Response of Fiscal Policies to the Cyclical Fluctuation of Output and Expenditure for Sustainable Debt in Egypt: An Empirical Study

استجابة السياسات المالية للتقلبات الدورية للإنتاج والانفاق لاستدامة الدين في مصر: دراسة تجريبية

Assoc. Prof. Dr. Mohamed Fathy Abdelgany
mfathy@eps.bsu.edu.eg & office@egypt.at
Head of the Economics Department, Faculty of Politics and Economics, Beni-Suef University, Egypt

Abstract

Governments strive to achieve the country's development by setting up big projects that may need massive financing, thus resorting to debt; a weak response to cyclical output and expenditure gaps may cause a breakdown in the financial balance, insolvency, and debt explosion. The rising public debt in Egypt has caused a big concern about solvency and debt sustainability. This paper examines whether Egypt's debt is sustainable and assesses its solvency. Moreover, estimating the reaction function of fiscal policies.

The study uses an empirical approach. That utilizes annual series data for the period 1990 to 2020. and applies the ARDL bounds testing method to capture the effect of long-run linkage between variables and employs it in two forms. The first estimate sustainable debt by estimating the regression of public revenues on public expenditures. In the second, the study employs three separate models to examine the effect of public debt as a total, external, and domestic besides output gap, expenditure gap, oil price, and exchange rate as regressor variables on primary budget balance regressed variables. This study found debt is sustainable, and the fiscal policy is countercyclical in public debt and external but weak. And it is procyclical in the domestic model. Furthermore, the oil prices negatively affect the primary budget balance, while the devaluation of the local currency positively affects it. The study recommended that there is a need to achieve a primary surplus in the coming years and to take robust countercyclical policies to maintain the sustainability of the debt.

Keywords: Sustainable Debt- Solvency - Domestic Debt - External Debt - Output and Expenditure Gap– Egypt – ARDL

المستخلص:

تسعى الحكومات جاهدة لتحقيق التنمية في البلاد من خلال إقامة مشاريع كبيرة قد تحتاج إلى تمويل ضخم، وبالتالي تلجأ إلى الديون؛ وقد تؤدي الاستجابة الضعيفة للتقلبات الدورية في الإنتاج والإنفاق إلى انهيار التوازن المالي، وعدم القدرة على السداد، وانفجار الديون. تسبب ارتفاع الدين العام في مصر في قلق كبير بشأن الملاءة المالية والقدرة على تحمل الديون. تبحث هذه الورقة فيما إذا كانت ديون مصر يمكن تحملها وتقيم ملاءتها المالية. علاوة على ذلك، تقدير دالة رد الفعل للسياسات المالية. تستخدم الدراسة نهجا تجريبيا. يستخدم ذلك بيانات السلاسل السنوية للفترة من 1990 إلى 2020. ويطبق طريقة اختبار حدود ARDL لالتقاط تأثير الارتباط طويل المدى بين المتغيرات وتوظيفه في صيغتين. الأول يقدر الدين المستدام من خلال تقدير انحدار الإيرادات العامة على النفقات العامة. وفي الثانية، استخدمت الدراسة ثلاثة نماذج منفصلة لفحص تأثير الدين العام كإجمالي، وخارجي، ومحلي، إلى جانب فجوة الإنتاج، وفجوة الإنفاق، وأسعار النفط، وسعر الصرف كمتغيرات ارتدادية على متغيرات انحدار الميزانية الأولية. وجدت الدراسة أن الدين يمكن تحمله، والسياسة المالية هي معاكسة للتقلبات الدورية في نموذج الديون العام ونموذج الديون الخارجية لكنها ضعيفة. وهي مسايرة للاتجاهات الدورية في نموذج الدين المحلي. علاوة على ذلك، تؤثر أسعار النفط سلبًا على رصيد الميزانية الأولية، بينما يؤثر انخفاض قيمة العملة المحلية عليها بشكل إيجابي. وأوصت الدراسة بضرورة تحقيق فائض أولي في السنوات القادمة واتخاذ سياسات قوية لمواجهة التقلبات الدورية للحفاظ على استدامة الدين.

الكلمات المفتاحية: الدين المستدام - الدين المحلي - الدين الخارجي - فجوة الإنتاج والإنفاق – مصر.

1. Introduction

Egyptian governments are keen to provide the basic needs required to achieve the desired development. Still, they often face the problem of the inability to finance the planned expenditures from available public revenues. On the other hand, many internal and external variables affect Egyptian revenues and spending, sometimes requiring urgent funding that burdens the budget. Thus, the fiscal deficit arises in the state public budget that should be financed by borrowing from local or external sources.

The continuous dependence on loans to finance the fiscal deficit has accumulated debt in several countries, including Egypt. The Egyptian economy has confronted waves of debt accumulation over the years. In recent years, Egypt has relied particularly on debt to finance its budget deficit. In addition, the January 25 revolution caused an increase in the financial burden

and the disruption of many vital economic activities in many productive sectors, which resulted in slowing economic growth and increasing consumption expenditure.

Public debt sustainability and the government's solvency have become a cause for concern and raise questions. It has emerged as the most critical issue that concerns public opinion, fiscal policymakers, and researchers in various world countries, including Egypt.

Beyond that, the Egyptian economy is facing complex challenges from the harmful effects of the outbreak of the Russian-Ukrainian war. for instance, rising energy and grain prices, limitations in supply chains, and a decline in tourism revenue. And above all, the central banks raised their interest rate and devaluated their local currencies. All these things set intense pressure on the stability of foreign inflow sources, particularly the extension of external sources of debt.

On the other hand, debt sustainability concepts, criteria, and measurement methods have developed to include other factors. However, the literature does not agree on determining situations in which debt is considered sustainable, which the research shows later.

This study aims to determine to what extent the sovereign debt is sustainable and solvency in Egypt and assess the financial policy reaction to confronting Egypt's output and expenditure fluctuation from 1990 to 2020.

The study uses an empirical approach. That analysis uses the ARDL bounds testing technique to capture the effect of long-run linkage between variables and applies it in two phases. The first one estimates debt sustainability by estimating the regression of public revenues on public expenditures, which is utilized as a primary indicator in most literature to detect the fulfillment of the sustainable debt condition. In the second phase, the study employs three separate models to examine the effect of public debt as a total, domestic, and external, besides output, expenditure gap, and oil price and exchange rate as regressor variables on primary balance as regressed variables.

The estimation in each model applies in three steps. The first is to explore the impact of debt fluctuations and the production and expenditure gap. In the second step, add exchange rate and oil price fluctuations, while in the third step, add stability status as a dummy variable.

This study depends on the Fiscal Reaction Function approach that is based on examining the behavior of government response to fluctuations of output and expenditure gap to control the primary balance, which ensures that the debt does not explode and fulfilling intertemporal budget constraints. Moreover, it is conscience with the literature from Bonn 1998 and 2007, Blanchard 1985 and 1993, Trehan & Walsh 1991, and others (Blanchard 1985, Trehan and Walsh 1988, Blanchard, Chouraqui, et al. 1991, Trehan and Walsh 1991, Blanchard 1993, Bohn 1998, Bohn 2007).

The study expects that the Egyptian debt will be sustainable and bearable. It also predicts that there will be a positive impact on the output gap, the expenditure gap, and the exchange rate, while the effect of the oil prices will be negative on the primary balance.

The study design is as follows. The second section is a detailed review of the literature, including the theoretical study of the research. The third section debates the crises, fiscal policy response, and Egypt's Debt status quo. The fourth section is devoted to the empirical investigation, and the last is the conclusions and recommendations.

2. Literature Review

IMF defines debt sustainability as "a situation in which a borrower is expected to be able to continue servicing its debts without an unrealistically large future correction to the balance of income and expenditure" (IMF 2002). From this definition, it can be concluded that:

- Accumulated debts need to be restructured at present or in the future.
- The situation of borrowing to pay off debt service arises due to the increasing inability to service this debt (Ponzi game).
- A situation of exceeding the current expenditures + the present value of the expected future expenditures for the value of the current revenues + the present value of the expected future revenues. (IMF 2002). In this sense, sustainability also includes the concepts of solvency and liquidity without defining a sharp separation between them and a reaction to financial policies. (The present value budget constraint)

Thus, assessing debt sustainability consider vexing; the difficulty is that it is about predicting the future. Estimating something in the future is related to

probabilities. Therefore, there is no single benchmark that is accurate and widespread. Hence, the issue of debt sustainability remains elusive. (Wyplosz 2005).

However, literature has defined four main approaches for assessing debt sustainability: the primary debt stabilization equilibrium, the IMF approach, the Value-at-Risk approach, and the fiscal reaction function method.

2.1 Measuring Debt Sustainability Approaches

2.1.1 Debt Stabilizing Primary Balance approaches

The debt-stabilizing primary balance considers the classical approach. Its meaning stabilizes the debt at its current or desired level, which examines the value of the primary balance needed to stabilize the debt. It measures the current debt-to-GDP ratio and calculates the primary balance at which the debt-to-GDP ratio would be unchanged. It matches interest rate and growth rate, i.e., the evolution of the real interest rate and the potential growth rate (Wyplosz 2007).

Eduardo Ley argued that it is an equation derived from budget constraints and expresses the difference between two terms, interest-rate growth differential (IRGD), Which is interest rate minus the growth rate (Ley 2009).

Escolano et al. argue that IRGD is affected by per capita GDP in many emerging markets or low-income economies. They emphasized that negative IRGD leads to lower debt ratios or stabilization, even if there is an initial deficit.

Since its growth is outpacing the interest rate, it needs less fiscal effort to stabilize the debt-to-GDP ratio (Escolano, Shabunina et al. 2011).

Ferrarini and Ramayandi confirmed this finding by applying to "Public Debt Sustainability in Developing Asia. They showed that as long as the IRGD is negative and the debt-to-GDP ratio is declining, the government can borrow at a lower interest rate (Ferrarini and Ramayandi, 2012).

2.1.2 IMF Approach

The International Monetary Fund (IMF) has introduced a standardized methodology for developed and emerging countries to assess debt sustainability that can be applied to all countries (Krueger 2002).

It consists of two components: the analysis of the sustainability of the total public debt and the total external debt, which is implemented through the following four steps (Abbas and Alex_ Rogoff 2020):

1. Identify the variables affecting the development of debt for five years: primary account, GDP growth rate, interest rate, exchange rate, and inflation.

2. Calculate the resulting development in the debt-to-GDP ratio over the next five years using an equation like that of the primary equilibrium approach to debt stabilization.

3. It tests the effect of shocks of previous variables on debt by separately shocking each of the three variables, interest rate, GDP growth, and current primary account. Then after that, all the variables are shocked together simultaneously. The exchange rate is depreciated only once, at 30%, and at the beginning of the simulation period.

4. Judging debt levels by stress tests as to whether one or all the results are incredibly high for the debt to be considered sustainable.

The IMF's approach to debt sustainability analysis distinguishes between countries based on their ability to access markets.

IMF uses Country Policy and Institutional Assessment (CPIA) through 12 indicators. Countries are classified into three groups according to the CPIA index (Wyplosz 2011).

for the low-income countries (LICs.) IMF provides concessional financial support through the Poverty Reduction and Growth Trust (PRGT). The fund offers three options Extended Credit Facility (ECF), Standby Credit Facility (SCF), and Rapid Credit Facility (RCF). It also provides non-financial assistance to stable countries through advice and policy support, monitoring activities, and capacity building (FAD, Garcia et al. 2018).

2.1.3 Value-at-Risk (VaR)

Value-at-Risk or VaR is the fundamental concept of risk dimensions utilized in the financial and industrial sectors as the probability-based risk measurement method.

The idea is with the help of history; it is possible to assess the probability of different events or groups of events. At that, the reaction is related to the potential severity of each event and the likelihood of occurrence (Wyplosz 2007).

The VaR approach was employed initially at the micro level to explore the risks associated with portfolios as it quantifies the level of financial risk within a company, portfolio, or position over a time horizon. Then it was extended to rely on it as a tool for assessing the debt sustainability of a particular economy during a specific time range (Wyplosz 2011).

The VaR approach includes three approaches. They are the historical simulation approach, the normal delta approach, and the Monte Carlo simulation approach.

The first method, the historical simulation approach uses pre-recorded data over time of rates of price and markets upon which the portfolio's profits or losses will be predicted over a specified period.

The second method, the Normal delta approach considers that fundamental market elements are normally distributed in determining portfolio profits and losses. Any underlying asset believes that the log returns are normally distributed, and it compares the returns of any option based on its delta-adjusted exposure. The delta-normal model considers the relationships between securities depicted by their correlation. For ease of application, it was utilized widely in the beginning, but for weak results, it is rarely used in practice today. It's still a good starting point when learning about VaR models.

The Monte Carlo Simulation Approach

The third method, a Monte Carlo simulation is employed in the process that cannot easily be predicted due to the intervention of random variables. It is based on a statistical frequency distribution assumed to approximate potential differences in market detachments (Ferrarini and Ramayandi 2012).

It is a technique employed to estimate the impact of risk and uncertainty and tackle many problems in many fields, including financing, business, physics, and engineering. It employs shock stress tests to variables affecting debt, where all possible scenarios are planned and then presented and analyzed.

The Monte Carlo simulation approach is the most widely practical method of estimating value at risk for debt sustainability assessment. It includes analytical models that identify how variables change over time (Barnhill and Kopits 2003).

Barnhill and Kopits (2003) used VAR approach to assessing debt sustainability and using historical data to estimate the impact of fluctuations in the exchange rate, interest rates, and production on debt sustainability in the Equator They Compared the present value of its revenues with the value of its outstanding debt to get the net worth (Barnhill and Kopits 2003).

After that, Da Costa, Silva and Baghgdassarian adopted Barnhill and Kopits model to evaluate Brazil's assets and liabilities. they compared the government's outstanding debt to the present value of its primary balance (Da Costa, W. et al. 2004).

2.1.4 Financial Reaction Function

It does not require stress tests or potential shocks to the economy. Still, it uses the previous behavior to estimate the function reaction of the government to fluctuations, which is one of the effective ways to measure debt sustainability. Where it investigates how changes in financial surpluses respond to changes in debt is studied and is not related to the current situation. Government policies to cope with changes differ from country to country, so the model parameters are selected based on their impact on the Primary balance of the target economy.

This approach was used in the late 1990s to assess the economy's ability to sustain public debt, developed by researchers and economists over time. In some cases, it was used as a complementary method in the debt sustainable assessment process.

The reaction function is the approach used in this study to assess Egypt's debt sustainability; Accordingly, the following section reviews the empirical studies based on this approach in the literature.

