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A Fiscal-Monetary Interaction Model for Inclusive Growth in the Middle-Income Arab Countries: Application to Egypt's Economy

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ABSTRACT

The paper examines the impact of exchange rate changes on inflation and output and assesses the feasibility of achieving debt stabilization within 2022, taking into account the framework of Libich and Nguyen (2015), in a small structural macroeconomic model. Our initial analysis of Structural Vector Autoregressive (SVAR) model suggests that inflation in Egypt appears to be less influenced by monetary policy as hikes in interest rates do not show significant intended impact on inflation, rather causality appear to be other way through cost-push. Clearly, exchange rate depreciation found to be inflationary in the short term, however, in the medium term it is inconclusive.

The results of the macro-fiscal structural model suggest that Egypt could still have space for fiscal policy even within the constraints of reducing public debt. Various simulations suggest that a policy mix of higher resource mobilization together with enhancing social investments could help in reaching the debt targets by 2022. The model also took into fiscal-monetary coordination such that in this case, the inflation remains within the range suggested by the inflation targeting framework and fiscal deficit remains in a stabilizing condition in the medium term. However, reaching the debt target of 74.5% by 2022 is too stringent, which necessitates sharper adjustments on both revenue mobilization and social investments. Alternatively, our analysis suggest that Egypt could target achieving debt stabilization of about 90 per cent with less stringent adjustments on revenues and social sector expenditures. We argued that a debt-stabilizing scenario is more realistic to achieve without significant reforms in expenditures and revenues that may urge hardships for people. In either case, there is a need for major policy reforms to support inclusive growth with a more sustainable fiscal space.

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Introduction

The ESCWA (2017) report 'Rethinking Fiscal Policy for the Arab Region' highlighted the need for co-ordination of fiscal policy with monetary and exchange rate policies. Such policy coordination is expected to support the expansionary structural transformation efforts of many economies in the Arab region through increased productivity. In the region, structural barriers such as overvalued currencies dampen exports and export competitiveness of non-oil sectors in several countries, which could be the root causes of lack of productivity growth and structural change.[1] In addition, high and rising public debt put limits on fiscal expansion for development expenditure toward achieving the Sustainable Development Goals (SDGs).[2] The reasons vary from country to country but common among them is laxity in adhering to fiscal rules relating to spending and earning choices.[3] Dramatic fiscal reforms have been adopted by several countries in the region to contain the public debt and also macroeconomic policy changes were introduced toward making exchange rate more flexible. These policy changes have macroeconomic consequences. In this background, this study looks into the interrelationships between fiscal, monetary and exchange rate policies to better understand the impact on macroeconomic policy changes on output, inflation and fiscal balance. Furthermore, the study examines the conditions under which the medium term target of debt stabilization could be achieved without hampering the countries' efforts in achieving more inclusive growth. Here, Egypt has been taken as a country as it has undertaken major policy changes both on the exchange rates as well as on the fiscal and monetary policy.

By 2016, Egypt was facing severe macroeconomic challenges, including high negative current account balance, debt-sustainability concerns and inadequate reserves to sustain imports, which declined to US$ 17 billion by mid-2016 that could finance barely three months of imports.[4] To overcome the balance of payment crisis, Egypt has changed their exchange rate regime to free-floating in November 2016, which led to sharp depreciation of Egyptian Pound from 8.8 to currently at 17.8 per US dollar. Inflation shot up and at this point Egypt adopted inflation targeting framework. While change in exchange rate regime is expected to have positive impact on balance of payments, it is not clear what could be its impact on inflation and growth and what kind of trade-off between inflation and growth will emerge while targeting inflation. On the fiscal side, Egypt has seen a sharp increase in the public debt to over 102% of GDP in 2016, which the debt sustainability analysis termed as unsustainable. The impact of these policy changes could be profound unless fiscal-monetary coordination issues are taken into consideration toward managing fiscal, monetary and real sector achievements.

The monetary-fiscal policy coordination is recently getting increased attention by proponents of the Fiscal Theory of the Price Level (FTPL) and it merits empirical examination in a country context. The monetarists view is that an explicit inflation targeting policy can be a panacea for all ills in the economy. However, there is often an ambiguity in understanding the determinants of inflation. Clarida et al (1999)[5] argued that there exists an output-inflation trade-off, and that depends on the pace at which monetary policy tries to reach optimal inflation rate. Therefore, success of achieving inflation targets while minimizing output gap requires strategic interaction between fiscal and monetary policies. The institutional variables are of course important, and they have significant impact on inflation-output gap interactions, as argued by Libich and Nguyen (2015)[6].

Given this background, this paper examines the impact of exchange rate changes on inflation and output and assesses the feasibility of achieving debt stabilization within 2022, taking into account the framework of Libich and Nguyen (2015), in a small structural macroeconomic model. The following section discusses the overview of macroeconomy and monetary-fiscal interactions in Egypt. The third section presents the structural macro econometric model and the empirical results are discussed in the following section.

