ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية
Working Paper Series

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Working Paper No. 1376

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December 2019

The author would like to thank Diaa Noureldin, Assistant Professor at the American University in Cairo for his valuable comments and suggestions at the Economic Research Forum's Annual Conference. The author is also grateful to Fatma El-Ashmawy, Senior Economist at the Ministry of Finance for providing very useful insights.

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First published in 2019 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

Is government debt solely a fiscal phenomenon? This paper aims to understand what drives government debt in Egypt. Towards this end, a debt decomposition exercise is undertaken, using annual data for FY2001/02—FY2016/17 to disentangle and quantify the cumulative impacts of the primary deficit to GDP ratio, movements in the exchange rate, the real interest rate, and real growth. Additionally, a Vector-Autoregression analysis is conducted, using quarterly data for FY2004/05—FY2016/17, including the same variables of interest, but also accounting for the borrowing by the public business sector (that is, to capture extra-budgetary obligations).

The findings from both the debt decomposition as well as the VAR estimation show that the primary deficit and the exchange rate depreciations have been the leading causes of debt accumulation in Egypt. Importantly, the analysis also points to extra-budgetary (below-the-line) items that have been contributing to higher-than-warranted government debt accumulation. Further, this research provides evidence that the domestic debt is partially inflated away, as the real interest rates have been negative for the larger part of the periods under study.

The bottom-line of this research is that Egypt's government debt is a multi-faceted problem, finding its roots not only in fiscal policy, but also in exchange rate policy, as well as in key fiscal transparency issues.

Keywords: Egypt, government debt, debt dynamics, VAR, primary balance, exchange rate, fiscal transparency
JEL Classifications: E60, E61, H60

I. INTRODUCTION

Government debt in Egypt has generally been elevated. The debt-to-GDP ratio has averaged 97 percent between FY2001/02—FY2017/18. This reflects Egypt's long-standing macro-fiscal imbalances, in the form of large fiscal deficits, modest real GDP growth, as well as the episodes of abrupt exchange rate depreciations that have had adverse valuation effects on the debt level. Throughout the past two decades, Egypt had successfully (but temporarily) brought down the debt-to-GDP ratio during periods of fiscal consolidation and growth spurts. It is important thus to understand what drives these surges (and reductions) in government debt in Egypt, in order to identify the conditions under which Egypt can put the debt-to-GDP ratio on a consistent downward trajectory.

Consolidating Egypt's public finances is crucial for the overall health of the economy. Indeed, Egypt's historically loose fiscal stance – manifested in the large fiscal deficit and debt levels over the past two decades – has entailed large financing needs. This has distorted the incentives of banks which found it safer, and at times, more profitable to lend to the government instead of the private sector. It has also contributed to inflationary pressures, especially due to the liquidity expansion fueled by the accelerating credit extended to the government. Additionally, the high (and rising) domestic price level associated with credit growth, in turn, contributed to real exchange rate appreciation, loss of competitiveness, a deterioration in the net exports balance, and finally an inevitable need to re-align the exchange rate at a weaker level. In fact, the two episodes of exchange rate depreciation, in the recent past (in FY2002/03 and again in FY2016/17) have occurred following periods of deteriorated government debt-to-GDP ratios that surpassed 100 percent of GDP. In turn, the exchange rate depreciation implies higher foreign currency interest payments in the State budget, and a higher government debt-to-GDP ratio (due to the valuation effect). This can lead the economy into a vicious cycle of macroeconomic imbalances. In brief, resolving the government debt problem in Egypt, is conducive to a sound overall macroeconomic environment.

The objective of this research paper is to disentangle and quantify the contributions of the various drivers of government debt accumulation, including the primary balance, the interest-growth differential, the exchange rate, as well as "below-the-line" (extra-budgetary) spending or on-lending by the government.

Using annual data for FY2001/02—FY2016/17, this research paper employs the International Monetary Fund's Market Access Debt Sustainability Analysis tool (IMF's MAC-DSA tool) in order to undertake a debt dynamics decomposition exercise that quantifies the contributions of the following variables to debt accumulation: the primary deficit-to-GDP ratio, the exchange rate, the real interest rate and real growth. This analysis shows that the primary deficit, followed by the adverse valuation effect of the exchange rate depreciations have been the leading causes of debt accumulation in Egypt. The analysis also provides evidence that the domestic debt is partially inflated away. This might explain the authorities' difficulty in extending the maturities of its domestic debt, as potential holders of sovereign debt would refrain from purchasing debt that may lose its 'real' value in the future. Importantly, an 'unidentified residual' that also contributes to debt accumulation emerges from this debt dynamics analysis, which points to fiscal transparency problems that show how unclear, below-the-line items or on-lending by the government may lead to higher-than-anticipated debt accumulation.

This research also conducts a Vector Autoregression (VAR) analysis, using quarterly data for the period FY2004/05—FY2016/17, including the following 5 endogenous variables: (i) the primary deficit, (ii) public

business sector borrowing from the banking sector, (iii) the interest rate, (iv) the nominal exchange rate and (v) the debt stock. The purpose of running this VAR estimation is to model the joint behavior of these variables that are deemed as relatively important contributors to government debt accumulation in Egypt. It is emphasized here that the "public sector borrowing" that is included in the VAR is meant to capture below-the-line borrowing that *might eventually* lead to government debt accumulation. Even though this variable represents the public business sector's borrowing from the *bank*ing *system (i.e., it is extra-budgetary borrowing from banks)*, it is arguably relevant to government debt analysis: Indeed, part of the public business sector's borrowing is covered by sovereign guarantees, and thus can be considered as a contingent liability (i.e., may end up becoming a direct liability on the budget, if these obligations do materialize). Thus, including the public business sector's borrowing in the VAR captures the extra-budgetary borrowing or the government's on-lending that might contribute to government debt accumulation.

The variance decomposition of the debt stock that is obtained from the VAR estimation shows that the shocks to the primary deficit stand out as the (relatively) most important contributor to the variability of government debt, followed by shocks to the exchange rate, and then the shocks to the public business sector borrowing, whereas the shocks to the interest rate are the least important. These results are broadly in line with the findings from the debt dynamics decomposition exercise.

The policy implications that follow from this research paper shed light on the multi-dimensional aspects of the government debt problem in Egypt. It is not solely a fiscal phenomenon, but rather an issue that finds its roots in exchange rate management, institutional issues such as fiscal transparency, as well as macroeconomic policy coordination, at large.

The rest of this report is organized as follows: **Section II** provides the background and literature review on "debt accumulation" and its drivers. **Section III** discusses the magnitude of Egypt's government debt during FY2001/02—FY2017/18, along with its structure in terms of maturity, residency of holder, and currency-composition. **Section IV** displays the results of the debt dynamics decomposition exercise, and presents the VAR estimation and findings. Finally, **Section V**. concludes and discusses the policy implications of this research.

II. THEORETICAL BACKGROUND AND LITERATURE REVIEW

What drives the government debt-to-GDP ratio? Government debt depends on the previous period's "stock" of debt and the current budget balance. Following the budget equation of Barro (1979), Cottarelli and Escolano (2014) express this concept, while breaking down the budget balance into interest payments and primary balance (non-interest revenues minus non-interest expenditures). Their basic identity for debt accumulation is written as:

$$\boldsymbol{D_t = (1 + i_t)D_{t-1} - P_t} \qquad \textbf{(1)}$$

Equation 1 says that the debt ***(D_t)*** at the end of period t[1] is equal to the stock of debt at the end of period t-1 ***(D_{t-1})***, augmented by interest ***($1+i_t$)*** and reduced (augmented) by the primary surplus (deficit) ***(P_t)*** (Cottarelli and Escolano, 2014).