2.2 Empirical Literature of Fiscal Reaction Function

Blanchard Ben revealed that fiscal policy equilibrium is decided by the primary balance, which needs to respond positively to a rising output level and negatively to a decreasing output level. And explained that reducing the budget deficit effects in a positive fiscal impact on aggregate demand (Blanchard 1993). And in study on the OECD countries, using the gap sustainable tax rate over time, the tax rate that maintains debt to GNI ratio unchanged, and the current tax rate as indicators for the short, medium, and long run, respectively, found that the short and medium term were positive and large among the countries (Blanchard, Chouraqui, et al. 1991). Many researchers declared that the impact of primary fiscal balance could be used to determine budgetary stability through changes in the business cycle (Galí 1994, Fatás and Mihov 2001, Sørensen, Wu et al. 2001, Guo and Harrison 2006). Moreover, Ramey & Ramey confirmed that volatility affects economic growth in the long run, especially in underdeveloped countries' financial systems, due to decreasing uncertainties that can boost investment and improve social capital (Ramey and Ramey 1994).

Henning Bohn is theoretically and empirically the founder of the financial reaction function approach. Bohn was the first to assess the sustainability of public debt by applying it to the United States from 1916-1995. Bohn verified that although the debt-to-GDP ratio has a uniform root, it is unstable, whereas corrective fiscal policies may lead to a reversal. Bohn explained that the US government responded to the debt ratio through the primary balance. Then emphasized that the primary surplus of the United States considers an increasing function of the debt-to-GDP ratio, in addition to the positive response to the primary surplus to changes in debt, confirming that the US fiscal policy meets the intertemporal budget constraint. Bohn also underlined that the financial reaction function approaches better than the univariate time series analysis of the debt-to-income ratio because it considered shocks (Bohn 1998).

Baharumshah investigated the nexus between fiscal policy changes and the sustainability of fiscal imbalance. The study concluded that the fiscal policy of Thailand and South Korea is sustainable, while the physical policy of the Philippines and Malaysia shows weak sustainability. In addition, the causality test shows a unidirectional relationship running from expenditure to revenue for Korea, Thailand, and Singapore. From revenue to expenditure for

Malaysia and Singapore. The study examined the sustainability of fiscal policy in Malaysia. The study revealed that the fiscal policy is sustainable. In addition, the study concluded that public debt beyond 55% could hinder economic growth. Also, the unidirectional causality runs from debt to economic growth (Baharumshah and Lau 2007).

In developing and emerging nations, Mello investigated debt sustainability in Brazil using the unit root and cointegration tests (1995-2004) and the variables of government revenue and expenditure, public debt, institutions proxies, output gap, and inflation. The study concluded that the government responds positively and strongly toward public debt (de Mello 2005).

(Kunvoro 2011) examined the government budget sustainability of Indonesia during the period (1990q1-2009q4). The study concluded that Indonesia's budget was unsustainable during the sample period. Studies from Mendoza, Cohen, and Dooley focused on sustainability and international debt, debt sustainability in Africa, and the meaning of sustainable public debt, respectively. The three studies considered the country as being fiscally solvent when the burden of foreign debt servicing and the ratio of debt service to export and import are considered. The external public debt to exports ratio is used to measure the sustainability of the external debt level because only exports can be utilized to finance foreign debt. Sustainable public debt requires the following conditions: (1) the country should achieve equilibrium in the balance of payment without using reserve assets or credit from any international institution. (2) the level of debt must be modest to avoid the issue of future debt service. The debt to export ratio and debt to GDP ratio should be calculated to deal with debt indicators (Dooley, Helkie, et al. 1986, Cohen 1999, D'Erasmo, Mendoza, et al. 2016)

(Pattillo and Ricci 2011) The impact of external debt on economic growth was examined using a sample of 93 developing countries (1969-1985). The study found that when external debt exceeds 35 to 40% of GDP, it negatively impacts GDP per capita. High debt also hinders growth by significantly reducing investment efficiency.

Checherita-Westphal & Rother, 2012 investigated the impact of growing and high public debt on economic growth in the Euro area for 40 years. The study concluded that debt exceeding 70 to 80 percent negatively affects economic growth. If the debt is not under control and exceeds 90 to 100 percent of GDP, this will negatively hinder economic growth. In addition, the study found a

negative and linear relationship between the annual change in debt to budget deficit ratio and GDP per capita (Baum, Checherita-Westphal, et al., 2013). (Köhler-Töglhofer and Zagler 2007) By using data on government budgets and government debt for 15 European countries, Norway, and the United States during the period (1960-2002). The study concluded that reducing government spending is more essential for lowering debt than rising revenues.

Frimpong and Oteng-Abayie used Vector Error correction model estimator to estimate the effect of external debt on economic growth in Ghana over the period (1970-1999). The study concluded that high debt accumulation has a negative impact on economic growth, and it showed that GDP growth rises as external debt inflows increase (Frimpong and Oteng-Abayie 2006). The study of Owusu-Nantwi and Erickson confirmed a significant and positive long-run relationship between public debt and economic growth. Also, the study recommended using public debt to finance priority projects to be able to pay debt services in Ghana (Owusu-Nantwi and Erickson 2016). In the developed nations, a study by Hamilton & Flavin, 1986 depended on the unit root test in their analysis. The study revealed that for the time series of public debt to be sustained, it must show a negative behavior in its level form (Hamilton and Flavin 1985).

Trehan & Walsh (1991) confirmed in their study that the cointegration between government revenues and government expenditures is a necessary test for the satisfaction of intertemporal budget constraints. Assuming the constant real interest rate (Trehan and Walsh 1991). On the contrary, Ahmed & Rogers (1995) confirmed that the critical condition for fulfilling intertemporal budget constraints is the cointegration between debt and primary balance and a quasi-difference stationary primary balance (Ahmed and Rogers 1995).

Egert (2010) Used business cycle variables as independent variables to estimate the fiscal policy response to the business cycle in OECD countries. The study revealed that fiscal policy in countries with high public debt and a high budget deficit tends to be procyclical, while countries with low public debt and government surpluses are more likely to implement countercyclical fiscal policy. Procyclical fiscal policy exists when governments choose to increase government spending and lower taxes during a boom; Cut spending and raise taxes during a recession (Égert 2010).

2.3. Literature review of Egypt's case

Al Sayed, Samir et al. (2021) used a time series from 1990 to 2018 to assess fiscal sustainability in Egypt and tried to examine the sustainability of debt through two models, the first based on measuring the impact of debt on Deficit accounts and on the second its impact on generational accounts. The first model applied the augmented Dickey-Fuller to test the stationarity of debt/GDP and then used the Johansen co-integration test between government revenues and expenditures. It estimated the impact of the debt and tax gap on the primary deficit. This study shows that Egypt witnessed fiscal sustainability but failed to implement the second model due to difficulties obtaining the data the model needed. It used it instead personal interview form. That concluded that various administrative, technical, legislative, and political obstacles hinder the application of the model of generational accounts in Egypt. This research is subject to criticism as it relies on a comparative approach by targeting the application of two models to assess debt sustainability. It implemented the traditional model and failed to apply the novel model (Al Sayed, Samir et al., 2021).

Al-Nashar (2019) argues that the exchange rate in Egypt is as important a factor in the accumulation of government debt as the primary deficit. Using data from 2001/2002 to 2016/2017, analyzed debt dynamics to determine the cumulative effects of primary deficit to GDP ratio, exchange rate, real interest rate, and real growth. Use the structural VAR technique and the following four variables: exchange rate, primary deficit, real rate, and debt level. The consequences of an impulsive response consider that debt responds equally to primary deficits and to exchange rate shocks, and the exchange rate shock also showed a negative impact on the change in the real interest rate (Alnashar 2019).

Hashem and Fahmy (2019) investigated debt sensitivity to macroeconomic variables between 2005 and 2015, utilizing a structural vector autoregressive model (SVAR). The results listed a positive relationship between government debt and the main economic variables except for inflation and government revenues. Further significant macroeconomic variables that impact public debt significantly are real GDP, inflation, and the exchange rate. A positive shock to government spending leads to a lengthy increase in the debt-to-GDP. A more increased inflation rate deteriorates the actual value of public debt, and an increase in government revenue shows a decrease in the debt-to-GDP.

But behind a three-quarter shift. A higher exchange rate causes an increase in debt-to-GDP. However, the results of this research are subject to criticism for two reasons; the first is related to the short study period, which covered only ten years, and the second is the lack of an Econometrics model confirming the variables' nexus. The research also exhausted a large part of the study in the variable relations (Hashem and Fahmy 2019).

Massoud (2014) considered the magnitude of debt and used the Vector Autoregression (VAR) model from 1991 to 2012 to estimate the debt in the future and its sustainability. The paper used five variables: the domestic debt % GDP, the per capita growth rate of the real GDP, real GDP per capita growth rate, inflation, and the real interest rate. The paper assumed six scenarios for the Egyptian authorities to deal with the public debt. The results concluded that the public debt in Egypt is sustainable until 2020, but the government should pay attention to increasing the accumulation of public debt. The government must adopt policies that promote economic growth and perform fiscal adjustments to keep the debt sustainable. A difference must be made between domestic and external debt to correctly assess the debt's sustainability (Massoud 2014).

Abutaleb and Hamad (2012) evaluated the external debt in Egypt and optimal policy from 1985-2008. It also provided forecasts for optimal debt over the period 2009-2014. this study used a stochastic control approach to discover the optimal debt policy. It linked uncertainty about interest payments or debt service and anticipation of the rate of return on investments. It showed that Egypt could borrow from abroad if the direction of return on investments exceeds the trend in the real interest rate or debt service rate. And found that Egypt's external debt was higher than the optimal level before 1997. However, Egypt's external debt is still below its optimal level (Abutaleb and Hamad 2012).

El Mahdy and Torayeh (2009) used annual data from 1981 to 2006 to investigate Egypt's debt sustainability and economic growth. This study employed the co-integration approach to examine the effect of debt on economic growth while using a simple algebra approach to estimate debt sustainability. It was using a measure of the primary Balance gap indicator. This indicator calculates the difference between the primary Balance gap, which measures the difference between the actual primary deficit and the primary balance required to maintain the debt-to-GDP ratio. In addition to

using the stress test/ deterministic approach. In considering debt sustainability, the study examined the effect of interest rate, economic growth rate, and primary balance on debt. The study revealed that the path of Egyptian debt was sustainable, and the public domestic debt in Egypt has a powerful negative consequence on economic growth. This study simulated the debt with six scenarios; however, only one scenario resulted in unsustainable debt, where they declined the values of the used variables. And recommended an urgent need for financial reforms to maintain debt sustainability. Policies must be adopted that keep growth rates higher than the interest rate (El-Mahdy and Torayeh 2009).

The study of (Abdel-Khalek 2007) aimed to assess the level of domestic debt and its consistency with achieving the Millennium Development Goals. And to suggest proposals ensuring debt restructuring aligned with sustainability based on the Millennium Development Goals and pro-poor growth. Therefore, it illustrated the issue of domestic debt in Egypt, its size and structure, and discussed the issue of substituting domestic debt for foreign debt. Examination of indicators of domestic debt and debt sustainability. This study concluded Egypt's external debt is, at study time, no problem, thanks to the Paris Club rescheduling, debt write-offs in 1991, debt and equity swaps, and the authorities' commitment to maintaining a ceiling on external debt. Essentially, domestic debt eats up domestic credit and crowds out investment. Achieving the Millennium Development Goals in Egypt requires expanding the fiscal space through spending cuts and revenue enhancement measures. The fiscal policy in Egypt is in the direction of cyclical fluctuations and not opposite the direction of cyclical changes. The government is inflating domestic debt, which does not support sustainable development. Despite the deep analysis, it did not go beyond descriptive analysis and did not present any economic model showing the conditions for debt sustainability.

In 2005, the World Bank studied Egypt's debt and considered its sustainability in two ways. The study adopted the primary balance approach to debt to know the primary surplus that must reach to maintain debt sustainability, even if the debt is unsustainable. And depend on the deterministic method, they developed a basic scenario with specific assumptions for the variables: growth rate, inflation rate, nominal exchange rate, nominal interest, external debt rate, imports to GDP, and external debt. The study tried to examine three different shocks. The results showed that the required primary surplus should be more significant than 2.4% (Bank 2005.).

Alba, El Shawarby, and Iqbal (2004) assessed Egypt's debt sustainability, where public debt was 126% of GDP in 2003. The study examined whether major fiscal trends were structural or cyclical, then calculated the debt-to-GDP ratio for 15 years based on assumptions about the growth rate, inflation rate, domestic and foreign interest rates, external debt, and the exchange rate. The study used the IMF approach / deterministic approach by shocking each variable separately. Simulation results for all scenarios showed that debt-to-GDP will grow continuously until 2018. The debt is driven by structural factors such as a weak taxation system and high government spending on wages, subsidies, and interest payments. The study recommended the necessity of fiscal adjustment and increasing economic growth rates to achieve debt sustainability (Alba, Shawarby, et al. 2004).

3. The crises, Fiscal Policy Response, and Egypt's Debt status quo

3.1 The Status Quo of Debt in Egypt

The Egyptian government resorted to financing its requirements through debt and foreign aid. This wave started with the total public debt rising by about 381 billion to reach 1.902 in 2012/2013, representing 89.3% of GDP. After that, debts crossed the threshold of 2 trillion EGP and increased by 19.6%, and then continued the annual increase by 22.4% and 34.7% at the end of June 2016 and 2017, respectively, then the debt growth rate started to decline to about 15.1% in June 2018, and to 11.3 in June 2019 respectively.

The negative consequences of the (COVID-19) pandemic was hurtful to the economies of most countries in the world, including Egypt. Still, the Egyptian economy was able to achieve positive economic growth, thanks to the results of the economic reform that the Egyptian government began in 2016. In contrast, the growth rate of debt declined, recording 6.1% in June 2020, despite the value rise to 5.094 billion pounds.

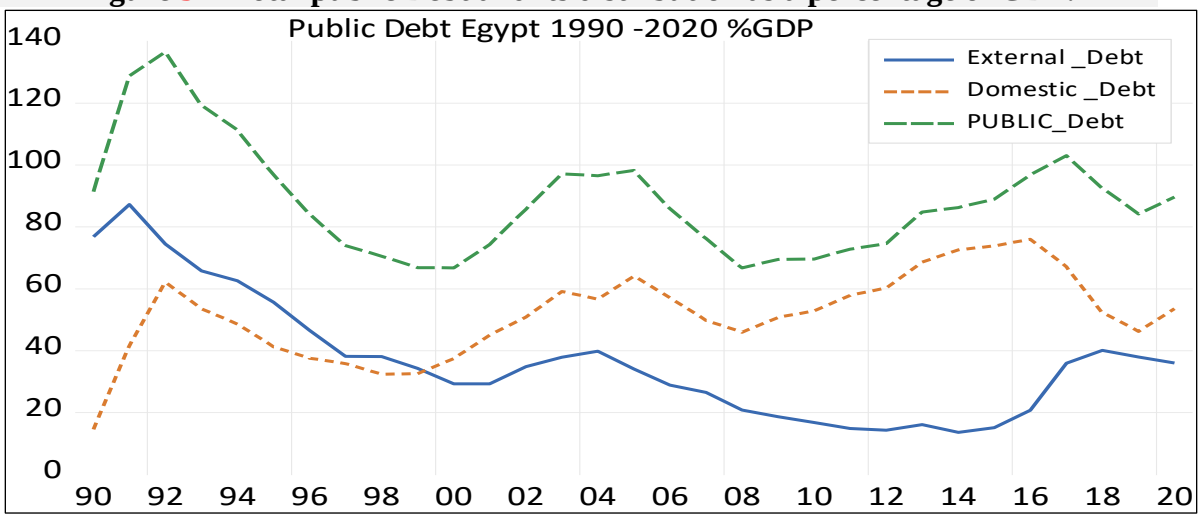
In general, the public debt as a percent of GDP recorded alarming rates in Egypt, which rose to represent 102% and 108% in 2016 and 2017, respectively; the means from 1990 to 2020 (during the study period) was 88%, thereof 51.5 % domestic debt and 36.8% external debt.