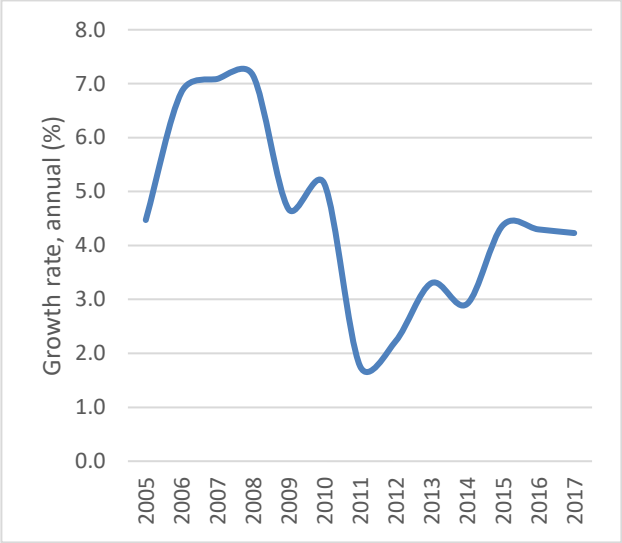
2. Overview of macroeconomy and monetary-fiscal interactions in Egypt

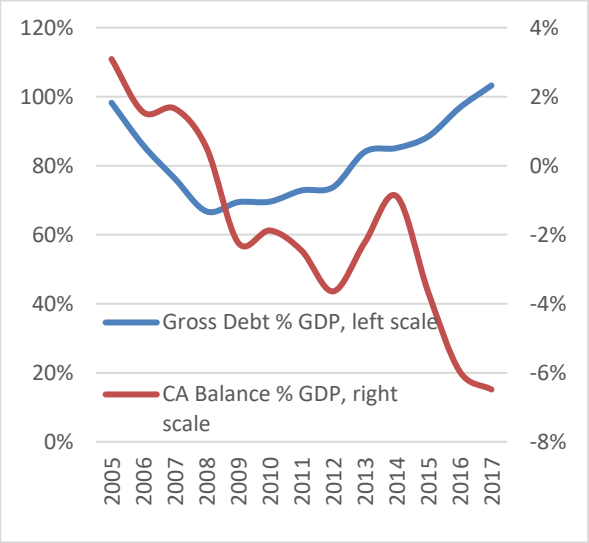
Economic growth in Egypt plummeted since global economic downturn. It reached the bottom at 1.8 percent in 2011, during the year of political instability, and recovered slowly thereafter to about 4 percent since 2015. Since the last three years, annual economic growth has remained stagnant, rather slightly declined (figure 1A). Current account balance remained negative and declined since 2008. By 2016, current account deficit reached -6 percent of GDP; general government gross debt grew close to 100 percent of GDP (figure 1B). Egypt's reserves declined to US$ 17 billion by mid-2016 that could finance barely three months of imports. Net foreign assets declined significantly and became negative by end 2015. To overcome the balance of payment situation, Egypt adopted a floating exchange rate regime since November 2016, which led to sharp depreciation of Egyptian Pound from 8.8 to currently at 17.8 per US dollar, as noted in figure 2A. The exchange rate appears to have a strong association with the ratio of net foreign assets (NFA) to net domestic assets (NDA). After the devaluation of Egyptian Pound, the NFA improved and the ratio of NFA to NDA became positive by mid 2017.