And as public debt can be denominated in both local and foreign currencies, then the debt accumulation equation above can also be written with notations for the foreign-currency debt component as well.

$$\boldsymbol{D_t = \left(1 + i_t^D\right)(1 - \alpha_{t-1})D_{t-1} + \left(1 + i_t^F\right)(1 + e_t)\alpha_{t-1}D_{t-1} - P_t} \quad \textbf{(2)}$$

Equation 2 is adopted by the IMF in its Debt Sustainability Analysis tool,[2] where ($\boldsymbol{i_t^D}$) is the interest rate on local currency public debt; ($\boldsymbol{\alpha}$) is the proportion of public debt that is denominated in foreign currency; ($\boldsymbol{i_t^F}$) is the interest on foreign currency-denominated debt; ($\boldsymbol{e_t}$) is the exchange rate depreciation (noting that the exchange rate is the local currency value of one unit of foreign currency). As such, a depreciation would imply a positive 'e' that would lead to an increase in D_t.

The first two arguments on the right-hand side of Equation 2 say that the previous period's local currency debt is augmented by the interest rate, and the foreign currency debt is augmented by the relevant interest rate, in addition to the exchange rate depreciation.

Equation 3 below is the same as equation 1 above, but after dividing through by nominal GDP, which through algebraic derivation, can be expressed in the form of real GDP growth and real interest rate (Cottarelli and Escolano, 2014 and Escolano, 2010).

$$\boldsymbol{d_t = \frac{1+r_t}{1+g_t}d_{t-1} - p_t} \quad \textbf{(3)}$$

Equation 3 thus expresses the debt-to-GDP ratio ***(d_t)*** at the end of year ***t*** as a function of the previous year's debt-to-GDP ratio ***(d_{t-1})***, but in this case augmented by the "real interest/growth differential" ($\frac{1+r_t}{1+g_t}$), which is also called the "automatic debt dynamics"; where ***(r_t)*** is the real interest rate, and ***(g_t)*** is the real GDP growth rate at year t.

Abbas, Belhocine, El-Ganainy and Horton (2011) also add a 'residual' term to the above equation to account for what they call "stock-flow adjustment term", which represents other items that contribute to changes in the government debt-to-GDP ratio, including valuation effects of exchange rate changes, "below the line" fiscal expenditures/revenues such as bank recapitalization or privatization proceeds, as well as errors and omissions. Consequently, they further expand equation (2) as follows:

$$\boldsymbol{d_t = \frac{1+r_t}{1+g_t}d_{t-1} - p_t + SFA_t} \quad \textbf{(4)}$$

Where the newly introduced term **(SFA_t)** accounts for that unidentified residual that affects the debt-to-GDP ratio.

Several studies have previously attempted to put these above equations into application in order to determine the factors behind the evolution of the public debt-to-GDP ratio. Abbas, Belhocine, El-Ganainy and Horton have compiled data on public debt in what they called the "Historical Public Debt Database" (HPDD), covering 178 countries. They employ equation 4 to analyze the evolution of the debt-to-GDP

[1] 't' can be any period (year or quarter, etc.)

[2] The IMF's Debt Sustainability tool can be accessed at: https://www.imf.org/external/pubs/ft/dsa/mac.htm

ratio, during episodes that they had identified as "large" accumulations or reductions of debt, in 19 advanced economies between 1800 and 2007. They attributed these episodes to the three factors in their equation 4 (above), namely, the primary balance, the interest/growth differential and the stock-flow residual term. They find that the primary balance has been the relatively most important factor in reducing the debt-to-GDP ratio, whereas the favorable interest/growth differential was more important during the World War II period to contain the accumulation of public debt. The impact of the 'residual' term on debt dynamics seems to be relatively more prominent during the episodes of large debt "increases". This, in part was due to the fact that they have not included the exchange rate as a separate explicit determinant of changes in the debt-to-GDP ratio. Thus, exchange rate valuation effects, in part, explained these large contributions from the residuals in the Abbas, Belhocine, El-Ganainy and Horton study. The realization of contingent liabilities was one other factor that they believe explains the large contribution of the residual factor to the growth in the public debt-to-GDP ratio.

Jaimovich, Panizza and Campos (2006) regress the debt-to-GDP ratio on the deficit to GDP ratio, in a panel dataset, controlling for heterogeneity across the countries by using fixed effects. They find that this model is not well fitted, as it has a low R^2 (that ranged from 0.08 to 0.25, depending on the sample and variable calculation). They also ran separate regressions for a number of countries where data permitted. For the Egypt model, the R^2 was very small (0.007).

Jaimovich, Panizza and Campos then go on to identify for all countries what "other unexplained factors" (beyond the budget deficit) can be driving the debt. They arrive at a similar conclusion to that of Abbas, Belhocine, El-Ganainy and Horton; that the "unexplained part of debt" is also in part a 'balance sheet' or valuation effect due to exchange rate depreciations, as well as the contingent or implicit liabilities that turn into a direct burden on the government budget. Such factors seem to be larger drivers of debt dynamics.

Easterly (2001) argues that economic growth has been an important determinant of the increase in the debt-to-GDP ratios in industrial countries as well as the debt crises in the Highly Indebted Poor Countries during the 1980s and 1990s, in addition to the debt crises in the middle-income countries during the 1980s. His regression analysis shows that these countries have not adjusted their budget deficits following the economic slump post-1975, and so the debt accumulation that would have been sustainable at previous (higher) growth rates of the past, became "explosive"/unsustainable.

Budina and Fiess (2005) use the same debt dynamics equations stated above, in order to decompose the changes in the debt-to-GDP ratio into contributions from primary surpluses, real interest rates, real growth rates, exchange rate depreciations as well as that residual which they call "other factors". For the period 1991—2002, they present an aggregate public debt decomposition for 21 Market-Access Countries (MACs). They find that primary surpluses and real GDP growth have had favorable impacts on the debt-to-GDP ratio throughout the whole period under study. The real exchange rate and real interest rates had a positive impact on containing the debt-to-GDP ratio during the first half of the 1990s, but became a cause of debt accumulation in the second half of the 1990s. The residual "other factors" were found to be a strong contributor to debt accumulation as well. Budina and Fiess then zoom in on 15 MACs that experienced episodes of large increases or decreases in the debt-to-GDP ratio. During the episodes of very big debt accumulation, the exchange rate and/or the real interest rate were important contributors thereof. They also find that in half of these cases, the debt-to-GDP ratio continued to rise despite the fact that these countries were running primary surpluses at the time.

Regarding Egypt-specific studies on the drivers of public debt, we cover two main research pieces (Abdel-Khalek (2000) and Alba, Al-Shawarby and Iqbal (2004): Abdel-Khalek provides a comprehensive description of the trends, structure and drivers of domestic public debt in Egypt between 1980 and 1997. On the underlying causes of its accumulation, Abdel-Khalek first employs the "debt dynamics" equation; assessing the developments in the primary balance to GDP ratio, as well as the interest/growth differential in Egypt. He shows that Egypt was caught in a debt/interest spiral during the late 1980s and throughout the 1990s. In addition, he analyzes the domestic debt accumulation in light of the broader macroeconomic context, focusing on the combined impact of the pegged exchange rate, free cross-border capital mobility, and the tightened monetary stance. This policy mix has led to an influx of large capital inflows during the early 1990s, and a large accumulation of reserves, which induced the central bank to conduct "sterilized intervention" to neutralize the impact of these capital inflows, through the issuance of domestic debt, to mop up the excess liquidity and to defend the peg. Indeed, he shows that Egypt has been issuing domestic debt in volumes that exceeded its fiscal needs during the early 1990s. This excessive sterilization of capital flows has had a flipside: Domestic debt accumulation.