Figure 3-1 shows the evolution of the total public debt and its distribution between domestic and foreign as a percentage of GDP.

Figure 3-1 also shows the fluctuations of the Egyptian government in its dependence on financing the deficit between domestic debt and external debt.

Indeed, Egypt recorded high external debt rates, which reached their peak in 1991, reaching 87% of the GDP. After that, during the next ten years, Egypt adopted a policy that reduced external debt, which did not exceed the threshold of 30 billion dollars representing 29% of the GDP until the year 2001.

Figure 3-1 Total public Debt and its distribution as a percentage of GDP.



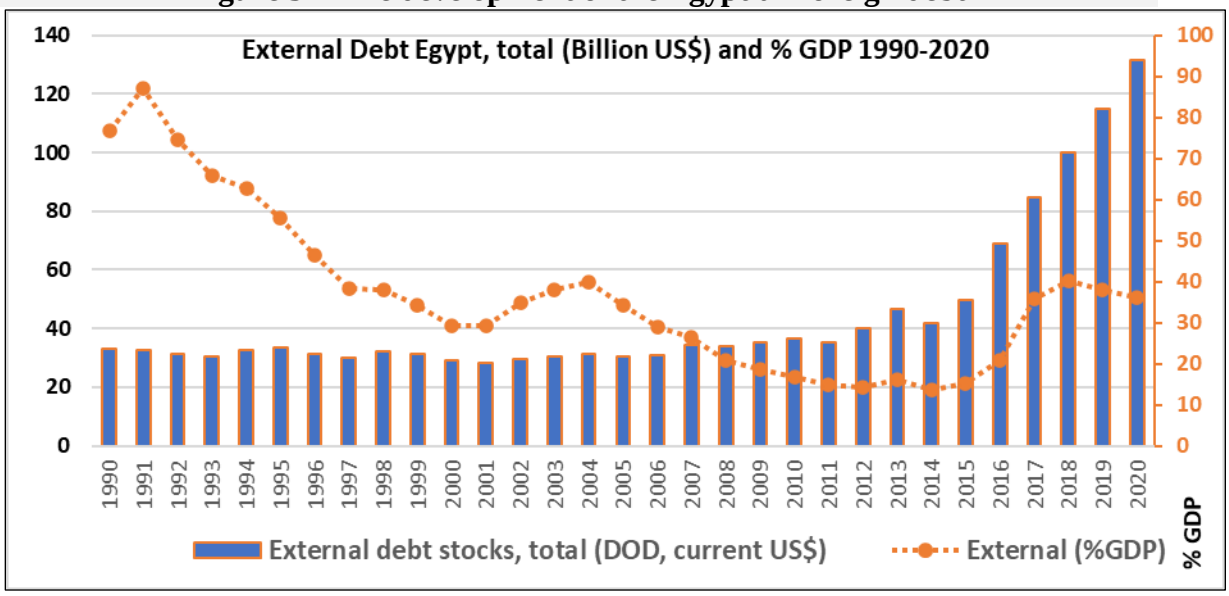
Source: Authors, using WDI

Then the external debt rose cautiously during the next ten years, recording its highest value in 2011 of $35 billion, and its percentage of the GDP decreased to about 15%. But the Egyptian government changed its policy again in the last ten years, increasingly relying on external debt, adding the debt volume five times to reach $145 billion, exceeding 35% of GDP in June 2021. These fluctuations can be outlined in Figures 3-2. It is worth noting and investigating that the Egyptian government has expanded in the last ten years in debt by changing its fiscal policy by increasing dependence on external debt and decreasing domestic debt.

It is worth noting and investigating that the Egyptian government has expanded in the last ten years in debt by changing its fiscal policy by increasing dependence on external debt and decreasing domestic debt.

Data from the Egyptian Ministry of Finance indicate that the debt-to-GDP ratio in Egypt decreased from 108% in 2017 to 90.6% at the end of the current fiscal year. The debt life extension increased from 1.3 years before 2017 to 3.45 years in 2021. The cost of debt servicing was reduced from 40% of the total expenditures during the fiscal year 2019/2020 to 36% during the year 2021, with a target to reach 31.5 of the total spending during the current fiscal year (Ministry of Finance).

Figure 3-2 The development of the Egyptian foreign debt



Source: Authors, using WDI

In 2021, government revenues achieved a rise of 119 billion pounds, representing 12.2 percent, while expenditures grew by 9 percent. Consequently, the primary budget achieved a primary surplus of about 93.1 billion pounds, representing 1.4 percent of GDP.

Table 3-1 Debt-related macroeconomic indicators from 2010 to 2021

Year	Debt (Total) Tr.EGP	% GDP	New Debt Bill.	increase rate	Economic Growth	Interest Rate	Inf. Rat	Total Deficit	Primary Deficit	inter. Reserve	Monat cover
2010	1.2	79			5.2	8.25	11.7	-8.1	-2.1	35.2	8.6
2011	1.3	82	100	7.7	1.8	8.25	11	-9.8	-3.6	26.6	5.9
2012	1.7	78	400	23.5	2.2	9.25	8.6	-10	-3.7	15.5	3.1
2013	1.9	88.1	200	10.5	2.2	9.75	6.9	-12.9	-5	14.9	3.1
2014	2.2	89.3	300	13.6	2.9	8.25	10.1	-12	-3.9	16.7	3.3
2015	2.5	93.1	300	12.0	4.4	8.75	11	-11.4	-3.5	20.1	3.9
2016	2.7	102.8	200	7.4	4.4	11.75	10.2	-12.5	-3.5	17.5	3.7
2017	3.4	108	700	20.6	4.2	16.75	23.5	-10.9	-1.8	31.3	6.4
2018	4.3	97.3	900	20.9	5.3	16.75	20.9	-9.7	-0.1	44.3	8.4
2019	5.2	90.2	900	17.3	5.6	15.75	13.9	-8.1	1.9	44.5	8
2020	5.5	87.5	300	5.5	3.6	9.25	5.7	-8	1.8	38.2	7.3
2021	6.4	89.8	900	14.1	2.8	8.25	4.5	-7.8	1.1	10.6	7.6

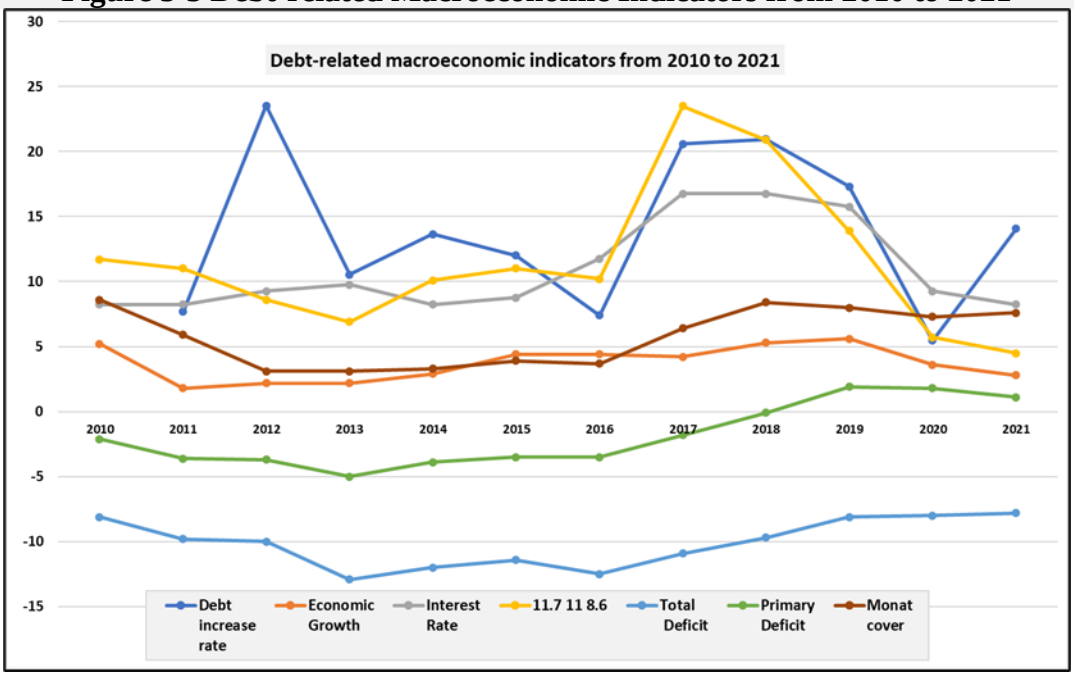
Source: Authors, using (Ministry of Finance) & CBE

At the same time, the total budget deficit decreased from 8% to 7.4%, while the public debt grew to 90.6 percent of GDP, compared to 87.5% in 2020.

The data also indicates targeting to increase investments from 289 billion pounds in 2020/2021 to about 358 billion pounds during the current fiscal year 2022/2021 budget by increasing investments funded by the public treasury at a rate of about 28% (Ministry of Finance). Table 3-1 summarizes the most important results of the interaction of financial policies with fluctuations resulting from internal and external shocks.

Table 3-1 and Figure 3-3 show the evolution of macroeconomic indicators related to the debt since 2010. It reveals the government's continued dependence on debt to finance the growing budget deficit. It also notes the decline in real interest rates (nominal interest rate - inflation rate), which would help the sustainability of debt compared to the economic growth rate. The most important is the reaction of fiscal policies to reduce the total deficit of the public budget t and perform a primary surplus in recent years.

Figure 3-3 Debt-related Macroeconomic Indicators from 2010 to 2021



Source: Authors, using (Ministry of Finance) & CBE

3.2 The Crises and fiscal policy response to debt sustainability

The literature indicates the development of the concept of debt sustainability from a mere statistical analysis to the study of the extent to which fiscal policy interacts with economic variables. It is obvious that to not reach the point of the accumulated debt explosion, policymakers must respond to the changing conditions in the macroeconomic environment.

The spread of Covid-19 and the world's suffering from a terrifying global health crisis caused a state of anxiety, uncertainty, and turmoil for many economic sectors, and this required taking massive financial measures to confront the spread of the disease, which caused the economy to enter a wave of a deep recession. The financial markets of most world countries, including Egypt, followed expansionary policies. That includes lowering interest rates and measures by central banks (the most important of which are large purchases of government debt). And are also motivated by the significant development of their financial markets.

That caused a rise in the debt, which recorded the most significant growth spurt in one year since World War II, according to the data of the International Monetary Fund, as the debt rose by 28 trillion dollars to reach 226 trillion dollars,

representing 256% of the gross domestic product in 2020. The advanced economies accounted for the largest share of the debt-increasing boom as the public debt in these countries rose from about 70% of GDP in 2007 to 124% of GDP in 2020. With the addition of China, the percentage increased to more than 90%, as these countries managed the Expansion of public and private debt. The rest of the developing economies are on the other side of the financing gap, facing limited access to finance and often at higher interest rates.

With the beginning of the global economy recovering from the repercussions of "Covid-19", the debt escalated to a record 300 trillion US dollars in 2021 (Institute of International Finance).

The matter did not end to this extent, as the world was surprised by the crisis.

What was more complicated and severe was the most significant economic crisis that appeared on the horizon since the Great Depression of 1929. Due to the repercussions of the Russian-Ukrainian war, there was a rise in energy and grain prices—the imposition of economic sanctions on Russia and the Russian countermeasures. All this affected the world in a state of Fear, anticipation, and uncertainty, which has caused successive and turbulent waves of inflation that the world had not witnessed for nearly half a century, in addition to a shortage of food and supply chains. High levels of inflation and uncertainty forced the central banks of the developing and developed world to take tight monetary policies to curb inflation and maintain financial balance, which inevitably led to the worsening of the debt crisis.

High levels of inflation and uncertainty forced the central banks of the developing and developed world to take tight monetary policies to curb inflation and maintain financial balance, which inevitably led to the worsening of the debt crisis.

And then, all countries of the world were forced to resort to increasing the demand for borrowing to reach its highest levels.

All of this has sparked uncertainty and anxiety about the ability of many countries to bear debt. The International Monetary Fund has confirmed through the statements of "Kristalina Georgieva," the head of the International Monetary Fund, likening the impact of the Russian-Ukrainian crisis to a strong earthquake that will have repercussions on all countries of the world, especially countries. In emerging countries, war will lead to lower growth rates and higher inflation rates

worldwide, and governments, companies, and families will face more severe debt problems.

The unprecedented rise in debt is justified, as it has been linked to protecting lives from the pandemic, supporting the poor, preserving jobs, avoiding bankruptcies, and slowing growth. Without it, the world will not bear the attendant socio-economic consequences.

The debt crash amplifies vulnerabilities, both in increasing the budget deficit, weakening the ability of governments to support recovery, the ability of the private sector to invest in the medium term, and slowing growth.

The challenge stems from the difficulty of reaching the optimal mix of fiscal and monetary policies at a time when high debt coincides with inflation.

During the Covid pandemic, central bank actions, especially in advanced economies, pushed interest rates towards their lower limits, facilitating governments' borrowing process.

Inflation may help raise the nominal growth rates, allowing an intangible decrease in the volume of debts. Still, on the other hand, the deteriorating situation forces monetary policy to combat rising inflation to raise the interest rate, which causes an increase in the debt balance and new borrowing costs, which may be inevitable. To pay off debt service, especially in heavily indebted countries. It will also lead to lower investment, employment, and thus slower growth rates.

In addition to the increase in interest rates, it causes additional pressures for emerging and developing countries, forcing them to raise the interest rate at higher to provide financing opportunities and to resist the flight of cash flows toward higher interest rates in developed countries.

On the other hand, high-interest rates require adjustment of fiscal policies by increasing spending and subsidies or reducing taxes.

Also, expanding the Central Bank's purchase of government debt has repercussions on economic recovery, where inflationary pressures reduce investment opportunities and increase fears of debt unsustainability.

The increase in debt balances, the escalation of interest rates at the global level, and the faltering of the growth process increase the degrees of risks, uncertainty,

and pessimism, which heavily pressures most governments, families, and companies indebted.