Figure 1: GDP growth, current account balance and public debt

A. GDP growth, annual (%)

B. Gross public debt and current account balance (% GDP)



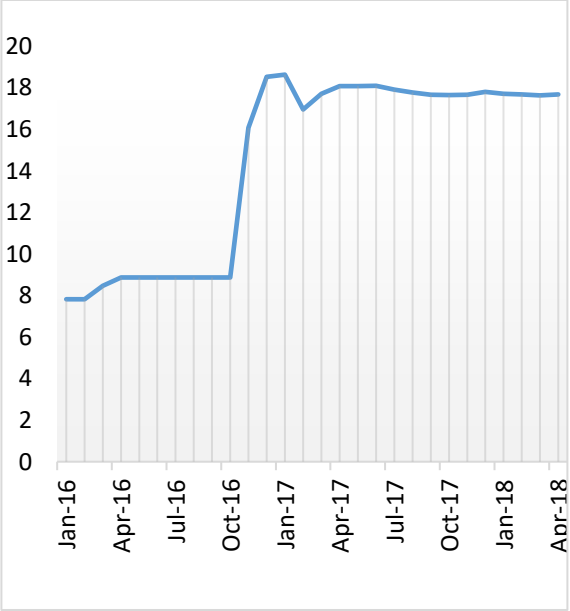


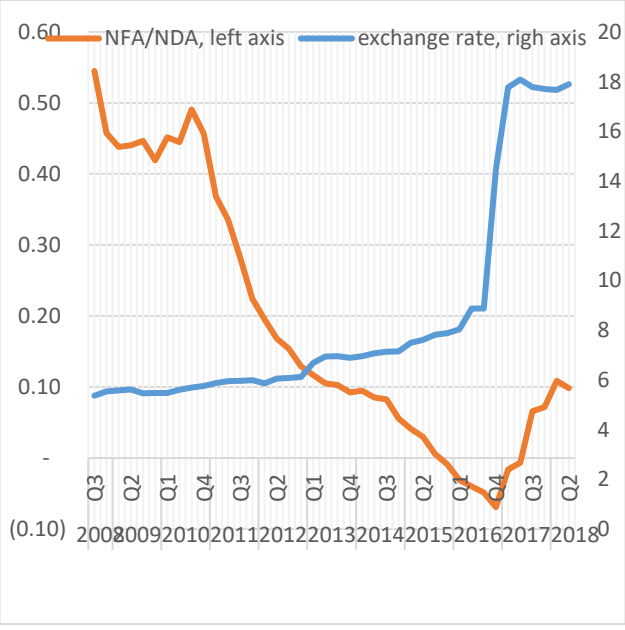
Source: Central Bank of Egypt 2018.

Figure 2: Exchange Rate (EGP –US$) and Net Foreign Assets

A. Monthly Average Exchange Rate (EGP –US$).

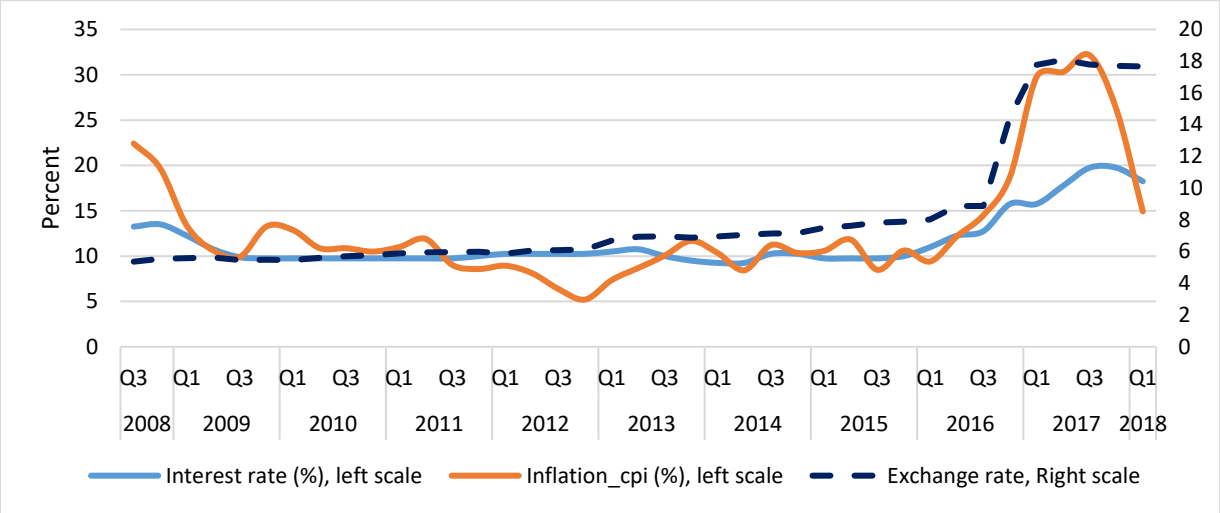
B. Exchange rate vs. ratio of net foreign assets (NFA) to net domestic assets (NDA)





Source: Central Bank of Egypt 2018.

Figure 3: Exchange rate, inflation (%) and interest rate (%), quarterly



Source: Central Bank of Egypt 2018.

As an immediate consequence of exchange rate depreciation, inflation shot up. The quarterly data shows significant jumps in inflation rates from 8 percent in the Q4 of 2016 to a maximum of 34 percent in Q4 of 2017 (figure 3). It sharply declined thereafter to reach about 13 per cent in Q1 2018. The pass-through effect of exchange rate to inflation is immediate considering that it is influenced by the low price elasticity of imports and the high import intensity of Egypt.[7] However, the sharp rise and fall in inflation may not be attributed entirely to impact of exchange rate shock. There could be other factors that influenced variation in inflation during the period since the Q4 of 2016. For instance, the central bank hiked the treasury bills rate from a 13 percent in Q4 2016 to 20 percent in Q4 2017, in order to build up its dwindling foreign currency reserves. While the rate hike itself could have brought down inflation in the first round, as a result of this, a large inflow of portfolio investment, amounting to about US$ 18 billion, was reported during the period until end 2017, contributing to a second round impact on inflation through demand side .