Alba, Al-Shawarby and Iqbal analyze Egypt's fiscal and public debt sustainability, but they also touch upon the "fiscal trends underlying debt developments in the 1990s". They attribute Egypt's precarious debt position at the time to the "large and persistently growing budget deficits", as deficits create the need to borrow, and as the debt level increases over time, interest payments continue to put upward pressures on the budget, which creates the possibility of a debt-deficit spiral. They also discuss the interest/growth differential and its impact on the debt level and its sustainability, but without quantifying their respective impact on debt accumulation.[3] They conclude that Egypt's debt-to-GDP ratio is above what may be considered as the "safe" range, and that the deterioration in public finances in the late 1990s and the early 2000s was driven by "structural" factors affecting the revenues and expenditures, rather than *transitory* cyclical factors.

Beyond the preceding literature review, the author is not aware of a separate 'Egypt' case study that utilizes the debt dynamics equations above in a quantitative fashion that would disentangle the specific impacts on debt accumulation of the primary balances, real growth, real interest rates as well as the exchange rate valuation effects. Thus, in an attempt to understand Egypt's public debt; its recent trends and driving forces, this research paper puts into application the debt dynamics equation. This is done first through a mechanical/accounting exercise using the IMF's Debt-Sustainability Analysis tool, and later through an empirical estimation. But first, we dedicate the next section to the analysis of the overall government debt structure and trends, with a focus on the debt dynamics variables.

III. Egypt's Government Debt: Definition, Magnitude, and Structure

In this section, we discuss three key aspects of government debt in Egypt: **First**, we clarify (and justify) the definition of government debt that is used in the analytical and empirical work later in this study (in Section IV). **Second**, we trace the trend of government debt in Egypt, and discuss the episodes of

[3] While they do not quantify the impact of these factors precisely on the debt accumulation, they highlight crucial issues for deficit-reporting at the time: In order to arrive at the true domestic financing requirements, they augmented the budget deficit with "investment arrears"[3], as well as the "errors" line that the government used to report, reflecting inconsistencies between financing flows and debt accumulation. This way of calculating the overall financing needs resulted in a value that is double the budget deficit at the time.

deterioration (and improvement) in Egypt's fiscal stance. This helps in distinguishing the "sub-periods of interest" in the analytical work later in the paper (in section IV.a.). And **third**, we discuss the structure of government debt, in terms of debt-holders (whether residents or non-residents), as well as in terms of its currency-denomination. Altogether, the analysis in this section is used to guide the choice of variables in the empirical work in the following section (Section IV.b.).

III.a. Definition of Government Debt

The public debt definition that is used in this research is that of the "central government". It is the sum of "gross domestic budget sector debt" [4, 5] published by Egypt's Ministry of Finance, and "external government debt"[6] published by the Central Bank of Egypt (CBE). This is considered the narrowest definition of the public sector.[7] The central government definition of debt remains however the largest in terms of magnitude, because it does not "net out" the large intra-debts that the central government has with other entities. See Annex 1 for the classification of the various definitions of the public sector. The main reason for choosing the "central government" debt in this research paper is because the fiscal accounts (budget data) are more comprehensively available under this definition. Also, the budget sector domestic debt coverage is the most comparable to the scope of external government debt published by the CBE, and so they add up, to obtain the "total government debt" that is henceforth used in this paper.

Government debt in this paper thus includes both, debt held by residents (domestic government debt), as well as debt held by non-residents (external government debt). The former is predominantly in local currency, but also has a foreign currency component. External government debt however is entirely denominated in foreign currency, in the Egyptian case (*see sub-section III.c. for further details*).

III.b. The Magnitude and Trends of Government Debt in Egypt

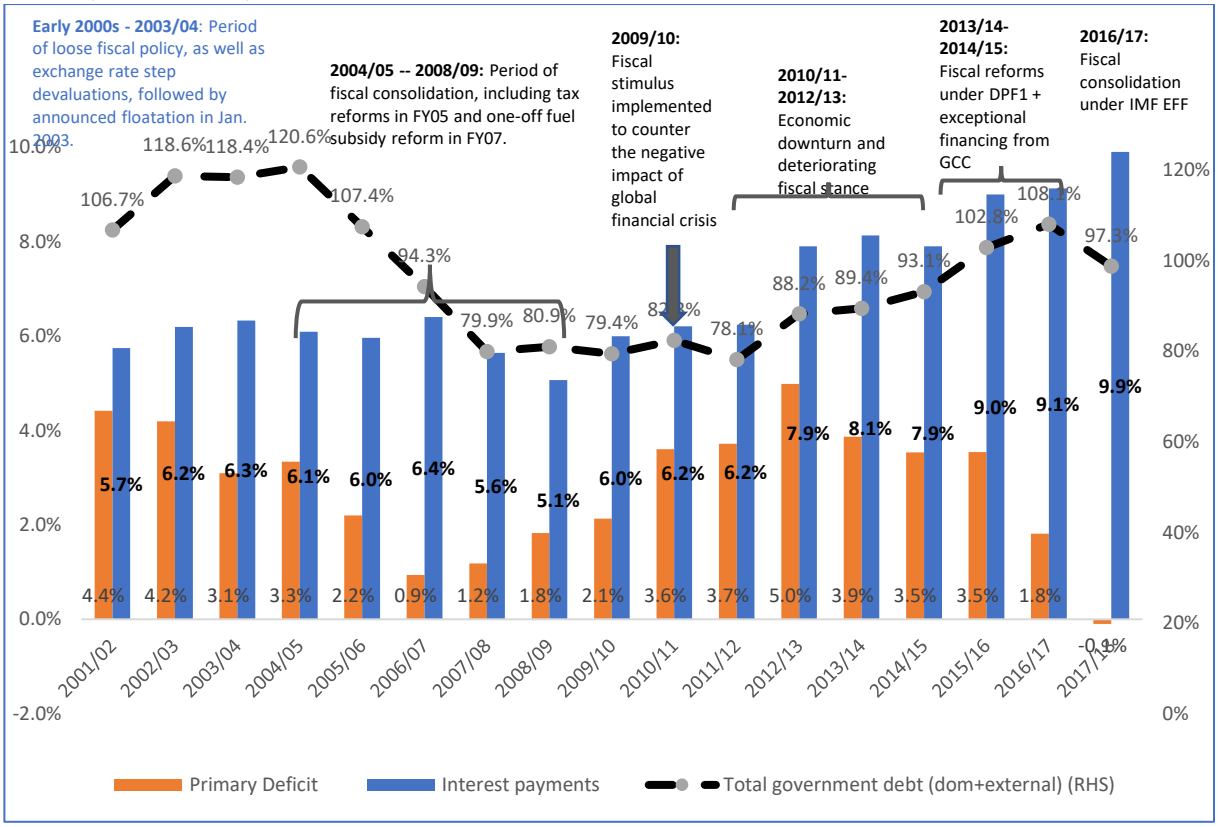
Egypt's total government debt has historically been elevated, averaging 97 percent of GDP between FY2001/02[8] and FY2017/18. It had previously reached a high of 120 percent of GDP in end-FY2004/05, but the fiscal reforms that started thereafter (including a one-off fuel price hike as well as tax reforms) led to a significant decline in the government debt-to-GDP ratio, albeit remaining relatively large at about 80 percent, during FY2005/06—FY2010/11. However, with the economic downturn, and the deteriorating fiscal accounts post-2011, government debt spiked once again, till it reached a 12-year high of 108 percent of GDP in end-FY2016/17, thus undoing almost all of the gains of the previous fiscal consolidation period (Figure 1).[9]

[4] The budget sector includes three entities: The central administration, local governments and public service authorities (Ministry of Finance, Financial Monthly, Various Issues).
[5] Cottarelli and Escolano (2014) say that debt dynamics and sustainability analyses are done usually using gross debt, rather than net debt.
[6] This is defined by the CBE as external debt of the central and local governments.
[7] The central government (or the budget sector) is the narrowest definition of the public sector, as it does not include the National Investment Bank (NIB), the Social Insurance Funds (SIF) and the public economic authorities. Please see annex 1 for a summary of the various definitions of the public sector in Egypt.
[8] The Ministry of Finance does not publish data prior to 2001/02 using the GFSM2001 classification. That is why the analysis starts in 2001/02.
[9] Section III draws on (and updates) analysis presented in Alnashar, Chowdhury, Jessen, Boitreaud and Youssef (2017).