The dangers of extending the external debt under rising international prices would raise the import bill and increase the current account deficit for some countries. This would make the situation more complicated. These countries would face fluctuations in exchange rates that require flexible and quick adjustment policies to prevent falling into financial hardship and further complicating the matter.

From here, achieving the appropriate balance requires policy flexibility and speed of adaptation to changing conditions and shocks, and financial support directed to protect low-income people while adhering to reliable and sustainable financial plans in the medium term. Policy balance, flexibility, and reaction speed are essential to reduce exposure to debt unsustainability and contain inflation.

More than this, resisting the pandemic, the financing gap, global waves of inflation, and the faltering of some countries requires local efforts, solid and practical international cooperation, and genuine support for the countries most affected by the crisis.

4. Empirical Study

4.1 Data description:

The study uses secondary time series data during the period (1990-2020). The choice of the period depends on the availability of data. The data are collected from International monetary fund (IMF) and World Bank, World Development Indicators Data set (WDI). (See table 1).

Table (4-1). Description and sources of data used in the study

Variable	Description	Source	Abbr.
Primary balance	Primary net lending/borrowing (percentage of GDP)	International monetary fund	PB
Public debt	General government gross debt (percentage of GDP)	International Monetary Fund	PD
External debt	Total external debt (percentage of GDP)	World Bank	ED
Domestic debt	Total domestic debt (percentage of GDP)	World Bank	DD
Output Gap	Derivation of real GDP from the value of Hodrick-Prescott (HP)	Calculated by author using world Bank Data	OG

Expenditure Gap	Derivation of government expenditure from the value of Hodrick-Prescott	Calculated by author using IMF Data	EG
Oil price	Price of crude oil, Brent ($/bbl)	World Bank-commodity price data	OP
Exchange rate	Official exchange rate (unit of local currency relative to U.S dollar).	World Bank	EXR
Expenditures	General government total expenditures (national currency)	International Monetary Fund	EXP
Revenues	General government revenues (national currency)	International Monetary Fund	REV

4.2 Descriptive statistics

Table (2) shows the descriptive statistics of the variables in the study. The mean value of PB is -0.53% with a maximum value of 6.62% and minimum value of -5.91%. While the mean value of PD, ED, DD, OG, EG, OP, EXR, are 88.38, 36.83, 51.55, 3.8E-10, -0.0003, 48.98, and 6.48, respectively. The mean value of log EXP is 5.30 and the mean value of log REV is 5.10.

Table (4-2) Descriptive statistics: PB, PD, ED, DD, OG, EG, OP, EXR, log EXP, log REV.

Variables	Mean	Median	Maximum	Minimum	Standard Deviation	Obs
PB	-0.53	-1.42	6.62	-5.91	3.34	31
PD	88.38	85.92	136.57	66.76	17.82	31
ED	36.83	34.84	87.20	13.65	19.57	31
DD	51.55	52.36	76	14.59	13.71	31
OG	-3.8E-10	0.031	0.218	-0.29	0.144	31
EG	-0.0003	0.029	0.392	-0.766	-0.215	31
OP	48.98	42.30	111.97	12.72	31.96	31
EXR	6.48	5.62	17.78	1.55	4.46	31
Log EXP	5.30	5.14	7.36	3.09	1.25	31
Log REV	5.10	4.89	7.02	2.91	1.116	31

4.3 The Study Model

Whether public debt is sustainable is the basis for the macroeconomic analysis of fiscal policy, and the importance of this issue has risen more than ever in Egypt. As the Central bank of Egypt targets effective nominal interest rates,

debt sustainability becomes at the forefront of discussions of general economic policies, primarily financial.

At the same time, the rise in public debt in Egypt's economy as one of the emerging economies in the presence of the current and previously mentioned economic crises increases bouts of tension and anxiety, reminding policymakers that debt sustainability is not a foregone conclusion. And since the intertemporal budget constraint is always constant, there are many ways to ensure this. However, there are not always precise approaches. For example, the choice between default or acceptance of high inflation. Hence, the notion of sustainability does not have a unique formula because it depends on the accepted strategy to meet the intertemporal budget constraint.

In a dynamic economy, a consumer's intertemporal budget constraint condition in an economy with perfect credit markets, the present value of their lifetime consumption does not exceed the present value of their lifetime income plus their initial wealth. While the temporary government budget constraints condition that the present value of current and future taxes be sufficient to cover the present value of current and future government spending in addition to the initial balance of government debt.

The government has a unique nature as a borrower; for instance, it is not expected to die or disappear, and then there is no clear end period in which all debts must be paid. And default on the part of the government is a frightening possibility that is hard to imagine as it entails massive destruction of wealth, the collapse of national income, and guaranteed misery (Borensztein and Panizza 2009).

Further, the government is sovereign and controlling; that is, it does not take bankruptcy procedures against it and can issue money to meet payment obligations in the local currency. In addition, it can increase revenues by increasing taxes at least to the highest point in the Laffer curve (the dreaded Laffer curve). Thus, intertemporal budget constraints are not specific and depend on more than one dimension(Abbas, Pienkowski et al. 2019).

In line with that, solve this to the following arithmetic operations:

In any given period t, total government spending must be covered by revenue and bond issuance. For simplicity and in line with the literature, we assume that the total outstanding balance of public debt (pDt-1) must be repaid at the end of the period plus accrued interest.

Accordingly, intertemporal budget constraints the are written as follows:

$$EXP_t + (1+rt)pD_{t-1} = REV_t + pD_t \quad (1)$$

Where EXP_t is the (non-interest) expenditure and REV_t, the total revenues. At the end of period *t*, public debt PD_t is the stock of past obligations PDt-1 to which we add the interest due *r*tPDt-1, and the difference between primary expenditure and total revenues, known as:

$$PB_t \equiv EXP_t - REV_t$$

So:

$$pDt = (1+r_t)pD_{t-1} + pB_t \quad (2)$$

Since revenue correlates with nominal GDP, the nominal amounts in equation (2) are attributed to GDP (denoted by *Y*t).

The main idea is that government revenue can grow indefinitely, and expenditure and debt can grow similarly. Assuming that *Y*t is growing at an annual rate Φ_t t, we can transform equation (2) as follows:

$$\frac{pD_t}{Y_t} = (1+r_t)\frac{pD_{t-1}}{Y_{t-1}}\frac{Y_{t-1}}{Y_t} + \frac{pB_t}{Y_t}$$

$$PD_t = \left(\frac{1+r_t}{1+\Phi_t}\right)PD_{t-1} + PD_t$$

$$PD_t = \left(\frac{1+r_t}{1+\Phi_t}\right)PD_{t-1} + PD_t \quad (3)$$

At any given time *t*, the public debt-to-GDP ratio derivative from the interest burden of past debt, which is only indirectly conditional on government policies, and the present primary deficit, which directly shows fiscal policy response.

Remark that the result of interest on debt ratio dynamics depends on nominal growth.

If the interest rate exceeds growth ($r > \Phi$), the debt-to-GDP ratio tends to increase automatically because the rise in GDP cannot offset the additional debt.

That would be directed to pay the interest with new debts. Ultimately, the growth of the public debt ratio depends on the government's decision to pay the interest with either its revenue or new debt. If at least portion of the interest can be funded with revenues, the budget displays a primary surplus, which pulls the debt ratio down (PB< 0).

If, instead, newly borrowed funds in period *t* exceed the interest, the primary deficit (PD > 0) other adds to debt in that period.

Notable: $\left(\frac{1+r_t}{1+\Phi_t}\right)=\tau$

$$PD_{t+1}=\frac{1}{\tau_{t+2}}PD_{t+2}-\frac{1}{\tau_{t+2}}PD_{t+2} \quad (4)$$

Substitute for PD_{t+1} in (4) to find:

$$PD_t=\frac{1}{\tau_{t+1}}\left(\frac{1}{\tau_{t+2}}PD_{t+2}-\frac{1}{\tau_{t+2}}PD_{t+2}\right)-\frac{1}{\tau_{t+1}}PD_{t+1}$$

The equation can be shortened to:

$$PD_t=\frac{1}{\tau_{t+1}}\frac{1}{\tau_{t+2}}PD_{t+2}-\frac{1}{\tau_{t+1}}PD_{t+1}-\frac{1}{\tau_{t+1}}\frac{1}{\tau_{t+2}}PD_{t+2} \quad (5)$$

thus, setting a relationship between current debt and the present value of future debt and the primary deficit. for refinancing existing debt indefinitely, we must solve equation (5) by recounting substitutions of future debt in equation (5) as:

$$PD_t=\prod_{j=1}^{T}\frac{1}{\tau_{t+j}}PD_{t+T}-\sum_{j=1}^{T}\prod_{k=1}^{j}\frac{1}{\tau_{t+k}}PD_{t+j} \quad (6)$$

If T approaches infinity, so rewrite as:

$$PD_t=\lim_{t\to\infty}\prod_{j=1}^{T}PD_{t+T}-\sum_{j=1}^{\infty}\prod_{k=1}^{j}\frac{1}{\tau_{t+k}}PD_{t+j} \quad (7)$$

Based on the government's infinite time horizon, the current amounts of debt are covered by the net present value of all future primary balances, as shown in the second part of the equation (7). It is self-evident that there can be no stock of debt without an end According to the Ponzi scheme, in which a government could always find an agent willing to hold a bond to finance interest payment is impossible. therefore, solvency requires that:

$$\lim_{t\to\infty}\prod_{j=1}^{T}\frac{1}{\tau_{t+k}}PD_{t+j}=0 \qquad (8)$$

In normal circumstances for economic growth rates and interest rates, solvency imposes that public debt *d*t to be at considerable equivalent to the present value of all future primary balances. to achieve that, primary deficits must be in some end completely offset by surpluses.

$$PD_t=-\sum_{j=1}^{\infty}\prod_{k=1}^{j}\frac{1}{\tau_{t+k}}PD_{t+j} \qquad (9)$$

Equation (9) shows that the debt sustainability assessment is mainly related to future fiscal policies by affecting the primary balance over an indefinite horizontal range.

(Chalk and Hemming 2000) indicated that the financial statements could only be used to assess sustainability since they are effectively estimated according to the more stringent concept of debt tolerance; this approach tests the stability of the two related time series in equation (9), namely, PD and PB. that means variables are stationary; that is, does not show any trend in their mean.

Hamilton and Flavin (1986) assert that stationarity in the primary balance series implies that public debt is also stationary if the solvency condition holds. therefore, this test is an acceptable condition for solvency. (Trehan and Walsh 1988) showed even if debt and the primary balance are non-stationary, solvency is satisfied if both are co-integrated.

(Bohn 1998) drives step distance, claiming that tests based on time-series properties of debt and the primary balance ignore the general equilibrium conditions related to fiscal policy to the other variables in the economy.

This study depends on "model-based-sustainability" by Bohn, which estimates the conditional relationship between public debt and the primary balance. With a single-equation empirical model. that explains the primary balance by public debt and transitory variations in government expenditure and output:

$$PB_t=\beta_0+\beta_1\tilde{g}_t+\beta_2\tilde{y}_t+\lambda PD_{t-1}+\varepsilon_t \qquad (10)$$

Not that in this research based on the equation (10) EG is used as a proxy for $\tilde{g}$ and OG proxy for $\tilde{y}$. Where OG = Output gap, and EG = Expenditure gap. Which they are estimated according to the Hodrick Prescott filter model.

According to Bohn, a positive dependent response of the primary balance to public debt ($\lambda_t > 0$) meets sustainability requirements in a general equilibrium model under appropriate assumptions.

This test is widely used in the literature, as indicated in the previous section assess whether the fiscal policy was "responsible" in the sense of being consistent with solvency.

With the oil price and the exchange rate as control variables, they present the two most influential variables that cause an essential impact on the primary deficit and their most severe effect on Output and consumption fluctuations in Egypt.

In addition, it adds a dummy variable that distinguishes between standard and unstable years. The estimation equation would become:

$$PB_t = \beta_0 + \lambda PD_{t-1} + \beta_1 EG_t + \beta_2 OG_t + \beta_3 OP + \beta_4 EXR + \beta_5 Dummy + \varepsilon_t \quad (11)$$

The λPD_{t-1} is substituted in Equation No. (11) to λED_{t-1} for estimate the external debt once and to λDD_{t-1}DD for estimate the domestic debt again

where the two equations are given:

$$PB_t = \beta_0 + \lambda ED_{t-1} + \beta_1 EG_t + \beta_2 OG_t + \beta_3 OP + \beta_4 EXR + \beta_5 Dummy + \varepsilon_t \quad (12)$$

$$PB_t = \beta_0 + \lambda DD_{t-1} + \beta_1 EG_t + \beta_2 OG_t + \beta_3 OP + \beta_4 EXR + \beta_5 Dummy + \varepsilon_t \quad (13)$$

Output gap and expenditure gap estimation model:

The Hodrick–Prescott filter (HP) is utilized in macroeconomics, mainly in business cycle theory, to drag the cyclical component from a time series data. This arithmetic tool through which the gap between the potential output and the real GDP is estimated (De Masi 1997).

This study relied on the use of an estimator HP to get the potential output according to (Hodrick and Prescott 1997):

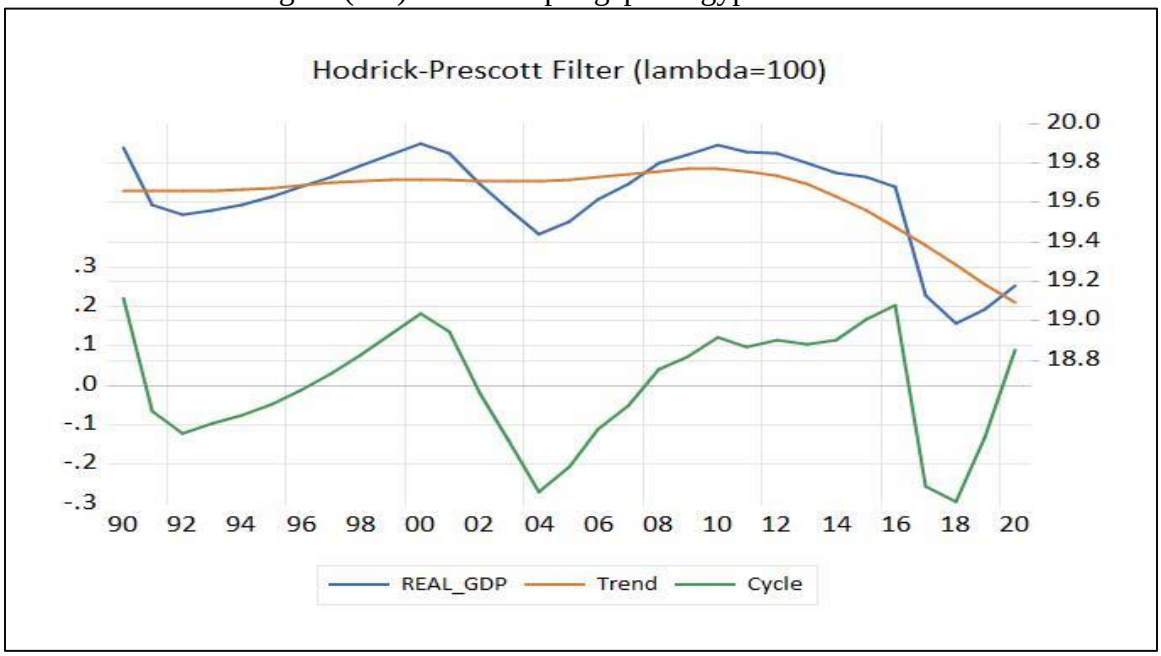
Where it is easier to use than the productivity function in terms of application and the availability of the needed data. Moreover, it is the most widely used in the literature.

$$\sum_{t=1}^{T} (InY_t - InY_t^*)^2 + \lambda \sum_{t=2}^{T-1} \left[(InY_{t+1}^* - InY_t^*) - (InY_t^* - InY_{t+1}^*) \right]^2$$

The Output gap represents the difference between the real GDP and the potential output, and in the same way the expenditure gap is calculated ((Hodrick and Prescott 1997)). for estimate the expenditure gap EG, it applied the same.