Fiscal reforms also contributed to inflation, particularly the implementation of energy subsidy reforms had a strong impact on inflation. For example, inflation increased from 6.9 per cent in 2013 to 12 per cent in 2015 following the first phase of subsidy reforms introduced in 2013. These reforms led to a 40-80 per cent increase in fuel and natural gas prices and a 10-50 per cent rise in electricity tariffs in 2014.[8] Furthermore, electricity tariffs were raised by 30 per cent in July 2016, and again by 40 per cent in July 2017. Prices were also raised for gasoline and diesel (by 53 per cent), LPG (by 100 per cent), kerosene (by 55 per cent) and fuel oil (by 40 per cent) in June 2017.[9] Egypt also introduced VAT in September 2016. All these fiscal reforms would have contributed to rise in inflation as well.

Besides, partly the rise and fall in CPI could be a measurement issue due to the low and high base effects in 2016 and 2017 respectively, as inflation is measured by month-to-month between the current year and previous year. We will need to wait to see more trends on CPI as well as other measures of inflation to unravel the recent interactions between inflation and exchange rate.

Therefore, these factors combined resulted in high inflation. Nevertheless, the impulse responses from our model are until 2016 and the results are not influenced by 2017 effects. A high and significant Granger causality between nominal exchange rate and inflation also confirms that shock to nominal exchange rate does increase inflation.

Box 1: Fiscal-monetary interaction: A Structural VAR analysis

We used a five variable VAR: nominal exchange rate, inflation, nominal interest rate, output gap and a measure of fiscal stance (fiscal balance to GDP). For specification of the structural VAR, the ordering is used based on theoretical literature and past studies on economies in the Arab region. The detail methodology is discussed in Annex II. The SVAR model uses quarterly data for 34 periods, between 2008 and 2016, using data from the Central Bank of Egypt. The year 2017 data on inflation turned out to be an outlier.[10]

Exchange rate shocks have major impact on inflation

The impulse response functions are plotted in figure 5. A positive shock to nominal exchange rate has a positive and significant impact on inflation until four quarters. Thereafter the impact moderates. The inflation pass-through effect of exchange rate is immediate considering that the pass-through effect is influenced by the low price elasticity of imports and the high import intensity of Egypt.[11]

However, how high is the impact of exchange rate shock on inflation can be misleading if one examines the data in recent period, since the devaluation in the last quarter of 2016. We have noted in the earlier discussion that the sharp movements in inflation were not well explained. While the steep rise in inflation in the four quarters of 2017 may not be entirely due to exchange rate shock, the steep fall in inflation since the first quarter of 2018 may not be entirely due to rise in interest rates. We will revert to the interest rate changes in the later paragraph on monetary policy effectiveness.

Effectiveness of monetary policy is inconclusive in containing inflation

Let's extend our understanding of interaction between exchange rate and interest rate through the channel of inflation. Following the Granger causality tests, the interaction between nominal interest rate and inflation is not significant. The impulse response of

interest rate to inflation shocks shows positive impact until four quarters but they are not significant. On the other hand, , the impulse response of inflation to interest rate shocks is slightly positive in the first two quarters and then becomes insignificant during the third and fourth quarters, indicating that interest rate shocks may influence inflation transitorily. It is possible to explain this in terms of cost-push inflation, such as higher interest rate leads to higher cost of production which pushes up the prices. Given the information and the impulse responses between inflation and interest rate, it is difficult to conclude any significant effect of monetary policy on containing inflation.

Quarterly data on inflation and interest rate for the latest period since the Q4 2016 shows an upward trend of interest rate along with inflationary pressures (figure 2), which tends to suggest that tightening monetary policy in terms of raising "discount rate" has somewhat impacted in containing inflation. However, there is some ambiguity about the steep decline in inflation rate since the first quarter of 2018. While the pass-through effect of monetary policy is unclear with the given evidence, the steep decline in inflation could partly be influenced by the high base effect in 2017, as inflation is measured by month-to-month between the current year and previous year. Therefore, the effectiveness of monetary policy in containing inflation in Egypt is inconclusive at least empirically.

The trade-off between managing inflation and output gap is apparent

The impulse response of output gap to interest rate shock shows low but adverse impact. While initially, the impact is close to zero and insignificant, the adverse impact is higher after a lag of two quarters when output gap shows a strong declining trend *albeit* the impact is still statistically insignificant. Nevertheless, the direction of impact supports few theoretical possibilities. Clarida et al (1999) argued that the pace at which monetary policy tries to reach optimal inflation rate, primarily through tightening interest rate, determines the cost to output growth. This sharp increase in interest rate has been noted during the year 2017. It is expected that any sharp increase in interest rate would make private sector borrowings too costly ; and that impacts output growth adversely. The empirical evidence will be clearer when more data are available for inflation targeting regime.

