). External Debt Burden and its Determinants in Nigeria: An ARDL Cointegration Technique. *Journal of Economics and Sustainable Development*, *8*(12), 31-37.

Sharaf, M. F. (2022). The Asymmetric and Threshold Impact of External Debt on Economic Growth: New Evidence from Egypt. *Journal of Business and Socio-economic Development*, *2*(1), 1-18.

Taylor, L. (1994). Gap Models. *Journal of Development Economics*, *45*(1), 17-34.

Tiruneh, M. W. (2004). An Empirical Investigation into the Determinants of External Indebtedness. *Prague Economic Papers*, *3*(2004), 261-277.

Udoh, E., & Rafik, R. (2017). Determinants and Transmission Channel of External Debt: Evidence from Malaysia. *Asian Journal of Economics, Business and Accounting*, *4*(1), 1-10.

Waheed, A. (2017). Determinants of External Debt: A Panel Data Analysis for Oil & Gas Exporting and Importing Countries. *International Journal of Economics and Financial Issues*, *7*(1), 234-240.