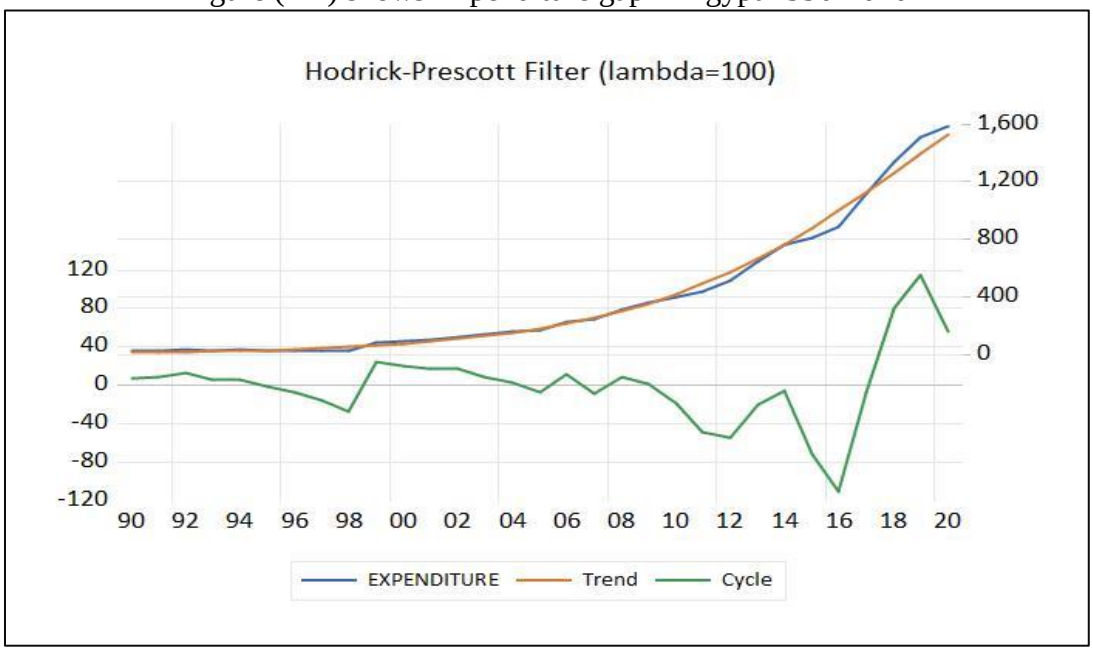
Figure (4-1) and Figure (4-2) capture the output gap and expenditure gap in Egypt 1990-2020 were $\lambda = 100$.

Figure (4-1) shows output gap in Egypt 1990-2020



Source: Authors, using WBI data set

Figure (4-1) shows Expenditure gap in Egypt 1990-2020



Source: Authors, using WBI data set

4. 4. Estimation results:

4.4.1 Results of unit root test:

Table (4-3) shows the results of the unit root test, the study uses the Augmented Dickey

Table (4-3) Results of Unit root Test

Variables	Level		First difference	
	ADF	PH-P	ADF	PH-P
PB	-1.75 (0.39)	-2.05 (0.26)	-5.72 (0.000)	-7.86 (.000)
PD	-2.05 (0.261)	-1.93 (0.312)	-4.01 (0.005)	-4.78 (0.000)
ED	-4.19 (0.002)	-2.18 (0.217)	-3.92 (0.005)	-4.07 (0.003)
DD	-2.46 (0.134)	-3.21(0.028)	-4.29 (0.002)	-4.33 (0.002)
OG	-3.71(0.009)	-3.003 (0.046)	-4.10 (0.003)	-5.09 (0.000)
EG	-3.48(0.015)	-3.33 (0.022)	-3.67 (0.011)	-9.08 (0.000)

OP	-1.44 (0.547)	-1.48 (0.526)	-4.54 (0.001)	-4.43(0.001)
EXR	-.054 (0.945)	-0.123 (0.937)	-4.01 (0.004)	-3.83 (.006)
EXP	-0.75 (0.818)	-0.764 (0.814)	-5.84 (0.000)	-6.32 (0.000)
REV	-1.14 (0.685)	-1.08 (0.707)	-5.04 (0.000)	-9.59 (0.000)

- ADF indicates Augumented Dickey Fuller test, PH-P indicates Phillips-perron test.
- Values in parentheses are p-values.

Fuller and Phillips -Perron tests to examine if there is a unit root in the data. The null hypothesis of the test is that there is a unit root. When the P-value is less than 0.05 then the null hypothesis will be rejected, which means the data is stationary.

The results of Dickey-Fuller test in table (4-3) report that at the level, external debt, output gap, and expenditure gap are stationary at 5%. While primary balance, public debt, oil price, exchange rate, revenues, and expenditures are stationary at the first difference (Dickey and Fuller 1979).

The results of the Phillips-Perron test show that domestic debt, output gap, and expenditure gap are stationary at level. In contrast, other variables are stationary at the first difference(Phillips and Perron 1988).

4.4.2. Cointegration Test: The Relationship between Revenues and Expenditures:

To investigate the long-run cointegration relationship between expenditures and revenues, the study applies the bounds test(Pesaran, Shin et al. 2001). The null hypothesis of the test means that there is no cointegration.

H0: $\beta 1 = \beta 2 = 0$

Against the alternative hypothesis

H1: $\beta 1 \# \beta 2 \# 0$

Table (A-1) shows the bounds test results. The value of F-statistic is (9.91) which is greater than the lower critical value and higher critical value at 5%, 10%, and 1%. Thus the null hypothesis should be rejected and the alternative hypothesis should be accepted which means there is long-run cointegration between the expenditures and revenues.

The absolute value of the t-statistic is (4.41) which is greater than the absolute value of the lower critical value and the absolute value of the higher critical

value at 5%, 10%, and 1%. Thus the null hypothesis should be rejected and the alternative hypothesis should be accepted which shows that cointegration is sensical(McNown, Sam et al. 2018).

Long Run Relationship:

$$Log\ EXP_t = \alpha_0 + \sum_{i=1}^{p} \left(B_1 \text{Log EXP}_{t-i}\right) + \sum_{i=0}^{p} \left(B_2\ Log\ REV_{t-i}\right) + u_t \qquad (1)$$

Where t refers to years. β_1 and β_2 refer to long run coefficients. Log EXP is the dependent variable and Log REV is the explanatory variable. u_t is the error term.

The estimated coefficient of Log revenues (REV) is 1.127 and it correlates positively with Log expenditures (significant at 5%). This reveals that a 1% increase in Log REV causes EXP to rise by 1.127%.

The equation of the long run can be written as:

EC = Log EXP – (1.127 Log REV)

Table (4-4) the relationship between revenues and expenditures

Cointegration test	
Long run	
Log revenues	1.127*** (46.52)
Short run	
Log revenues (-1)	0.607*** (4.34)
CointEq (-1)	-0.538*** (4.53)
R-square	0.99
Normality test	0.637
LM test (probability chi-square)	0.36
Heteroscedasticity	0.118
CUSUM	Figure (A-1)
CUSUMSQ	Figure (A-2)

Short-Run Relationship:

$$\Delta Log\ EXP_t = \alpha_0 + \sum_{i=1}^{p-1}\left(B_1\ \Delta \text{Log EXP}_{t-i}\right) + \sum_{i=0}^{Q-1}\left(B_2\ \Delta \text{Log REV}_{t-i}\right) + \psi ECT_{t-1} + U_t \quad (2)$$

Where Δ represents the first differences, β's refers to short-run coefficients, and ψ is the speed of adjustments to the long-run equilibrium.

According to results in table (4-4) Log REV has a positive and significant impact on Log expenditures. When Log REV increases by 1%, Log EXP rise by 0.607% in the short run.

R-square is 99% which means that 99% of the variations in the dependent variable can be explained by variation in the explanatory variable.

The coefficient of error correction form is negative and significant. This confirms that there is cointegration between the two variables in the long run. The coefficient indicates that expenditures adjust by 53% yearly to return to the equilibrium level.

4.4.3 Debt and primary budget balance:

The study estimates three models to examine the relationship between public debt, external debt, and domestic debt on primary budget balance. In the long run, the study uses the following specification of the models:

$$PB_t = \alpha_0 + \sum_{i=1}^{p}(B_1\ PB_{t-i}) + \sum_{i=0}^{p}(B_2 PD_{t-i}) + \sum_{i=0}^{p}(B_3\ OG_{t-i}) + \sum_{i=0}^{p}(B_4 EG_{t-i}) + \sum_{i=0}^{p}(B_5\ OP_{t-i}) + \sum_{i=0}^{p}(B_6 \text{Log EXR}_{t-i}) + u_t \quad (3)$$

$$PB_t = \alpha_0 + \sum_{i=1}^{p}(B_1\ PB_{t-i}) + \sum_{i=0}^{p}(B_2 ED_{t-i}) + \sum_{i=0}^{p}(B_3\ OG_{t-i}) + \sum_{i=0}^{p}(B_4 EG_{t-i}) + \sum_{i=0}^{p}(B_5\ OP_{t-i}) + \sum_{i=0}^{p}(B_6 \text{Log EXR}_{t-i}) + u_t \quad (4)$$

$$PB_t = \alpha_0 + \sum_{i=1}^{p}(B_1\ PB_{t-i}) + \sum_{i=0}^{p}(B_2 DD_{t-i}) + \sum_{i=0}^{p}(B_3\ OG_{t-i}) + \sum_{i=0}^{p}(B_4 EG_{t-i}) + \sum_{i=0}^{p}(B_5\ OP_{t-i}) + \sum_{i=0}^{p}(B_6 \text{Log EXR}_{t-i}) + u_t \quad (5)$$

Where t refers to years. β1, β2, β3, β4, β5, and β6 refer to long run coefficients. PB is the primary budget balance. PD is public debt, ED is external debt, DD is domestic debt, OG, EG, OP, EXR are output gap, expenditure gap, oil price, and exchange rate, respectively. u_t is the error term.

While in the short run, the specification of the models is:

$$\Delta PB_t = \alpha_0 + \sum_{i=1}^{p-1}(B_1 \Delta PB_{t-i}) + \sum_{i=0}^{Q-1}(B_2 \Delta PD_{t-i}) + \sum_{i=0}^{M-1}(B_3 \Delta OG_{t-i}) + \sum_{i=0}^{S-1}(B_4 \Delta EG_{t-i}) + \sum_{i=0}^{N-1}(B_5 \Delta OP_{t-i}) + \sum_{i=0}^{X-1} B_6 \Delta EXR_{t-i}) + \psi ECT_{t-1} + U_t \quad (6)$$

$$\Delta PB_t = \alpha_0 + \sum_{i=1}^{p-1}(B_1 \Delta PB_{t-i}) + \sum_{i=0}^{Q-1}(B_2 \Delta ED_{t-i}) + \sum_{i=0}^{M-1}(B_3 \Delta OG_{t-i}) + \sum_{i=0}^{S-1}(B_4 \Delta EG_{t-i}) + \sum_{i=0}^{N-1}(B_5 \Delta OP_{t-i}) + \sum_{i=0}^{X-1} B_6 \Delta EXR_{t-i}) + \psi ECT_{t-1} + U_t \quad (7)$$

$$\Delta PB_t = \alpha_0 + \sum_{i=1}^{p-1}(B_1 \Delta PB_{t-i}) + \sum_{i=0}^{Q-1}(B_2 \Delta DD_{t-i}) + \sum_{i=0}^{M-1}(B_3 \Delta OG_{t-i}) + \sum_{i=0}^{S-1}(B_4 \Delta EG_{t-i}) + \sum_{i=0}^{N-1}(B_5 \Delta OP_{t-i}) + \sum_{i=0}^{X-1} B_6 \Delta EXR_{t-i}) + \psi ECT_{t-1} + U_t \quad (8)$$

Where Δ represents the first differences, β's refers to short-run coefficients, and ψ is the speed of adjustments to the long-run equilibrium.

Table (4-5) shows the estimated relationship between public debt and budget balance. The model is estimated in three steps to confirm the relationship between two variables.

According to long-run results, column (1) shows that the estimated coefficient of public debt (PD) is 0.035 and it correlates positively with budget balance (significant at 5%). Also, output gap and expenditure gap correlate positively with primary budget balance.

In column (2) price oil was added to the equation as an additional control variable. The results confirm the positive relationship between public debt and budget balance. In column (3) exchange rate was added to the equation. Thus, budget balance became a function of public debt, output gap, expenditure gap, oil price, and exchange rate. The estimated coefficient of public debt is 0.092 and it correlates positively and significantly with budget balance. This reveals that 1% increase in public debt increases budget balance by 9.2%. The estimated coefficient of output gap is 18.13 (significant at 5%) and the estimated coefficient of expenditure gap is 7.72 (significant at 5%). Also, results confirm the negative association between the oil price and budget balance, and the positive correlation between exchange rate and budget balance.

The equation of the long run can be written as:

EC = PB – (0.092 PD + 18.13 OG + 7.72 EG - 0.099 OP + 0.294 EXR)

In the short run, results confirm the positive association between public debt and budget balance.

The parameter of error correction form in the three steps is significant and has a negative sign. This reveals that there is cointegration between the variables in the long run. The coefficient of the error correction form in column (1) is (-0.54) indicates that primary budget deficit adjusts by 54% yearly to return to the equilibrium level. Also, the parameters of error correction form in columns (2) and (3) are -0.72 and -0.92 respectively. This indicate that primary balance adjusts by 72% and 92%, respectively, yearly to return to the equilibrium.

External debt effect (DD):

Table (4-6) show the relationship between external debt and primary budget balance. The equation is estimated in three steps to confirming the relationship between external debt and primary budget deficit. column (1) shows primary budget balance as a function of external debt, output gap, and expenditure gap.

The results in column (1) show that the estimated coefficient of external debt is 0.275 and it correlates positively and significantly with budget deficit. The estimated coefficient of output gap is 11.133 (significant at 5%) while the estimated coefficient of expenditure gap is 7.07 (significant at 5%).