The results of the SVAR model reinforce the potential trade-off between tightening monetary policy to achieve inflation vis-à-vis minimizing output gap, as well as complex inflation and fiscal balance interactions over short and long run, thereby urging the necessity for greater monetary and fiscal policy coordination. While SVAR provides these diagnoses, our structural macroeconomic model on fiscal-monetary interactions aims to solve the linkages between debt stabilization and real GDP growth within the inflation targeting framework. The solutions, however, are challenging when exchange rate shocks have immediate and high impact on inflation.

Source: Note on "Assessing Exchange Rate Pass Through Effects in a Monetary-Fiscal Interaction Framework: Evidence from Egypt", prepared by N. Sarangi and R. Akill, ESCWA, 2018.

3. A structural macro-fiscal model

In the context of Arab countries, where countries are grappling with multiple policy issues such as inflation targeting, raising debt levels, inclusive growth that helps in enhancing employment opportunities as well as achieving SDGs, there is a need to establish consistency between these multiple policy objectives. As these policy objectives are interrelated and the adjustment between the policy instruments to achieve these objectives interact dynamically over the medium-term time path, here we propose a framework. One of the two main objectives that needs to be addressed through this model is to suggest an optimal fiscal policy mix that helps in achieving macro consistency between inflation, debt sustainability as well as inclusive growth objectives. In a sense, there is a need for a framework that helps in achieving fiscal-monetary co-ordination in such a way that it helps reduce output gap at the same time achieve the inflation target, which is discussed in Section-I (Libich & Nguyen (2015)). Another issue that needs to be focused is the issue of SDG expenditures, which is in addition to the existing social expenditures. While SDG expenditures expected to enhance public debt levels initially, over the medium term it is expected to smoothen. This is largely due to expected increase in the potential GDP through both productivity as well as revenue enhancement as SDG expenditures could create additional capacities. While medium term debt sustainability analysis may be used, it is just a partial framework where output is assumed exogenously. Here the proposed framework tries to derive both output as well as debt stabilizing fiscal rules endogenously.

Key features of the proposed framework

The proposed model basically follows a structuralist approach in the Tinbergen tradition. It has been developed as a tool that policymakers, in the medium term can use to assess how various policy choices could affect the outcomes. While there are various policy suggestions, such as tight fiscal rules imposed on some Arab countries, largely based on multi-country studies (public debt target suggested by Reinhart & Rogoff, 2009[12], is one such example), for country specific assessment, policy makers need to check these suggestions with country specific model. However, the model itself should be a reasonable approximation of the immediate past behavior.

While there are many other theoretical frameworks exist in the literature (Real Business Cycles based DSGE models being one of the popular ones at present), to build a model that is user friendly especially for the policy makers, it needs to have few characteristics. The applicability of the proposed model becomes most crucial and depends on the data availability. Another important feature is that it should be flexible enough to adjust the structure as and when specific policy questions are raised. Indeed, in some situations exogenous policy options needs to be generated endogenously from a framework. The model has to be simple and clear in terms of policy transmission mechanisms. Keeping these issues in mind, the proposed model

is developed in the case of Egypt and it is a simultaneous equations system model developed basically for policy simulation purpose. The outcomes of the model would be the medium path of the endogenous variables, such as growth, inflation, public debt, etc, conditional upon some of the exogenous variables. The policy simulations basically address 'what if' kind of policy questions.

The proposed model is a simple one and it is easy to understand the cause-effect relationships. In the large models and some of the models based on micro foundations, while they are powerful tools, sometimes the ambiguity gets in while empirical estimations. The proposed model is also flexible and easy to answer different types of competing policy questions.

One of the main issues that this proposed model likes to address in the context of Egypt is that of what could be the ideal fiscal policy rule that Egypt could adopt in order to achieve the broader objective of macroeconomic stability. Here the purpose is to derive a medium term fiscal path consistent with other macro objectives such as achieving growth-inflation as well as address debt sustainability issues. At this stage, there could be two constraints that needs to be imposed: explicit inflation target as well as the debt rule. As Egypt also devalued its currency recently, there could be some open-economy macroeconomic issues that needs to be endogenized in the model. While it is not clear what is the medium term growth objective of Egypt, the model could be used to answer what policy mix could drive higher growth in the country.