The recently adopted reform program since FY2013/14 (which was later augmented and supported by the IMF's Extended Fund Facility in 2016) has helped achieve a primary surplus, and the debt-to-GDP ratio declined to just above 97 percent in end-FY2017/18.

Egypt's chronic primary deficits have been financed by the perpetual issuance of government debt. This in turn led to further borrowing in order to "service" the existing debt. The interest payments have thus remained very high, increasing from an average below 6 percent of GDP in the mid-2000s (following the fiscal consolidation and the rapid decline in the debt ratio) to almost 10 percent of GDP in FY2017/18. The contributions of these factors (the primary balance and interest rate, along with real growth and exchange rate) are later explored in section IV.a., on Egypt's debt dynamics.

Figure 1: Egypt's Fiscal Stance: Government Debt, Primary Deficit and Interest Payments (% of GDP) FY2001/02—FY2017/18



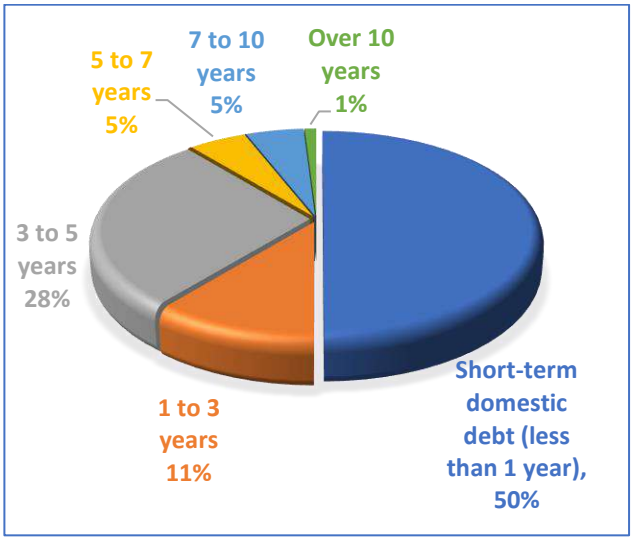
Source: Ministry of Finance and Central Bank of Egypt.

III.c. The Structure of Government Debt in Egypt

Egypt's government debt is characterized by a challenging structure, especially the domestic portion thereof. The domestic government debt (which has formed, on average, 84.6 percent of total government debt during FY2001/02—FY2017/18) is mostly issued on a short-term (of up to one year) basis (Figure 2). In fact, at least 50 percent of domestic government debt is "rolled-over" annually, thus increasing Egypt's financing requirements significantly, and raising its exposure to refinancing risks, such as sudden increases in domestic interest rates, in case of a contractionary monetary policy or tighter liquidity conditions. This

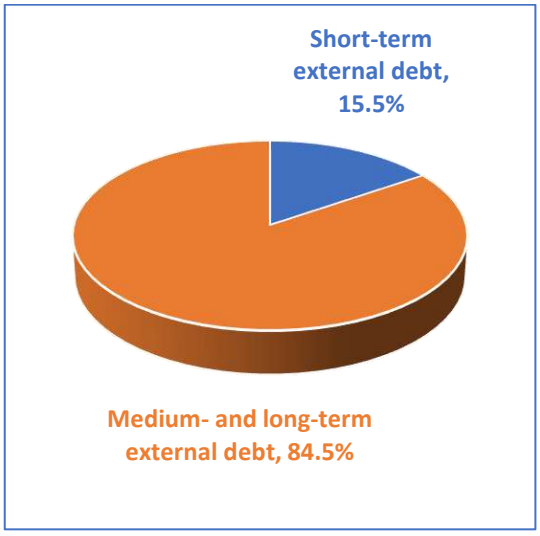
is a manifestation of what Eichengreen, Hausmann and Panizza (2007) called "the original sin" where most countries would not be able to issue long term domestic debt. While their study did not arrive at any robust reason behind this phenomenon, other than the "size of the country", the short-term maturity of Egypt's domestic debt may be related to the chronically high inflation rates that threaten to erode even seemingly high nominal interest rates in the long-term. The external debt on the other hand is mostly long term and on a concessional basis (Figure 3).

Figure 2. Domestic Budget Sector Debt (end-June 2017)



Source: Ministry of Finance.

Figure 3: Total External Debt (end-June 2017)



Source: Central Bank of Egypt.

Egypt's debt exposure to foreign exchange shocks has been limited over the past two decades, but has increased in recent years, due to the rise in external debt as well as the foreign-currency portion of domestic debt. The external government debt (that is, debt held by non-residents, and in the Egyptian case, entirely denominated in foreign exchange[10]) has been generally low averaging just above 15 percent of GDP (15.4 percent of total government debt) during FY2001/02—FY2017/18. It has also been on an overall declining trend; coming down from a high of 27.3 percent of GDP in end-2002/03, reaching a low of 8 percent of GDP in end-FY2015/16. However, external government debt jumped suddenly by 10 percentage-points to reach 18.1 percent of GDP in end-FY2016/17, and continued to rise to 19.1 percent of GDP in end-FY2017/18, thus approaching its elevated levels of the early 2000s once again (Figure 4). The recent uptick in external government debt (in FY2016/17) was, in part, driven by the "valuation" effect of the exchange rate depreciation (similar to what happened back in FY2002/03), in

[10] The CBE provides the currency breakdown of total external debt (not external government debt separately). As of March 2018 (latest data available), the US dollar is the most important currency (forming about two-thirds of total external debt), followed by the Euro (13.9 percent), and then by the Special Drawing Rights (10.2 percent), the Chinese Yuan (3.2 percent), the Kuwaiti dinar (2.8 percent), and the Japanese yen (2.7 percent). The remainder is grouped together by the CBE under "other currencies" (CBE, Egypt External Position, Vol. 61).

addition to the increased external borrowing, in light of the International Monetary Fund's Extended Fund Facility, along with the associated financing package from the World Bank, African Development Bank as well as other bilateral partners (such as the GCC) and the international Eurobond issuances. Similarly, the foreign currency component of domestic debt (held by residents) has almost doubled to 13.5 percent of GDP in end-FY2016/17 (Figure 5), thus bringing total foreign currency-denominated debt (both domestic and external) to 31.6 percent of GDP, from 15.1 percent in end-FY2014/15. The recent uptick in foreign currency-denominated domestic debt was fueled by the need to ramp up foreign reserves during the severe shortages in hard currency prior to the liberalization of the exchange rate in November 2016.