In column (2) primary budget balance became a function of external debt, output gap, expenditure gap, and oil price. The results show a positive association between external debt and primary balance. Also, results confirm the positive correlation between output gap and expenditure gap with primary balance. While oil price shows a negative association with primary budget balance.

In column (3) exchange rate was added to the equation. The results confirm the positive correlation between external debt and primary balance. As results show that a 1% increase in external debt causes budget deficit to rise by 16.7%. Also, the estimated coefficient of output gap is 9.60 and the estimated coefficient of expenditure gap is 6.83. Also, results confirm that the oil price correlates negatively with primary deficit while the exchange rate correlates positively with primary budget deficit.

The equation of the long run can be written as:

EC = PB – (0.l67 ED + 9.60 OG + 6.83 EG - 0.031 OP + 0.157 EXR)

According to short-run results, the results confirm the positive association between external debt and budget balance in the short run. Also, the parameter of the error correction form confirms the long run cointegration between the variables.

Domestic Debt Effect:

The results in Table (4-7) show the statistical correlation between domestic debt and the primary budget balance. column (1) in table (4-7) shows the estimation coefficients of the simple model which considers primary balance as a function of domestic debt, output gap, and expenditure gap.

The results show that the estimated coefficient correlated with domestic debt is 0.077. Also, the coefficients of output gap and expenditure gap are 29.43 and -38.92, respectively. Column (2) includes price oil as an additional control variable. The estimated coefficient of domestic debt is 0.167 confirming the positive association with the dependent variable.

In column (3) exchange rate was added as an additional control variable. The estimated coefficient of domestic debt is 0.098 which means a 1% increase in domestic debt causes primary balance to rise by 9.8%. the results also show a positive correlation between output gap and exchange rate with budget balance. and negative association between expenditure gap and oil price with primary balance.

The equation of the long run can be written as:

EC = PB – (0.098 DD - 10.62 OG – 26.94 EG - 0.096 OP + 0.779 EXR)

According to results in the short run, the results confirm the positive correlation between domestic debt and primary balance.

In tables (A-2), (A-3), and (A-4) the value of F-statistic is greater than the lower critical value and higher critical value at 1%, 5%, and 10%. This means that there is long run cointegration between the variables in the three models.

In tables (A-2) and (A-3) the long-run cointegration is sensical because the absolute value of t-statistic is higher than the absolute value of lower and higher critical values. While in table (A-4) cointegration is not sensical.

4.4 Robustness:

After estimating coefficients, it is very important to run the diagnostic tests. These tests are Breusch-Godfrey serial correlation LM test to examine the existence of serial correlation in the residuals. The null hypothesis of the test is there is no serial correlation in residuals. To accept this hypothesis the probability of Chi-square should be more than 0.05. Also, Breusch- Pagan-Godfrey test for heteroscedasticity in the model, Jarque-Bera test for normality, CUSUM and CUSUMSQ for the stability of the model.

According to the results in Table (A-4), the probability of F-statistic in Breusch-Godfrey serial correlation LM test is more than 0.05. Thus, this confirms that there is no serial correlation in residuals. Also, the p-value of Chi-square is more than 0.05 which means that heteroscedasticity does not exist in the model.

According to the normality test, the P-value of the Jarque-Bera is more than 0.05 which confirms that residuals follow the normal distribution.

Finally, the study draws the CUSUM and CUSUMQ graphs to test the stability of the model. According to figures (A-1) to (A-20), coefficients are between the critical bounds which denote that the model is stable.

Results in tables (4-5), (4-6), and (4-7) confirm that there is no serial correlation in residuals, there is homoscedasticity in the two models, and the coefficients are stable over time. The results of the normality test in tables (4-5) and (4-6) prove that residuals follow the normal distribution. While in table (4-7) the results show that residuals don’t follow the normal distribution.

Table (4-5) Model 1, (4-6) Model 2 and (4-7) Model 3

	Table (4-5) Public Debt			Table (4-6) External Debt			Table (4-7) Domestic Debt		
Variable	**Long Run**								
	Model (1)			**Model (2)**			**Model (3)**		
Step	**-1**	**-2**	**-3**	**-1**	**-2**	**-3**	**-1**	**-2**	**-3**
PD / DD /ED	**0.035*****	**0.06*****	**0.092*****	**0.275*****	**0.177*****	**0.167*****	**0.077*****	**0.167*****	**0.098****
	(6.46)	(8.8)	(14.35)	(9.22)	(9.5)	(9.56)	(3.32)	(4.51)	(1.83)
OG	**26.03*****	**16.22*****	**18.13*****	**11.13*****	**5.77****	**9.60****	**-29.43*****	**-17.62****	**-10.62****
	(3.1)	(3.15)	(5.56)	(4.08)	(1.8)	(1.76)	(2.16)	(1.95)	(1.92)
EG	**6.65**	**7.69****	**7.72*****	**7.07*****	**7.05*****	**6.83*****	**-38.92*****	**-23.10*****	**-26.94*****
	(1.32)	(1.98)	(5.6)	(3.54)	(2.53)	(3.74)	(2.27)	(2.29)	(2.92)
OP		**-0.029*****	**-0.099*****		**-0.015*****	**-0.031*****		**-0.084*****	**-0.096*****
		(-3.26)	(-8.4)		(-2.06)	(-3.7)		(-3.2)	(-3.82)
EXR			**0.294*****			**0.157****			**0.779****
			(6.68)			(2.03)			(2.15)
Short Run									
PD/DD/ED (-1)	**.019*****	**.044*****	**0.085*****	**0.244*****	**0.139*****	**0.121*****	**0.016**	**0.053****	**0.032**
	(2.28)	(2.27)	(4.21)	(4.43)	(5.002)	(4.32)	(1.52)	(2.07)	(2.42)
OG (-1)	**14.24*****	**11.79**	**16.83*****	**9.90*****	**4.55**	**6.99****	**-6.35**	**-5.58**	**-3.47**
	(1.83)	(1.55)	(3.56)	(2.99)	(1.35)	(1.97)	(1.46)	(1.33)	(0.81)
EG(-1)	**3.64**	**5.59**	**7.17*****	**6.28*****	**5.55*****	**4.97*****	**-8.39*****	**-7.32****	**-8.82*****
	(0.739)	(1.142)	(3.96)	(3.56)	(2.91)	(2.58)	(2.22)	(1.99)	(2.43)
OP (-1)		**-0.021**	**-0.09*****		**-0.011**	**-0.022****		**-0.026**	**-0.031**
		(-1.41)	(-4.06)		(-1.4)	(-1.73)		(-1.56)	(-1.55)
EXR (-1)			**0.273*****			**0.114*****			**0.255**
			(2.63)			(1.15)			(1.6)
Dummy			**0.364**			**0.82**			**0.94**
			(0.312)			(0.635)			(0.742)
CointEq(-1)	**-0.54*****	**-0.72*****	**-0.928*****	**-0.88*****	**-0.788*****	**-0.728*****	**-0.21*****	**-0.31*****	**-0.327*****
	-4.99	**-5.77**	**-7.16**	**-6.18**	**-5.98**	**-5.82**	**-3.55**	**-4.22**	**-5.47**
R-square	**0.92**	**0.94**	**0.83**	**0.85**	**0.75**	**0.74**	**0.83**	**0.85**	**0.89**
Normality test	**0.339**	**0.424**	**0.113**	**0.69**	**0.576**	**0.58**	**0.085**	**0.01**	**0.005**
LM test (probability chi-square)	**0.596**	**0.759**	**0.84**	**0.461**	**0.789**	**0.626**	**0.441**	**0.354**	**0.19**
Heteroscedasticity (probability chi-square)	**0.861**	**0.589**	**0.556**	**0.976**	**0.383**	**0.419**	**0.905**	**0.946**	**0.98**
CUSUM (Figure)	**(A-3)**	**(A-4)**	**(A-5)**	**(A-9)**	**(A-10)**	**(A-11)**	**(A-15)**	**A-(16)**	**(A-17)**
CUSUMSQ (Figure)	**(A-6)**	**(A-7)**	**(A-8)**	**(A-12)**	**(A-13)**	**(A-14)**	**(A-18)**	**(A-19)**	**(A-20)**

The absolute t-statistic values are in parentheses () below the coefficients of the regressors.
(***, **, *) denote significance level at 1%, 5%, and 10%, respectively.

4.5 Finding

The co-integration test's first approach revealed a significant positive relationship between the regression of revenues on expenditure, which is robust with a coefficient of 1.127. that means the public debt in Egypt is sustainable.

Furthermore, the coefficient of error correction factor indicates that expenditures adjust by 53% yearly to return to the equilibrium level.

The ARDL Bounds testing result indicated a co-integration relationship between the independent variables: debt, production gap, spending gap, oil prices, and the exchange rate in the direction of the primary balance. It also confirmed that this relationship is stable by carrying out F-statistic and t-statistic tests.

The ARDL Bounds testing results, in the long run, revealed that:

First Model (1) Public Debt

1. The results revealed a statistically significant and positive regression between changes in public debt as a percentage of GDP and the primary budget balance with a coefficient of 9.28 %, which means (statistically significant in 1%). That when the government borrows a debt equivalent to 9.28% of GDP, it adjusts the primary budget by 1% of GDP to maintain the public debt sustainable. So, the fiscal policy is countercyclical. The result is consistent with this study's hypothesis, which means the financial policy fulfills the intertemporal budget constraint and solvency needed for Debt sustainability.

2. The results also showed a statistically significant and positive relationship between the output gap and the expenditure gap on the primary budget balance—the estimated coefficients were18.13 and 7.72, respectively (statistically significant at 1%).

That means the government increases the primary balance if the output fluctuation rises. And the response represents an adjustment in the case of the expenditure gap. Here in Egypt, the government policy is countercyclical.

The result is consistent with this study's hypothesis and the literature that claims the financial policies of emerging countries function in the same direction of the business cycle, which worsens the debt problem. However, in

the advanced economy, economic policies operate in the opposite direction of the business cycle.

But the high value of the parameters indicates the weak response from the government to take a counter-reaction to the economic cycle.

3. The results also confirmed the negative association between the oil price and budget balance; an increase in world oil prices by 9.9% causes a decrease in the primary balance by 1% of GDP (statistically significant at 1%), which indicates the meaningful impact of the change in oil prices on the primary budget balance in Egypt.

4. The result found a positive correlation between the exchange rate and budget balance. The devaluation of the currency price by 29.4% leads to an improvement in budget conditions by 1% of GDP (statistically significant at 1%). This show that, in Egypt's case, the devaluation of local currency reduces spending on imported goods and services, encourages exports, increases demand for domestic goods and services, and increases the flow of foreign exchange, which leads to a modification in deficit conditions—the current account and, therefore, the primary balance. Although, the devaluation of local currency leads to an increase in the actual value of external debt and the value of the import bill of goods and services.

5. The study finally showed that the effect of political stability is not significant.

Model (2) Domestic Debt

The results of the external debt differed from the public debt, neither in statistical significance nor in correlation. Only differed in the value of the parameters, which came as follows: 0.167, 9.6, 6.8, -0.03, and 0.157 for Domestic debt, output gap, expenditure gap, oil prices, and exchange rate, respectively.

Model (3) Domestic Debt

The results of the domestic debt were like the public debt, except in:

The debt parameter came to almost the same value with a statistical significance of 10%. But the result revealed that the parameter sign of the output and expenditure gap is negative, which means that fiscal policy is

procyclical. The parameter's value is also high, which confirms the weak response to the financial policies taken by the government.

The ARDL Bounds testing results, in the short run, revealed that:

The error correction parameter for all models was statistically significant and had a negative sign. And indicated that the government needs to correct the error caused by shocks and return to a position of equilibrium, 92.8%, 72.8%, and 32.7% of the year, for the public, external, and domestic debt, respectively.

It also showed the lagged debt from the previous year affected the primary budget balance to 8.5%, 12.1%, and 3.2% for public debt, external, and domestic, respectively.

And the one-year effect of the output and expenditure gaps did not change except for the value of the parameters, which confirms that the response of the primary balance to the policies is weak and countercyclical about public and external debt and the procyclical of domestic debt.

The delayed change in oil prices for one year negatively affects the primary budget balance. In contrast, the impact of the exchange rate affects positively.

Finally, the impact of political instability factors was insignificant, such as in the long term.

5. Conclusion and Recommendation:

This study aimed to estimate the reaction of the fiscal policy to fluctuations in output and expenditure to maintain the sustainability of debt.

This study used an empirical approach by annual time series data from 1990 to 2020. the study employed the ARDL Bound testing estimation. As outstanding models for estimating co-integration and assessing the response of the conditional variable to the independent variables.

The tests were carried out through two approaches to confirm the validity and documentation of the results.

The first approach examined debt sustainability through the co-integration methodology. The regression of revenue over expenditure was estimated.

The second utilized the model to estimate the impact of debt on the primary budget (Fiscal Reaction Function approach) in addition to examining the response of the primary budget balance to fluctuations in output and expenditure, as well as the impact of changes in oil prices and exchange rates. Further, the study employed a dummy variable to investigate the effect of political instability.

The study also examined the public debt as a total and then investigated the impact of external debt and domestic debt separately. The application was in three steps for each model. The finding of this study can be summarized as follows:

The co-integration test's first approach revealed a significant positive relationship between the regression of revenues on expenditure, which is robust with a coefficient of 1.127. that means the public debt in Egypt is sustainable.

Furthermore, the coefficient of error correction factor indicates that expenditures adjust by 53% yearly to return to the equilibrium level.

The ARDL Bounds testing result indicated a co-integration relationship between the independent variables: debt, output gap, expenditure gap, oil prices, and the exchange rate in the direction of the primary balance. It also confirmed that this relationship is stable by carrying out F-statistic and t-statistic tests.

The results revealed a statistically significant and positive regression between changes in public debt as a percentage of GDP and the primary budget balance with a coefficient of 9.28 %, which means (statistically significant in 1%).

The results also showed a statistically significant and positive relationship between the output gap and the expenditure gap on the primary budget balance—the estimated coefficients were18.13 and 7.72, respectively (statistically significant at 1%). The results also confirmed the negative association between the oil price and budget balance; an increase in world oil prices by 9.9% causes a decrease in the primary balance by 1% of GDP (statistically significant at 1%). The result found a positive correlation between the exchange rate and budget balance. The study finally showed that the effect of political stability is not significant.

The error correction parameter for all models was statistically significant and had a negative sign. And indicated that the government needs to correct the error caused by shocks and return to a position of equilibrium, 92.8%, 72.8%, and 32.7% of the year, for the public, external, and domestic debt, respectively.

It also showed the lagged debt from the previous year affected the primary budget balance to 8.5%, 12.1%, and 3.2% for public debt, external, and domestic, respectively.