The theoretical base of proposed model is basically eclectic and it is largely driven by empirical reality rather than imposing theoretical relationships on the data. For example, there are various competing theories that could explain inflation in an economy. It could be cost push, demand-supply based formation, or policy induced. However, the applicability of these competing theories on the actual inflation need not be static as drivers of inflation could be time varying as well as dynamic in nature. Hence, sticking to one school of thought could be fraught with model misspecification. But as the model is meant to address some fiscal policy issues, it has a Keynesian flavour as most countries in the Arab world follow demand driven approach for growth. In addition to this, as it happened in the Arab world recently, the rise in involuntary unemployment also makes a strong case for Keynesian approach. The basic model is presented below.

Macroeconomic Block

The aggregate (nominal) demand in the economy in period t (Y_t) is given by the standard Keynesian identity

$$Y_t = C_t + I_t^p + I_t^g + G_t + X_t - IM_t \quad \ldots\ldots(1)$$

where C_t is aggregate private consumption expenditure, I_t^p is aggregate private investment demand, I_t^g is aggregate government investment, G_t is aggregate government consumption expenditure, X_t and IM_t are exports and imports (includes both goods and services), respectively.

In the case of inflation, Egypt already following inflation targeting framework with Monetary Policy Committee setting the interest rates to achieve its targets. However, following the existing theoretical underpinnings, as happens in other emerging economies, there could be a 'fix price' segment where prices are determined as a mark-up over cost and another segment where prices are public policy determined. There is also a flexi price which is outcome of the disequilibrium in the market. There could a third segment of the economy, which is basically through global shocks, say international commodity (oil and food) prices. Hence, in any economy, price level is determined by the above three fundamental factors, namely, mark-up, policy induced, and global factors. Here the demand side prices are largely determined by the money supply in the economy while the policy induced inflation is through fiscal policy. The third element is largely determined by the exchange rate, in case the exchange rate is determined by market forces. In Egypt, as the exchange rate was devalued in 2016 and the current system is floating/managed exchange rate system, imported inflation could be significantly be determined by the exchange rate fluctuations[13]. However, there appears to be multicollinearity between exchange rates and oil prices and, hence, including exchange rate in inflation equation resulting in theoretically opposite sign. Hence, here only oil is used for estimations purpose.

Thus, inflation in period t ($\dot{p}_t$) is given by

$$\dot{p}_t = \emptyset(M_t, \dot{oil}) \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

where M_t is the growth rate of money supply, while oil is the international oil prices. Other option could be imported inflation which could be captured through exchange rate depreciation. While the expansionary fiscal policy could result in increase in the aggregated demand, if there are any supply constraints in the economy or if the economy is close to its potential growth, it could result in higher inflation through increase in the money supply growth.

In the case of private investments, following Mundle, et al (2012) we assume there is an accelerator type private investment function. Here private investment is assumed to depend on the cost of capital as well as the crowding in effect of public investment, and the output gap (expected rate of capacity utilization). Hence, the rate of private investment ($\frac{I_t^p}{Y_t}$) is given by:

$$\frac{I_t^p}{Y_t} = \varphi\left(r_t, \frac{I_t^g}{Y_t}, \frac{Z_t^O}{Zt} \right) \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

where r_t is the average cost of borrowing from the domestic credit market, I_t^g is government investment in period t, Z_t^o is the output gap estimated through Hodrick Prescott filter in period t and Z_t is the actual output in period t.

In the case of fiscal policy, as we understand there are two types of expenditures, current and capital (the expenditure classification could depend on the availability of data). While public capital expenditure is expected to create capital assets and improve the overall investments in the economy through crowding-in effect on private investments, current expenditures are largely towards wages & salaries, subsidies, administrative expenses, transfer payments as well as expenditure on human capital. These expenditures are expected to not only help in creating demand in the demand-constrained economy, it is also expected to create capacities that enhance potential output and also enhance human capital in the medium term and improve the outcomes of other expenditures. There are also commitments towards to achieving SDGs, which could also put additional pressure on the government finances. While the public expenditures expected to be expansionary, it is also expected to create productive capacities and at the same time, some of these expenditures (especially current expenditure) could create inflation through the demand channel. There are also tax policies, which not only for redistributive policy, it is also expected to create fiscal space for additional expenditures. But this could depend largely on the tax buoyancies. Given this, the government block is modelled as below.

The level of government revenue (both tax and non-tax revenues) in period t is given by (T_t):

$$\Delta T_t \equiv \hat{\beta} \times Y_t \& \times T_{t-1} \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

where revenue buoyancy $\hat{\beta}$ is a policy determined variable. It is assumed that government can set this through adjustments in tax rates and the administrative tax effort.

On the expenditure side, in the current expenditure, we assume there is an autonomous component (committed expenditures such as salaries, defence expenditures, etc), which is expected to follow Autoregressive process, and there are other factors. One of them is clearly the resource availability and the other is the social expenditures for the SDGs. Hence, the government current expenditures (G_t) is given by

$$G_t = f(G_{t-1}, R_t) \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5)$$

where R_t is the government revenues. However, following the commitments for achieving SDGs, the total government current and capital expenditures would be augmented by

additional expenditures for SDGs (S_t), which is in addition to existing committed government expenditure, which again depend on the resources available.