Figure 4: Total Government Debt (% of GDP): Domestic VS. Foreign (by residency) FY2001/02—2017/18

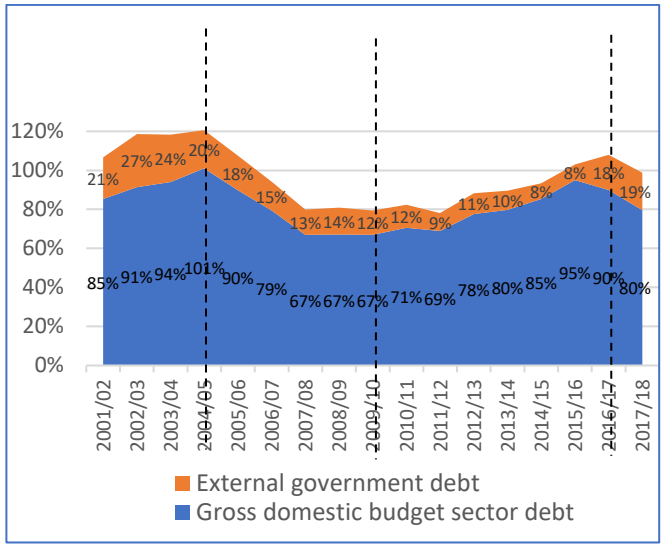
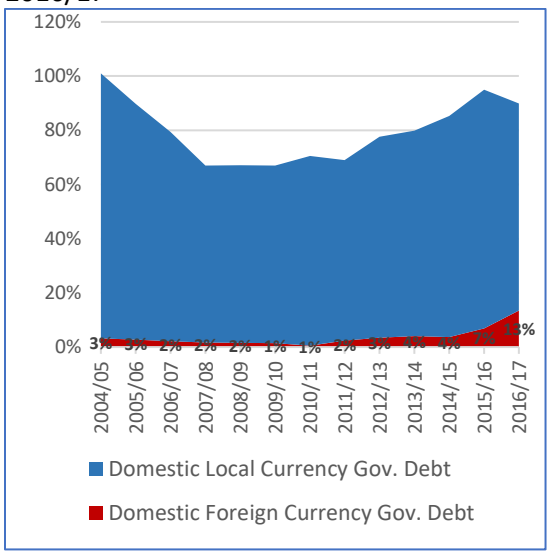


Figure 5: Domestic Debt (% of GDP): Local Vs. Foreign Currency-denomination FY2004/05-2016/17



Note: Figures 4 and 5 are not combined together, because the breakdown of domestic government debt by currency denomination is only available for the period FY2004/05—FY2016/17, whereas the domestic/external classification (i.e., debt by residency) is available for FY2001/02—FY2017/18.
Source: Ministry of Finance and Central Bank of Egypt.

The preceding description of the government debt-to-GDP ratio shows that there are broadly three sub-periods of interest: **The beginning of the 2000s and up until FY2004/05** when the debt-to-GDP ratio was generally on the rise. The following period from the **2005/06 to 2009/1**0 when the government debt-to-GDP ratio dropped rapidly, and finally the **post-2011 period** when the economic activity in Egypt slumped, and fiscal accounts deteriorated, and government debt spiraled up again. **What are the reasons behind these trends?** This is the question that we seek to answer in the next section, using the debt dynamics equation in order to distill contributions of the various factors that affect the debt-to-GDP ratio.

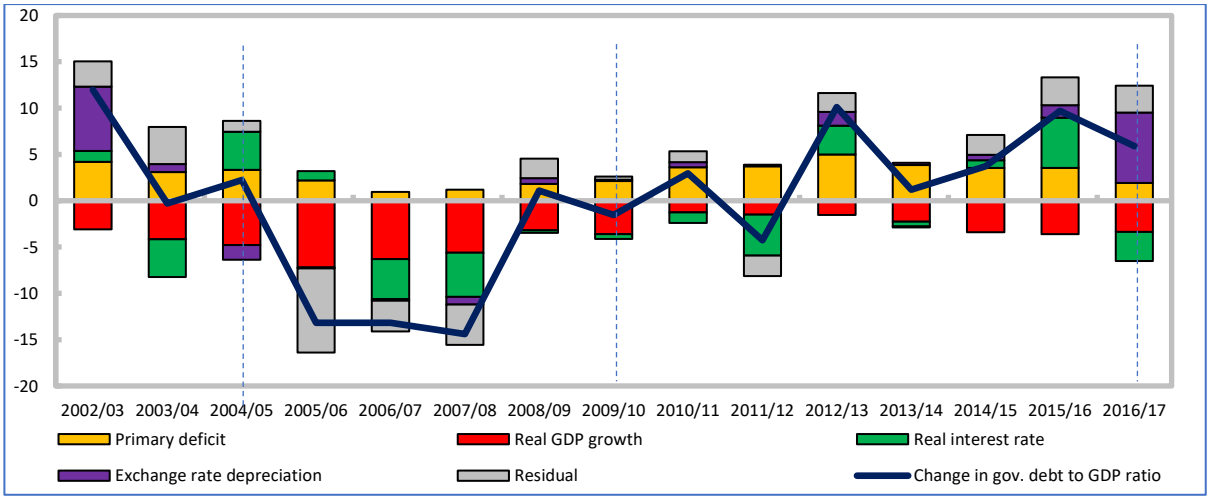
IV. What Are the Drivers of Egypt's Government Debt?

This section aims to provide an explanation for government debt accumulation in Egypt. This is done using analytical as well as empirical investigations. In section IV.a. a debt decomposition exercise is conducted, using annual data for the period FY2001/02—FY2016/17. In section IV.b., a Vector Autoregression analysis is conducted using quarterly data for the period FY2004/05—FY2016/17.

IV.a. Egypt's Debt Accumulation: Decomposition Using the Debt Dynamics Equation

In this part, the IMF's Debt-Sustainability Analysis tool[11] is employed in order to disentangle and quantify the impact of the various drivers of the total government debt to GDP, namely, the primary deficit to GDP ratio, the exchange rate, the real interest rate as well as the real GDP growth rate. Using annual data for the period FY2001/02—FY2016/17, this DSA tool shows that perpetual primary deficits and bouts of exchange rate depreciations, as well as extra-budgetary borrowing or on-lending by the government (as captured by the "residual" in the DSA tool) have been driving the increases in the government debt-to-GDP ratio. On the other hand, real GDP growth and the (mostly) negative real interest rates have partially contained this increase (Figure 7). The quantification of the impact of these factors on the debt-to-GDP ratio is done for the three sub-periods of interest and is summarized in Table (1) below.

Figure 7. Contribution to changes in total government debt-to-GDP ratio (FY2001/02—FY2016/17)



Source: Authors' calculations performed on the Market-Acess Debt Sustainability Analysis platform.

During the first sub-period (FY2001/02—FY2004/05), the government debt-to-GDP ratio increased by 14 percentage-points, to reach a high of above 120 percent of GDP in end-FY2004/05. This sub-period coincided with the depreciation (FY2002/03), which had an adverse valuation effect on the debt level, in addition to the elevated primary deficit and the interest payments that averaged around 4 percent and 6 percent of GDP, respectively. This sub-period also suffered from underperforming growth that had averaged 3.9 percent.

Using the DSA tool, we breakdown this 14 percentage-points cumulative increase in the debt-to-GDP ratio during FY2001/02—FY2004/05 into the following contributing factors: The primary deficit to GDP ratio contributed by 10.6 percentage-points cumulatively, while the exchange rate depreciation contributed by 6.2 percentage-points, and the (positive) real interest rates were responsible for 1.2 percentage-points. On the other hand, the real growth helped contain the debt-to-GDP ratio by 12 percentage-points cumulatively over the same period. That is to say that the DSA model was able to exactly explain 9 percentage-points out of the 14 percentage-point increase in the government debt-to-GDP ratio during

[11] The IMF's Market Access Debt Sustainability Analysis tool is available at: https://www.imf.org/external/pubs/ft/dsa/mac.htm

FY2001/02—FY2004/05 (Table 1).[12] The 8 percentage-points of 'remaining balance' is accounted for by a 'residual' that includes unidentified items affecting the debt-to-GDP ratio. This is the stock-flow adjustment (SFA) that was previously presented in equation 4 earlier. By inspecting the "sources of financing" published by the Ministry of Finance, we find that below-the-line "payment of outstanding arrears" during this first sub-period have contributed to increasing the borrowing needs, and thus to debt-to-GDP accumulation by around 3.3 percentage-points. Apart from the arrears, the rest of the residual remains unexplained.