Recommendation:

Although the study results confirm the sustainability of debt, Egypt significantly exceeds the debt threshold set by the World Bank for emerging countries, 70% of GDP. For a long time, the average debt-to-GDP ratio has exceeded 85 % in the study period. In addition, much of the literature confirms that economies in emerging countries face severe obstacles when debt exceeds the threshold of 90% of GDP.

In the light of the result, the recommendation can be summarized in the following point:

- The government should not exaggerate or underestimate the arrival of the public debt to this extent. In all cases, it is required to delay acquiring more government loans or external debt and a lot of wisdom in dealing with the debt problem.
- Commitment to achieving a primary surplus in the general budget for the coming years, i.e., increasing revenues over expenditures, except debt service from interests and due installments.
- New loans certainly must not exceed the amount of the primary surplus to ensure the sustainability of the debt. This surplus contributes to financing part of the cost of the debt, thus reducing the total budget deficit and, with it, the need to borrow.
- Increasing GDP growth rates would boost the economy's ability to service debt and absorb new loans.
- The exchange rate is an influential factor in the debt problem in Egypt. thus must take into account the potential shocks of foreign inflows. A flexible policy in determining the exchange rate and working to form an international monetary reserve helps absorb sudden fluctuations.

- The increase in oil prices negatively affects debts. Therefore, natural gas must be relied upon as the primary energy source in Egypt, in addition to expanding the use of renewable energy.
- The interest rate affects the size and sustainability of debts. Therefore, achieving the required balance must be considered.
- It is creating a boom in public debt management, especially in using loans in projects with an economic and social return that exceeds their cost.
- It should be working to extend the life of the debt by limiting short and medium-term borrowing.
- Although the financial policies in Egypt are countercyclical, their impact is weak. Therefore, the effects of fiscal policies must be revisited. Such as adopting a budgetary reform strategy focused on improving the tax structure, broadening the tax base, and increasing tax recovery, developing a tax system that follows international standards, and enhancing tax gradation. Moreover, spending should be rationalized by revisiting some sub-items to solve the budget deficit, integrating the informal sector, and curbing tax evasion. Enhancing the business environment to attract and retain domestic and foreign investment can be an excellent alternative to debt.
- Dependence on foreign debts must be diminished, as the growth of foreign debt has escalated at a high rate considering a procyclical fiscal policy, which may raise concerns and fears of an explosion of debt, which may cause an explosion of debt.
- It should Issue legislation to define the debt threshold as a percentage of GDP and set a ceiling for the budget deficit.

References

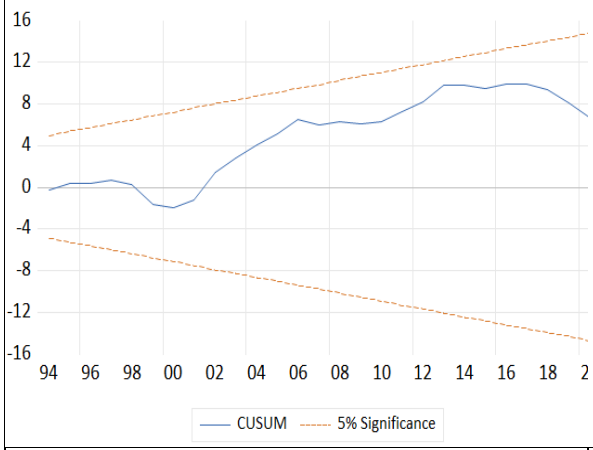
1. Abbas, S. A. P. and K. S. Alex_ Rogoff (2020). "Sovereign Debt, Sovereign debt a guide for conomists and practitioners." (Oxford University Press).
2. Abbas, S. A., A. Pienkowski and K. Rogoff (2019). Sovereign debt: A guide for economists and practitioners, Oxford University Press.
3. Abdel-Khalek, G. (2007). MDG-based Debt Sustainability Analysis, Country Discussion Paper prepared for a joint UNDP/UNDESA initiative on ….
4. Abutaleb, A. S. and M. G. Hamad (2012). "Optimal foreign debt for Egypt: A stochastic control approach." Economic Modelling 29(3): 544-556.
5. Ahmed, S. and J. H. Rogers (1995). "Government budget deficits and trade deficits Are present value constraints satisfied in long-term data?" Journal of Monetary Economics 36(2): 351-374.
6. Al Sayed, O., A. Samir and H. H. Anwar (2021). "Assessing fiscal sustainability in Egypt: a comparative study." Review of Economics and Political Science 6(4): 292-310.
7. Alba, P., S. Shawarby and F. Iqbal (2004). Fiscal and public debt sustainability in Egypt, World Bank, Middle East and North Africa, the Office of the Chief Economist.
8. Alnashar, S. (2019). "Egypt's government debt: Perpetual deficits and exchange rate depreciations." The World Bank.
9. Baharumshah, A. Z. and E. Lau (2007). "Regime changes and the sustainability of fiscal imbalance in East Asian countries." Economic Modelling 24(6): 878-894.
10. Bank, W. (2005.). "Fiscal and Public Debt Sustainability: Egypt Public Expenditure Review." (World Bank.).
11. Barnhill, T. and G. Kopits (2003). "Assessing fiscal sustainability under uncertainty."
12. Baum, A., C. Checherita-Westphal and P. Rother (2013). "Debt and growth: New evidence for the euro area." Journal of international money and finance 32: 809-821.
13. Blanchard, O. (1993). "Consumption and the Recession of 1990-1991." The American Economic Review 83(2): 270-274.
14. Blanchard, O. J., J.-C. Chouraqui, R. Hagemann and N. Sartor (1991). "The sustainability of fiscal policy: New answers to an old question." NBER Working Paper(R1547).
15. Bohn, H. (1998). "The behavior of US public debt and deficits." the Quarterly Journal of economics 113(3): 949-963.
16. Borensztein, E. and U. Panizza (2009). "The costs of sovereign default." IMF Staff Papers 56(4): 683-741.
17. Chalk, N. and R. Hemming (2000). Assessing fiscal sustainability in theory and practice. Fiscal Sustainability Conference.
18. Cohen, D. (1999). The sustainability of African debt, World Bank Publications.
19. D'Erasmo, P., E. G. Mendoza and J. Zhang (2016). What is a sustainable public debt? Handbook of macroeconomics, Elsevier. 2: 2493-2597.
20. Da Costa, E., A., C. S. a. W. and Baghdassarian (2004). "Assessing Three Models for the Analysis of Debt Sustainability." (Getulio Vargas Foundation. April. Unpublished.).
21. de Mello, L. (2005). "Estimating A Fiscal Reaction Function."
22. Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association, 74(366a), 427-431.
23. Dooley, M., W. Helkie, R. Tryon and J. Underwood (1986). "An analysis of external debt positions of eight developing countries through 1990." Journal of Development Economics 21(2): 283-318.

24. Égert, B. (2010). "Fiscal Policy Reaction to the Cycle in the OECD: Pro-or Counter-cyclical?".
25. El-Mahdy, A. M. and N. M. Torayeh (2009). "Debt sustainability and economic growth in Egypt." International journal of Applied Econometrics and quantitative studies 6(1): 21-55.
26. Escolano, J., A. Shabunina and J. Woo (2011). "The Puzzle of Persistently Negative Interest Rate-Growth Differentials: Financial Repression or Income Catch-Up? 1." IMF Working Papers 2011(260).
27. FAD, S. A., K. Garcia, D. Hostland, M. Jarmuzek, A. Jewell and K. Kalonji (2018). "debt sustainability in market access countries (MACs), particularly in AEs. As."
28. Fatás, A. and I. Mihov (2001). "Government size and automatic stabilizers: international and intranational evidence." Journal of international economics 55(1): 3-28.
29. Ferrarini, B. and A. Ramayandi (2012). Public debt sustainability assessments for developing Asia. Public Debt Sustainability in Developing Asia, Routledge: 61-123.
30. Frimpong, J. and E. Oteng-Abayie (2006). "The impact of external debt on economic growth in Ghana: a cointegration analysis." Journal of Science and Technology (Ghana) 26(3): 122-131.
31. Galí, J. (1994). "Government size and macroeconomic stability." European Economic Review 38(1): 117-132.
32. Guo, J.-T. and S. G. Harrison (2006). "Government size and macroeconomic stability: A comment." European Economic Review 50(5): 1339-1346.
33. Hamilton, J. D. and M. Flavin (1985). On the limitations of government borrowing: A framework for empirical testing, National Bureau of Economic Research Cambridge, Mass., USA.
34. Hashem, H. Y. M. and H. A. Fahmy (2019). "Sensitivity of public debt to macroeconomic shocks: An application to the Egyptian economy." Business and Economic Horizons (BEH) 15(1232-2020-344): 219-241.
35. IMF (2002). "Assessing Sustainability." the Policy Development and Review Department(May 28, 2002).
36. Köhler-Töglhofer, W. and M. Zagler (2007). "The composition of the government budget and the dynamics of public debt." FinanzArchiv/Public Finance Analysis: 244-263.
37. Krueger, A. O. (2002). A new approach to sovereign debt restructuring. A New Approach to Sovereign Debt Restructuring, International Monetary Fund.
38. Kunvoro, H. (2011). "The indonesias state budget sustainability and its implication for financial system stability." Romanian Journal of Fiscal Policy (RJFP) 2(1): 36-53.
39. Ley, E. (2009). "Fiscal (and external) sustainability."
40. Massoud, A. A. (2014). "Dealing with the Increasing Public Debt in Egypt." International Journal of Social Science Studies 3(1).
41. Owusu-Nantwi, V. and C. Erickson (2016). "Public debt and economic growth in Ghana." African Development Review 28(1): 116-126.
42. Pattillo, C. and L. A. Ricci (2011). "External debt and growth." Review of economics and institutions 2(3): 30.
43. Phillips, P.C.B., Perron, P., 1988. Testing for a unit root in time series regressions. Biometrica 75, 335–346. Sari, R., Soytas, U., 2004. Disaggregate energy consumption, employment, and income in Turkey. Energy Economics 26, 335–344.
44. Ramey, G. and V. A. Ramey (1994). Cross-country evidence on the link between volatility and growth, National bureau of economic research Cambridge, Mass., USA.
45. Sørensen, B. E., L. Wu and O. Yosha (2001). "Output fluctuations and fiscal policy: US state and local governments 1978–1994." European Economic Review 45(7): 1271-1310.

46. Trehan, B. and C. E. Walsh (1988). "Common trends, the government's budget constraint, and revenue smoothing." Journal of economic dynamics and control 12(2-3): 425-444
47. Trehan, B. and C. E. Walsh (1991). "Testing intertemporal budget constraints: Theory and applications to US federal budget and current account deficits." Journal of Money, Credit and banking 23(2): 206-223.
48. Wyplosz, C. (2005). "Sustainability in Brazil." Inflation targeting, debt, and the Brazilian experience, 1999 to 2003: 193.
49. Wyplosz, C. (2007). Debt sustainability assessment: The IMF approach and alternatives, Graduate Institute of International Studies Geneva.
50. Wyplosz, C. (2011). "Debt sustainability assessment: Mission impossible." Review of Economics and Institutions 2(3): 37.
51. Abbas, S. A., A. Pienkowski and K. Rogoff (2019). Sovereign debt: A guide for economists and practitioners, Oxford University Press.
52. Bohn, H. (1998). "The behavior of US public debt and deficits." the Quarterly Journal of economics 113(3): 949-963.
53. Borensztein, E. and U. Panizza (2009). "The costs of sovereign default." IMF Staff Papers 56(4): 683-741.
54. Chalk, N. and R. Hemming (2000). Assessing fiscal sustainability in theory and practice. Fiscal Sustainability Conference.
55. De Masi, M. P. (1997). IMF estimates of potential output: theory and practice, International Monetary Fund.
56. Dickey, D. A. and W. A. Fuller (1979). "Distribution of the estimators for autoregressive time series with a unit root." Journal of the American statistical association 74(366a): 427-431.
57. Hodrick, R. J. and E. C. Prescott (1997). "Postwar US business cycles: an empirical investigation." Journal of Money, credit, and Banking: 1-16.
58. McNown, R., C. Y. Sam and S. K. Goh (2018). "Bootstrapping the autoregressive distributed lag test for cointegration." Applied Economics 50(13): 1509-1521.
59. Ministry of Finance "Financial Monthly."
60. Pesaran, M. H., Y. Shin and R. J. Smith (2001). "Bounds testing approaches to the analysis of level relationships." Journal of applied econometrics 16(3): 289-326.
61. Phillips, P. C. and P. Perron (1988). "Testing for a unit root in time series regression." Biometrika 75(2): 335-346.
62. Trehan, B. and C. E. Walsh (1988). "Common trends, the government's budget constraint, and revenue smoothing." Journal of economic dynamics and control 12(2-3): 425-444.

Appendix

Figure (A-1)



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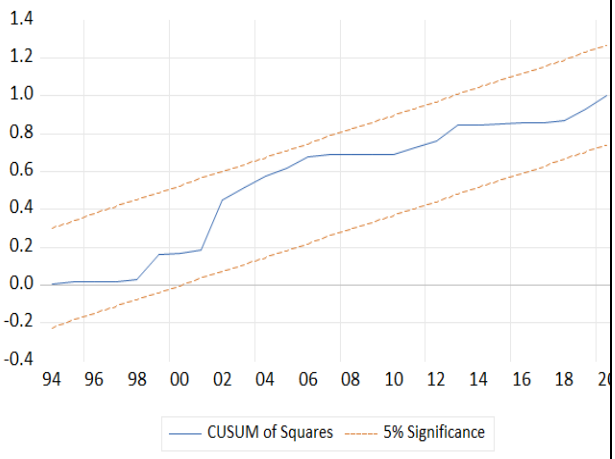

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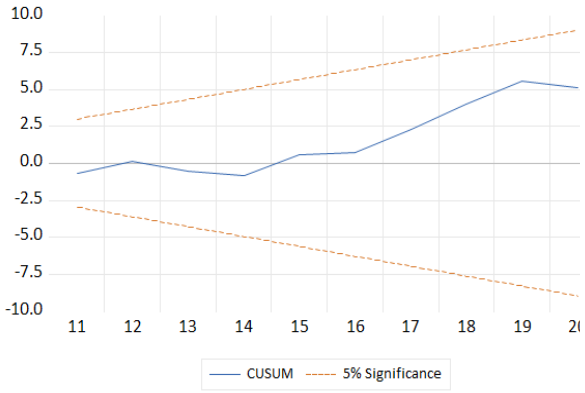

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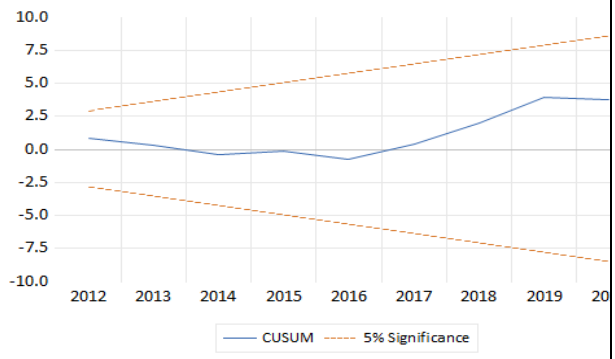