The fiscal deficit in period t (F_t) is the difference between total government (current and capital) expenditure as well as SDG expenditures and the total government (tax and non-tax) revenues. And this is expected to be equal to total government borrowing (D_t^g)

$F_t = G_t + S_t - T_t = D_t^g$ … ……. (6)

Where D_t^g will be equal to domestic borrowing (DD_t^g) and the external borrowing (ED_t^g)

Here the assumption is that government borrows required additional resources from the markets, both domestic and external, (households, banks and corporates), which adds up to the public debt, which is the sum of domestic and external public debt. Domestic borrowing and its servicing is expected to be a transfer payment to the domestic savers and hence, such borrowing would not be a leakage. However, external borrowing and its servicing leads transfer payments outside the economy, the decision to go for external debt depend heavily on the international interest rates.

EDEBT = f(FD, FEDRATE) … (7)

In the case of trade sector, export demand is expected to be largely determined by the external demand as well as changes in the exchange rate. While Egypt has devalued its currency recently and would not determine the past exports and there could be some presence of J curve effect, the export function includes exchange rates for future policy simulations purpose.

$X_t = f(e_t, \bar{Y}_t^w)$ … … … … (8)

where e_t is the nominal exchange rate and $\bar{Y}_t^w$ is the *GDP* of world economy, an exogenous variable.

Theoretically, the imports demand depends on the exchange rate as well as the domestic demand component and this is specified as follows.

$IM_t = f(e_t, Y_t)$, … … … … (9)

where e_t is the nominal exchange rate and Y_t is nominal GDP in period t.

In the case of exchange rate, there are various theories that helps in understanding its movements and the validity of these theories are subject to empirical validation. As the country has only recently moved towards market determined exchange rates, the exchange rate determination is specified in a simple manner. While exchange rate could be determined by the interest rate or price differentials between the countries, as a reduced form model,

capital inflows could be a major determinants of exchange rate. Here the exchange rate determined largely by the components of current account, i.e., exports and imports. However, as Egypt has devalued its currency recently, the specification also include a policy component (exogenous).

Thus:

$$et = f(Xt, IMt, E_t^P) \quad \text{.....(10)}$$

where Xt is exports, IMt is imports and E_t^P is policy intervention, which may be captured through dummy variable. This is especially required in the case of recent devaluation of currency by Egypt.

In the monetary block, following the components side in the balance sheets, money supply could be determined by government's market borrowing as well as net accretion of foreign exchange reserves. However, for simplification, it is largely determined by the government borrowing, which is fiscal deficit, and the money demand represented by nominal output.

$$M_t = F(D^g_t, Yt) \quad \text{.....(11)}$$

Here D^g_t is the additional government borrowing and Y_t is the nominal output.

Domestic interest rates largely follow the extended Taylor rule where interest rates are largely driven by the output gap as well as differences. However, as Egypt came under inflation targeting regime recently, it becomes difficult to estimate inflation gap empirically. Hence, the estimable interest rate function includes output gap, actual inflation as well as government's additional borrowing. Here government borrowing is used in order to capture its crowding-out impact on private investments while inflation do capture the exchange rate pass-through effect.

Hence,

$$r_t = f(Y_t - Y^P_t, \dot{pt}, D^g_t) \quad \text{.....} \quad (12)$$

where r_t is the interest rates, $Y_t - Y^P_t$ and output gap is estimated through HP filter. The monetary policy interest rates would be a simple function of r_t.

But the most important question here is what could be the optimal fiscal and monetary policy mix and how will the proposed model address this question. Theoretically, the outcome of the fiscal and monetary interaction is the overall public debt path, which should be sustainable. Egypt was having a public debt to GDP ratio of about 103% in 2017. While high public debt could be due to lower GDP growth in the country, as the country also holds large external public debt, increase in public debt is also due to exchange rate deprecation in the 2017. In

2017, external public debt was around 30%. There is a need for an assessment whether such public debt is sustainable. The simple thumb rule of difference between nominal GDP growth and nominal interest rates suggest that the current level of public debt is sustainable. However, the IMF Article IV (2018) suggest that public debt needs to be brought down to 74.5% by 2022. This is largely due to decline in the projected nominal GDP growth numbers. But this also requires that the primary balances should be increased from -1.7% in 2017 to close to 2% by 2022. This is basically putting a squeeze on the fiscal policy.

In our framework, one way to address this issue could be assessing the overall outcomes under the public debt path suggested by the IMF. In a sense, the proposed public debt path acts a constraint on the model below which the model needs to be solved. The outcomes that are of interest are the kind of fiscal deficit path, real GDP growth, inflation, and the current account deficit as they are interrelated and have dynamic interactions with each other.