During the second sub-period (FY2005/06—FY2009/10), the government debt-to-GDP ratio *decreased* by 41 percentage-points cumulatively, and stabilized at about 80 percent of GDP, as the government implemented a fiscal consolidation program including a one-off fuel price adjustment (in FY2006/07), as well as tax reforms, altogether bringing down the primary deficit to an average of 2 percent of GDP (half its ratio in the previous sub-period). This period also coincided with a growth spurt of 5.5 percent on average annually, and the exchange rate appreciated[13], thus containing the domestic value of the foreign currency debt due to the favorable (re)valuation effect. Interest payments remained rather high, but the inflation spike of 2008 (due to the international food crisis, as well as the global oil prices) has led to an overall negative real interest rate during this period.

Using the DSA tool, this 41 percentage-points cumulative decrease in the government debt-to-GDP ratio is explained by the uptick in economic growth, negative real interest rates and the exchange rate appreciation, which brought down the debt-to-GDP ratio by 25.9, 8.9, and 0.3 percentage-points, respectively. These favorable debt dynamics have over-compensated for the accumulation of the primary deficit to GDP ratio (8.3 percentage-points, cumulatively) during the same period. The balance (residual or stock-flow adjustment) during the second sub-period was estimated at -14.2 percentage-points (see Table 1). This may be partially attributed to the one-off privatization proceeds which were used to finance the budget deficit (in lieu of issuing debt), in addition to the domestic currency appreciation (revaluation) against other currencies. Nevertheless, the bulk of this residual remains unexplained.

The third sub-period (FY2010/11—FY2016/17) saw an increase in the government debt-to-GDP ratio by 30 percentage-points, reaching a 12-year high of 108.1 percent of GDP in end-FY2016/17. This was driven by step devaluations in the exchange rate, which culminated with a large depreciation in November 2016.[14] The fiscal accounts also had deteriorated at the beginning of this time-period, with populist measures (such as increasing the civil servants' wage bill and converting temporary staff into permanent government employees, in addition to the sharp increases to the energy subsidy bill). This has led to a ballooning in the primary deficit, until it reached a peak of 5 percent of GDP in FY2012/13. However, starting FY2013/14, the government adopted measures to contain the wage bill as well as the energy subsidy bill and shifted the General Sales Tax into a modern Value Added Tax that expanded the tax base and raised the tax rate. The fiscal accounts have since started improving.

[12] That is to say that the 9 percentage points are basically 11.5ppt from the primary balance + 7.5ppt from the depreciation + 2ppt from the real interest rate – 12ppt from real growth.

[13] The exchange rate appreciated by 14.5 percent, to LE5.3/US$ in end-FY2007/08, compared to LE6.2/US4 in end-FY2003/04.

[14] On November 3, 2016, Egypt's exchange rate depreciated from EGP8.88/US$ to EGP14/US$, and over-shot to EGP19.5/US$ in mid-December 2016, and then appreciated slightly and remained stable at just below EGP18/US$ throughout calendar years 2017 and 2018.

Using the DSA tool, this 30 percentage-point rise in the debt-to-GDP ratio can be explained as follows: The primary deficits during this period were responsible for a cumulative increase of 25 percentage-points. The exchange rate depreciation accounted for a 12 percentage-point increase in the debt-to-GDP ratio. On the other hand, real growth helped to partially ameliorate the debt-to-GDP trajectory by bringing the ratio down by around 17 percent cumulatively. The real interest rate had a mostly neutral cumulative effect on the debt-to-GDP ratio between FY2010/11 and FY2016/17, as the bouts of positive real interest rates were counterbalanced with negative real interest rate episodes.

Similar to the previous two sub-periods, the balance (residual) is estimated at 8.9 percentage-points. The Ministry of Finance's data indicate that the "difference between the face value and present value of T-bills" has been responsible for around 1.5 percentage points increase in the debt-to-GDP, as it implied additional borrowing needs. The rest of the residual is mainly explained by on-lending to other State entities that are considered "extra-budgetary" (i.e., do not count as part of the budget sector fiscal accounts). The main on-lending by the government was made to the Social Insurance Funds, which accounted for 4.7 percentage-points of the increase in the debt-to-GDP ratio between FY2010/11 and FY2016/17. Another 0.8 percentage-points of the increase in the debt-to-GDP ratio remains as a "residual", which in part may be explained by the economic authorities borrowing from the Treasury Single Account, as highlighted in the latest IMF Article IV consultations report (Table 1). [15]

Table (1): Egypt's Debt Decomposition

	Sub-period 1 (↑) FY2001/02—FY2004/05	Sub-period 2 (↓) FY2005/06—FY2009/10	Sub-period 3 (↑) FY2010/11—FY2016/17
Cumulative change in government debt-to-GDP ratio	**14**	**-41**	**29**
Debt-creating flows ("+" indicates a contribution to debt accumulation, "-" means a reduction in debt accumulation); *in percent of GDP*			
Primary Deficit	**+10.6**	**+8.3**	**+25.0**
Real GDP Growth	**-12.0**	**-25.9**	**-17.0**
Real Interest Rate	**+1.2**	**-8.9**	**+0.1**
Exchange Rate Valuation Effects	**+6.2**	**-0.3**	**+12.0**
Residual	**+8.0**	**-14.2**	**+8.9**
Arrears	*+3.3*	*+0.4*	*0*
Difference between T-bills present- and face-value	*N.A.*	*+1.5*	*+3.4*
Bonds to Social Insurance Funds	*0*	*N.A.*	*+4.7*
Unexplained residual	+4.7	-16.1	+0.8

Source: Author's calculations based on data from the Ministry of Finance, Central Bank and Ministry of Planning, Monitoring and Administrative Reform.

In summary, the primary deficit stands out as the largest contributor to the increase in the government debt-to-GDP ratio, but only in the absence of the episodes of exchange rate depreciation. In fact, in the

[15] The same was also recorded in the IMF's Article IV Consultations Report, January 2018. The report showed that out of the 5.3 percentage points increase in the government debt-to-GDP ratio in 2016/17, 2.2 percentage points alone were due to the "on-lending to government entities" as well as "economic authorities' borrowing from TSA".

year of a depreciation (like FY2002/03 and FY2016/17), the exchange rate depreciation has been a much larger contributor to government debt accumulation.

On the other hand, the real GDP growth and the largely negative real interest rates have ameliorated the debt to GDP trajectory throughout the whole period under study (FY2001/02—FY2016/17).

In light of the above debt decomposition exercise that relied on annual data, we complement this analysis with an empirical test using Vector Auto-regression (VAR), in order to better understand the drivers of debt accumulation in Egypt. Importantly, the additionality of the following empirical investigation is that it exploits a higher-frequency dataset of quarterly observations.

IV.b. An Empirical Investigation into the Main Drivers of Debt Accumulation: A Vector-Autoregression Model

The purpose of this empirical investigation is to model the joint behavior of government debt, along with its main drivers in order to explore the relative importance of the various determinants in debt accumulation. The variables of interest are found to be of different orders of integration (as detailed below), and no cointegration is detected. Thus, in the absence of an equilibrium long-term relationship amongst the series for interest, a vector autoregression (VAR) analysis can be appropriate.