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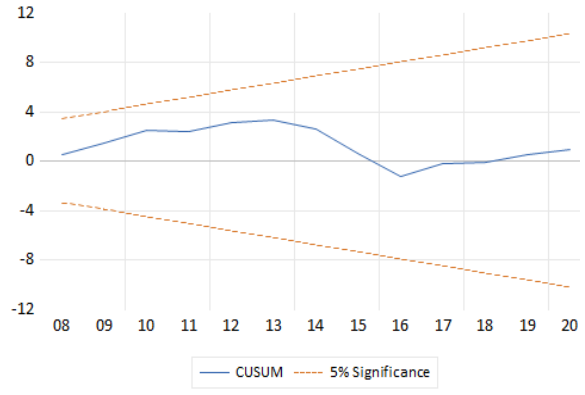

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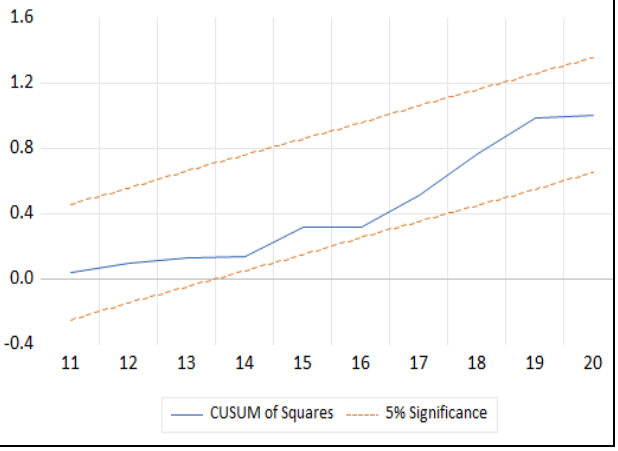

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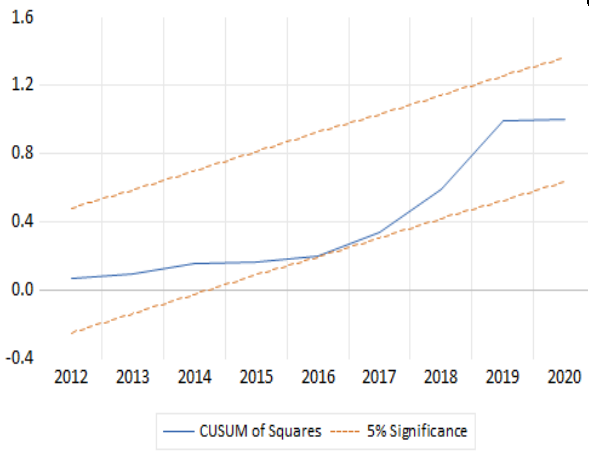

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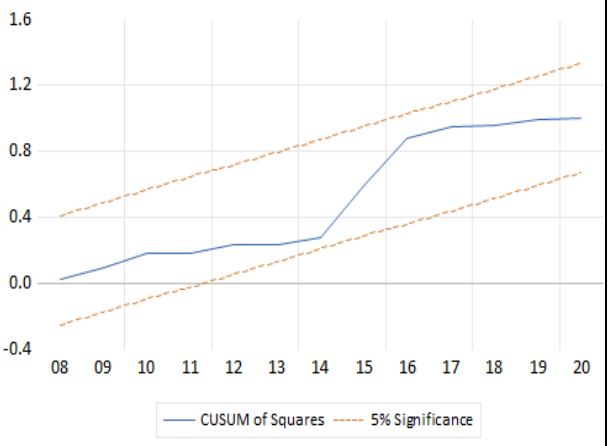

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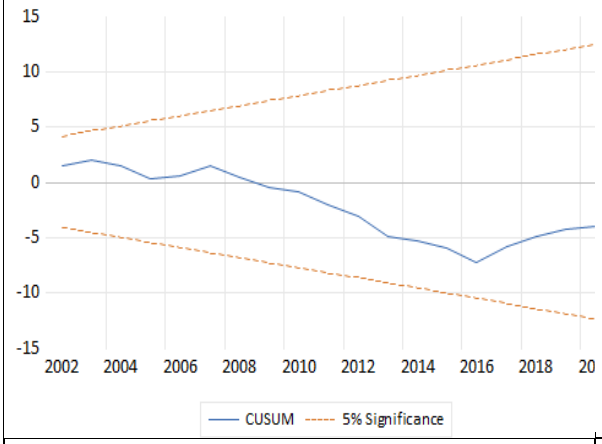

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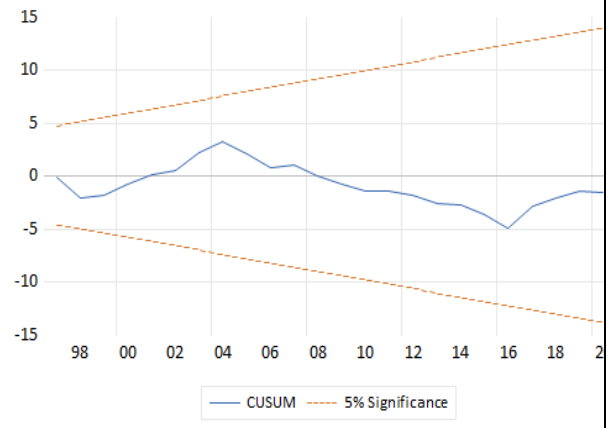

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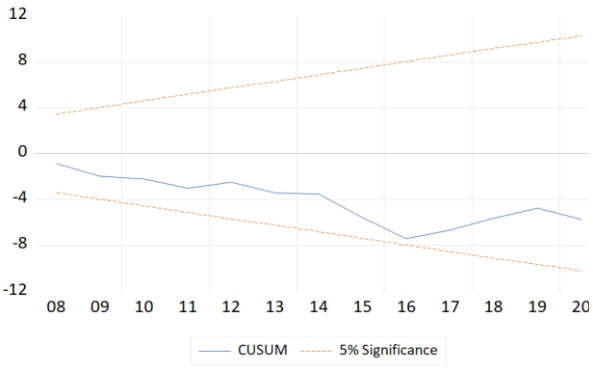

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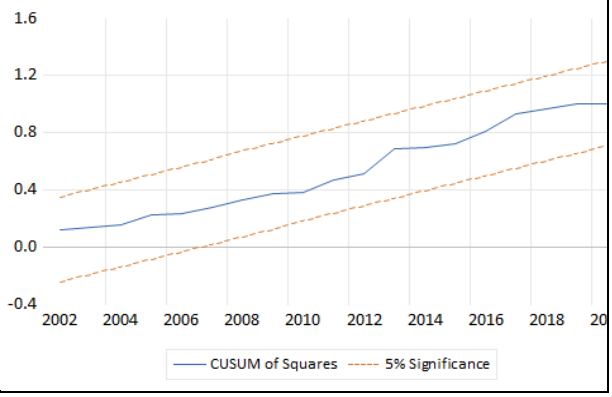

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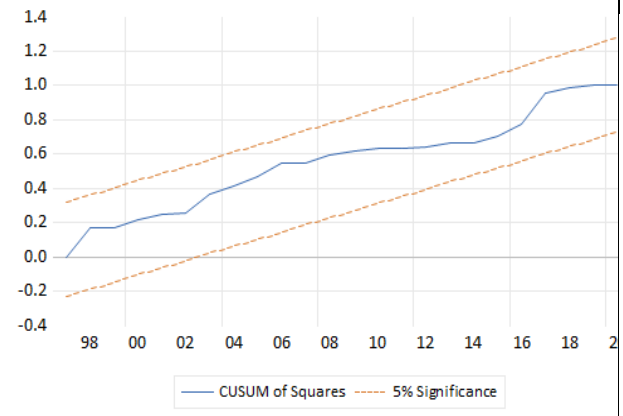

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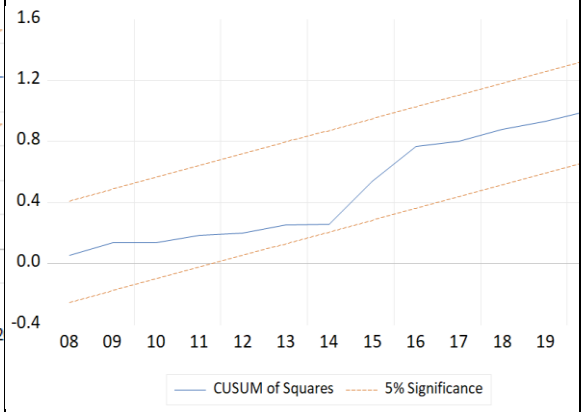

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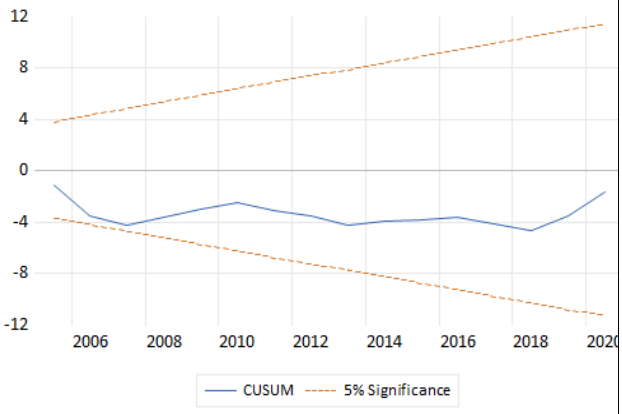

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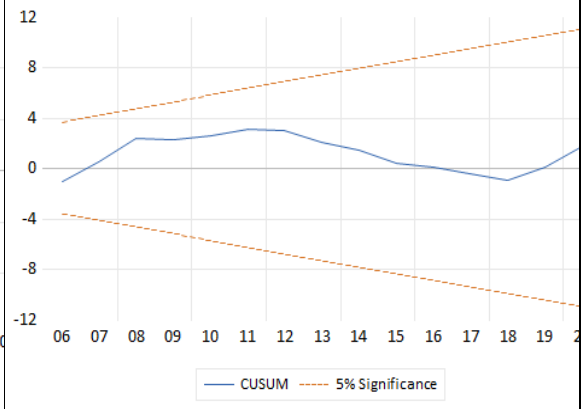

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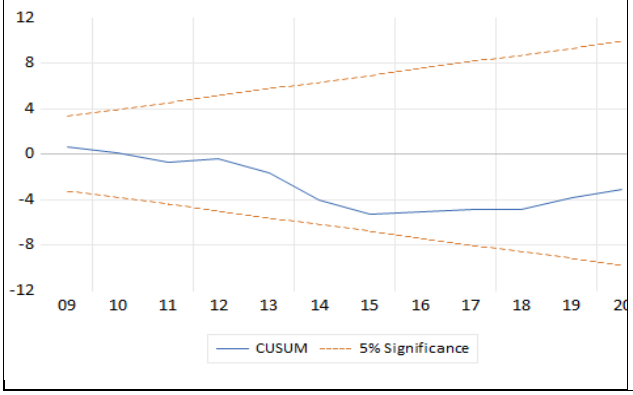

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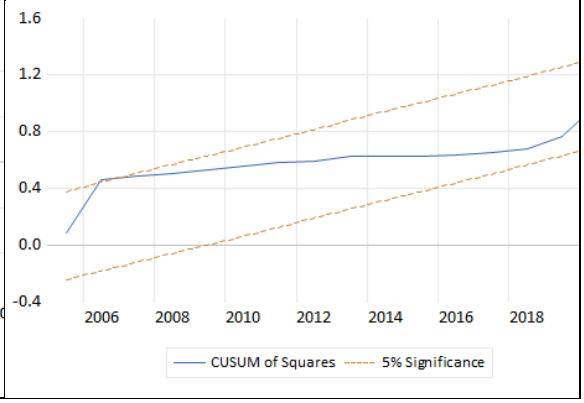

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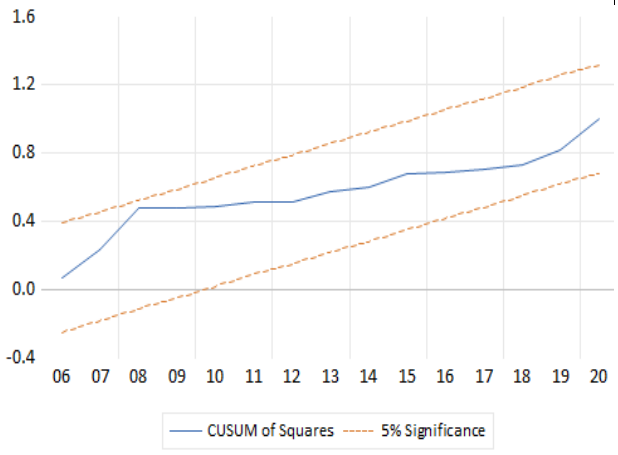

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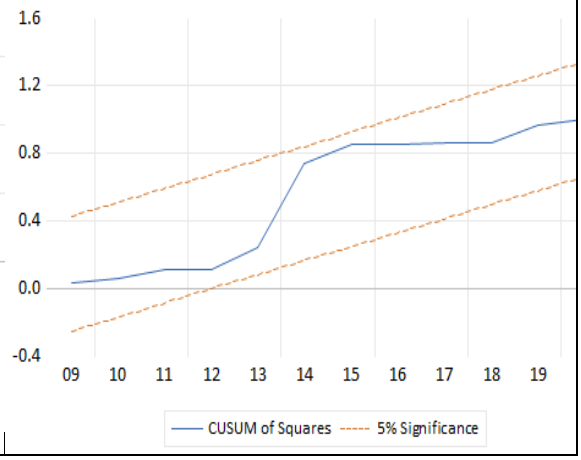

Table (A-1) Bounds test results:

F-Stat./ T-Stat.	Critical value at					
	5%		10%		1%	
	Lower	Upper	Lower	Upper	Lower	Upper
F: 9.91	4.94	5.73	4.04	4.78	6.84	7.84
t: -4.41	-2.86	-3.22	-2.57	-2.91	-3.43	-3.82

K=1, where K denotes the number of explanatory variables.

Table (A-2) Bounds test results:

F: 6.769	2.14	3.34	1.81	2.93	2.82	4.21
t: -5.55	-1.95	-3.83	-1.62	-3.49	-2.58	-4.44

K=5, where K denotes the number of explanatory variables.

Table (A-3) Bounds test results:

F: -4.63	2.14	3.34	1.81	2.93	2.82	4.21
t: -4.94	-1.95	-3.83	-1.62	-3.49	-2.58	-4.44

K=5, where K denotes the number of explanatory variables.

Table (A-4) Bounds test results:

F: -3.52	2.14	3.34	1.81	2.93	2.82	4.21
t: (-2.42	-1.95	-3.83	-1.62	-3.49	-2.58	-4.44

K=5, where K denotes the number of explanatory variables.