In light of the debt decomposition exercise conducted in the previous sub-section, the determinants of debt accumulation that are included in the VAR estimation are as follows: the exchange rate, the interest rate, as well as the primary deficit. In addition to these *usual-suspects*, we also add the "credit extended by the banking system to the public business sector" as another endogenous variable in this VAR system. That is, to capture below-the-line borrowing that might eventually lead to government debt accumulation. Even though this variable represents the public business sector's borrowing from banks, it is arguably relevant to government debt analysis: Indeed, despite the fact that the public business sector is considered an extra-budgetary entity, part of its borrowing is covered by sovereign guarantees, and thus can be considered as a contingent liability[16] (i.e., may end up becoming a direct liability on the budget, if these obligations do materialize). Thus, including the public business sector's borrowing in the VAR captures the extra-budgetary borrowing (or on-lending) that may contribute to government debt accumulation.

As such, the VAR consists of five endogenous variables and its estimation is conducted using the following ordering: (1) Primary deficit, (2) public business sector borrowing, (3) interest rate, (4) exchange rate, and (5) government debt.

This ordering of the variables follows from Mundell (1963, p. 478) which indicates the following sequence of actions: An increase in the deficit (say, due to increased government expenditure) tends to increase demand for goods and raises income. This in turn would raise demand for money, and consequently interest rates, and would attract capital flows, and appreciate the exchange rate.

The VAR is estimated using one lag, based on the Schwartz Information Criterion (See Annex 3).

[16] Contingent liabilities were estimated at 20.4 percent of GDP in end-December 2018 (Ministry of Finance, 2019)

The Data Used in the Empirical Investigation

The data used for the VAR estimation consists of quarterly data for the period FY2004/05—FY2016/17. The **total government debt** used in the VAR is the budget sector domestic debt plus the external government debt. The external government debt is multiplied by the end-of-period exchange rate in order to obtain its local currency value at the end of each quarter. As mentioned earlier in section III, the domestic debt is obtained from the Finance Ministry, while the external government debt is obtained from the CBE. The end-of-period exchange rate is obtained from the IMF's International Financial Statistics (IFS) database. The **primary deficit** is obtained from the Ministry of Finance, and the **credit extended to the public business sector** is obtained from the CBE. The **exchange rate** used in the VAR estimation is the *period average* exchange rate, obtained from the IFS. The period average is used (instead of the end-of-period), because the latter was found to be I(2) which would have been more complicated to include (and interpret) in the VAR. The **interest rate** in the VAR estimation is the "implicit (or effective) interest rate", calculated as the interest payments at time "t", divided by the total debt stock in "t-1". The data on interest payments are obtained from the Ministry of Finance.

The time series properties of the variables of interest are first investigated, using the Augmented Dickey-Fuller (ADF) test. All variables are found to be I(1), with the exception of the primary deficit which is I(0). (*The results of the ADF test are deferred to Annex 2*). In order to avoid spurious regressions, all non-stationary variables in the model (namely, the total government debt, the credit extended to the public business sector, the exchange rate, and the interest rate) enter the VAR in their first differences. On the other hand, the primary deficit enters in its 'level' (as it is already stationary). The exchange rate, the credit extended to the public business sector, as well as the debt are transformed to their natural logs. The exchange rate is transformed into its natural log for ease of interpretation, as the differenced natural log of the exchange captures the "depreciation", rather than a unit increase in the LE/US$. The public business sector's borrowing as well as the total government debt are transformed for scaling purposes (since they are very large numbers, compared to the rest of the variables in the VAR system). On the other hand, the primary deficit and the interest rate are left without the log-transformation. The primary deficit cannot be transformed into log as it takes on a negative value in some quarters. The interest rate is not transformed for ease of interpretation (i.e., changes in the interest rate are expressed as percentage-points).

Interpreting the Variance Decomposition of Government Debt

Following the VAR estimation, we obtain the forecast error variance decomposition of the total government debt. This helps us quantify the average contribution of each shock to the observed variability of the data (Kilian, 2011). In other words, the variance decomposition gives the relative importance of each shock as a contributor to the variability of each one of the endogenous variables in the VAR model.

Table 2 below displays the variance decomposition of the government debt, due to the five shocks in the model. Initially, the variability of the total government debt is explained in large part by its own shocks. This may be explained by the short-term maturity structure of government debt (especially the domestic portion thereof, as explained in sub-section III.c above). That is to say that a large portion of the outstanding debt needs to be refinanced (rolled over) within the same year. Any shock to the debt is indeed expected to have a larger effect in the short-term. This is confirmed by the finding that the relative importance of the shocks to debt (as a contributor to the variability in debt) declines, as we go further in the forecast horizon.

Shocks to the primary deficit as well as the exchange rate are of relatively equal importance at the beginning of the forecast horizon; each initially explaining around 20 percent of the variability in the government debt. Their relative importance however diverges, going forward in the forecast horizon: The shocks to the primary deficit becomes relatively the most important contributor to the variability in government debt, whereas the relative importance of the shocks to the exchange rate diminishes sharply further down the forecast horizon. This may be explained by the nature of the exchange rate movements in Egypt, as the exchange rate has historically been held steady, until there is a large and abrupt depreciation. Finally, shocks to the public business sector borrowing as well as shocks to the interest rate are relatively less important determinants of the variability in the government debt, although the impact of the former seems to remain rather stable across the forecast horizon, and remains larger than that of the interest rate.

On average, as shown in Table (2), shocks to the primary deficit stand out as the (relatively) most important contributor to the variability of government debt (at 44 percent), followed by its own shocks (39 percent). Also shocks to the exchange rate are considered an important contributor to the variability of debt (at just below 13 percent). This is followed by the shocks to the public business sector borrowing, that are slightly more important compared to the shocks to the interest rate (each at about 2 percent).

Table (2): Variance Decomposition of Total Government Debt

Period	*S.E.*	*Primary Deficit Shock*	*Public Business Sector Borrowing Shock*	*Interest Rate Shock*	*Exchange Rate Shock*	*Debt Shock*
1	0.038	20.244	3.298	3.238	20.802	52.418
2	0.046	37.478	2.608	2.277	14.915	42.722
3	0.050	44.045	2.296	1.941	12.650	39.069
4	0.052	46.687	2.159	1.815	11.773	37.567
5	0.053	47.875	2.109	1.752	11.376	36.888
6	0.054	48.451	2.084	1.722	11.189	36.553
7	0.054	48.733	2.073	1.708	11.099	36.388
8	0.054	48.874	2.067	1.701	11.053	36.305
9	0.054	48.944	2.064	1.697	11.031	36.264
10	0.054	48.979	2.063	1.695	11.020	36.243
Average		***44.031***	***2.282***	***1.955***	***12.691***	***39.042***

V. Conclusion, Key Findings and Policy Implications

Egypt's government debt has historically been very high. This paper applied a debt dynamics decomposition, using annual data for FY2001/02—FY2016/17, in order to disentangle the effect of the various drivers of the government debt-to-GDP ratio. Based on this analysis, the primary deficit stands out as the main contributor to the increases in the government debt-to-GDP ratio, followed by the adverse valuation effect stemming from the episodes of exchange rate depreciation. The real growth has had a favorable impact, as it helped to partially contain the rise in the debt-to-GDP ratio. The real interest rate has also had a favorable impact on debt accumulation, as real interest rates have been largely 'negative'

during the period of study. This provides evidence that government debt is, in part, "inflated away". And it might also explain the predominance of short-term maturities in Egypt's domestic debt, as customers would refrain from holding debt that they know might lose 'real' value in the medium- to long-run. Importantly, the debt dynamics decomposition also unveiled a **residual**; accounting for as much as a third of the change in the debt-to-GDP ratio. This residual, in part, is explained by valuation effects that may not have been captured by the single bilateral exchange rate that was included in the debt dynamics model, but also indicates that 'below-the-line' items (or on-lending by the government) contribute to debt accumulation (such as the securities issued to the Social Insurance Funds, for example). It is also worth noting that part of this *residual* that was quantified in this research paper remains unexplained. This points to fiscal transparency issues.

This paper also runs a Vector Autoregression using quarterly data between FY2004/05—FY2016/17 for the following five variables: The primary deficit, the public business sector's borrowing, the interest rate, the exchange rate, as well as the total government debt level.

The variance decomposition obtained from the estimated VAR in an attempt to explain the relative importance of the determinants of debt accumulation. The relative weights of the shocks in the VAR system in terms of explaining the observed variability in the debt stock were as follows in descending order of importance: The primary deficit, exchange rate, public business sector borrowing and finally the interest rate.

The policy implications that follow from this paper touch upon various crucial issues: First, the (unsurprising) urgency of continued fiscal consolidation, whilst boosting economic activity, in order to bring the debt-to-GDP ratio downwards. Second, the foreign currency-denominated debt needs to decrease and remain low in order to reduce Egypt's vulnerability to exchange rate valuation effects. Third, bringing down the inflation rate, and gradually extending the maturity structure of domestic debt. Fourth, institutional reforms that enhance fiscal transparency are critical to eliminate this unexplained "residual" that drives debt. Fourth (related to the previous point), proper accounting of government expenditures is key, in order to enhance predictability; that is through minimizing the on-lending/contingent liabilities that may cause a sudden and unexpected jump in financing needs. Fifth, the exchange rate needs to remain market-determined, such that its management would avoid the large and abrupt depreciations that result in adverse valuation effects on total government debt.

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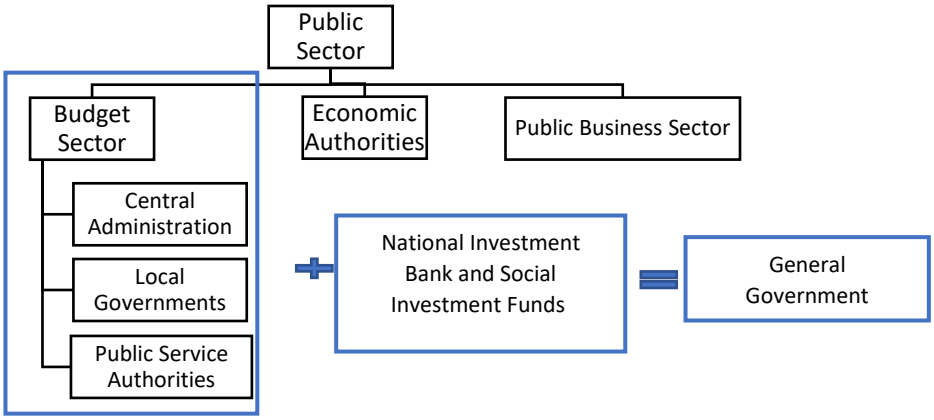
ANNEX 1: DEFINITIONS OF THE BUDGET SECTOR, GENERAL GOVERNMENT AND PUBLIC SECTOR

The scope or definition of the government/public sector in Egypt could be grouped into three categories.[17] In ascending order of coverage/comprehensiveness, these are: The 'budget sector', the 'general government' and the 'public sector' (Figure A-1).

Figure A-1: The various levels of the public sector/government



The budget sector includes three entities: the central administration, the local governments and the public service authorities. The general government is a relatively wider definition of the government, and encompasses three entities under the budget sector in addition to the National Investment Bank (NIB) and the Social Insurance Funds (SIFs). Finally, the public sector includes the general government in addition to the economic authorities as well as the public business sector (State-Owned Enterprises).

According to the Ministry of Finance data on government debt, the gross domestic budget sector debt is that of the budget sector as described above. Similarly, the gross consolidated general government domestic debt represents the debt of general government as described above. However, gross consolidated public domestic debt is the debt of general government and economic authorities, but does not include the public business sector debt where state-owned enterprises (SOEs) fall. There are no data on the outstanding debt of SOEs.

In terms of magnitude, budget sector debt is by and large the highest, because general government debt accounts for (subtracts) the inter-debt that exists between the Budget Sector and the National Investment Bank and the Social Investment Funds. This debt includes Ministry of Finance securities held by both the NIB and SIF as well as SIF bonds.[18] Economic Authorities debt has on average made up 7.6 percent of gross consolidated public domestic debt over the period from FY12 to FY16 and averaged 5.9 percent of GDP over the same period. The National Investment Bank debt on the other hand has averaged 12.9 percent of gross consolidated public domestic debt and 10 percent of GDP from FY12 to FY16.

[17] This annex draws on Alnashar, Chowdhury, Jessen, Boitreaud and Youssef (2017), with thanks to Rana Fayez (World Bank Consultant, at the time) for preparing Figure A-1 and contributing to this annex.

[18] For example, in FY12, gross domestic budget sector debt was recorded at EGP1,155 billion (69 percent of GDP) while gross consolidated general government domestic debt was at EGP1,081 billion (64.6 percent of GDP) and gross consolidated public domestic debt was at EGP1,122 billion (67 percent of GDP), in FY16 the figures recorded were EGP2,573 billion (95 percent of GDP), EGP2,411 (89 percent of GDP) and EGP 2,481 billion (91.6 percent of GDP) respectively.

ANNEX 2: AUGMENTED DICKEY-FULLER TEST RESULTS

The times series properties of the five variables that are included in the VAR estimation are investigated using the Augmented Dickey-Fuller test. The results are presented in table A-1 below. The null hypothesis is "variable has a unit root". The variable is deemed stationary when the null hypothesis is rejected.

Table A-1: Augmented Dickey-Fuller Test Results for the period 2005Q1 – 2017Q4

Series tested for stationarity	ADF test details	ADF test statistic	MacKinnon one-sided p-value associated with t-statistic of the ADF test	ADF test details	ADF test statistic	MacKinnon one-sided p-values associated with t-statistic of the ADF test
	Variable in Levels			Variable in First Difference		
Log Exchange Rate (period average)	Constant, 0 lags	3.33	1.00	Constant, 0 lags	-4.96	0.00***
Log Total Government Debt	Constant, 0 lags	2.61	1.00	Constant, 0 lags	-6.94	0.00***
Log Public Business Sector Borrowing	Constant, 0 lags	1.885	0.9997	Constant, 0 lags	-6.51	0.00***
Implicit Interest Rate	Constant, 3 lags	-1.21	0.662	Constant, 0 lags	-18.52	0.00***
Primary Deficit	Constant, 0 lags	-5.27	0.0001***			

*** Significant at the 1% level.

Note: Lag selection in ADF test is generated in EViews automatically, based on the Schwartz Information Criterion (SIC).

The results of the above ADF test show that the exchange rate, the total debt and the real interest rate are stationary after taking their first differences, and the primary deficit is stationary in its level.

ANNEX 3: VAR ORDER SELECTION

Table A-2: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: PD L_SOE_CREDIT IMPLICIT_I L_EX L_TDEBT
Exogenous variables: C

Sample: 2005Q1 2017Q4
Included observations: 47

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-188.3744	NA	0.002578	8.228696	8.425520	8.302762
1	33.74832	387.5332	5.91e-07	-0.159503	1.021442*	0.284895*
2	66.68828	50.46121	4.37e-07	-0.497374	1.667693	0.317355
3	95.92325	38.56527*	4.03e-07*	-0.677585	2.471603	0.507475
4	124.2869	31.38105	4.25e-07	-0.820718*	3.312590	0.734673

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

Based on the FPE, AIC, SC and HQ criteria, one lag is selected for the VAR estimation.