In the literature, there are few studies that looked at the impact of fiscal and monetary policies as well as its interaction issues and most of the studies are based on post-2008 crisis as well as the fiscal and monetary policy responses following the crisis. Some studies have shown that the composition of government expenditures have a major role as they had differential impacts on growth (due to different size of fiscal multipliers) (Afonso & Sousa (2009), Mundle et al (2012)). On the interaction, few studies suggest, especially in the context of Arab countries, there is a need for having explicit fiscal rules with credible inflation targeting in order to achieve medium term objective of debt sustainability (Elbadawi, et al (2017)). But these studies focus on the ex post analysis as well as it is focused more on the short term relations and the analysis are mostly focused on VAR-type models that do not clearly capture feedback relationships. As we understand the debt-deficits dynamics as well as the interaction between fiscal and monetary policy rules are more over the medium term, there is a need to empirically examine these issues ex ante and over the medium term. Such exercise does also help in suggesting fiscal paths as well as available fiscal space under various policy simulations.

The proposed empirical strategy would be to first estimate the robust parameters for the specifications that are presented in the model using the annual data of Egypt from 1990 to 2016, for which the data is available for most of the variables. The estimated model would be solved simultaneously for both in-sample and the simulations for various policy options would be done for out of sample (up to 2022).

Model results

Based on the above model specifications, we have broadly estimated the same specifications and the estimated OLS results are presented in the Appendix. It may be noted that in most of the equations, we have used error dummy variable in order to derive the underlying theoretical relationship between the dependent and independent variables. As it is it is known that Egypt economy has faced both political as well as economic upheavals in the recent period,

it was expected there would be noise in both data as well as economic relationships. Hence, the dummy variable introduced should take care of both observed and unobserved errors and this is not very different from the error correction mechanism in the time series econometrics. In that sense the coefficients thus estimated are more of long run coefficients. All the estimated equations were solved simultaneously for the in-sample period 2012 to 2016 and examined the forecast error. While for most of the endogenous variables, the RMSPE (Root Mean Square Percentage Error) is within the 5 per cent acceptable level, for some variables, such as exports, imports, exchange rate, some of the tax revenues, the RMSPE is between 5 to 10 percent. The finalised model has been solved for the base line by assuming the paths for exogenous variables as well as policy variables. For instance, the tax buoyancy for all the taxes assumed to be unity for the forecast period. For the world GDP, we have taken the IMF projections, Brent Crude oil prices assumed to be at the present level of US$ 80 per barrel, trade openness index assumed to be at 37, which was same for the period 2017; output gap values have been simulated using AR(1) model; population growth projections are assumed to decline from 2 per cent in 2017 to 1.74 by 2022; and finally the average tariff rates assumed to be at the current level of 20.5% as in 2017.

Based on these assumptions, we have solved the model up to 2022, which is the period by which the IMF suggests Egypt to contain the public debt/GDP level to 74.5%. In the base case, a business as usual scenario, assuming that there is no specific public policy intervention to contain public debt, Egypt is expected to see the public debt increasing to 103 per cent by 2022, from the current level of 96.9 per cent in 2016. Under this scenario, the GDP growth is expected to be about 4 per cent with an average GDP growth of 4.46 per cent between 2018 and 2022. In the same period, the fiscal balance expected to about -11 per cent.

Sensitivity analysis on the fiscal policy options suggest that there could be four pathways through which one could help in containing the public debt with growth is endogenously determined by policy changes in various scenarios. They are i) expanding the social expenditures that have higher growth impact over long term, which we refer here as “social investments” on education, health and housing sectors; ii) by improving the tax buoyancies that could help in generating own resources for SDG expenditure needs and do not put pressure on the private resources; and iii) a mix of both expenditure expansion as well as improving tax buoyancy policies. Here, in addition to base case, the above three scenarios are analyzed and the results are compared with the base case. In the first case, it may also be noted that as the expenditures on education, health and housing are based on functional classification, these expenditures include both capital and current expenditures that could have higher multiplier impact on the aggregated demand. The results are presented in table 1 and 2 below and the real GDP growth is shown in figure-4. Further, as the adjustment on the public debt within five years is very sharp (by about 29% reduction in the public debt between 2017 and 2022), we undertake another scenario in which debt stabilization of about 90% is achieved by 2022. In our view, compared to three scenarios that are suggested to achieve the

IMF's debt target that require sharp adjustments in both fiscal and growth targets, the fourth scenario of achieving debt stabilization at 90% appear to result in feasible and reasonable fiscal and growth projections.[14]

Scenario 1: Growth impact under sole emphasis on improving social investments

Our results suggest that to achieve the IMF's public debt target, if the option is only from the expenditure side, there is a need to increase the social investments, which is currently at 6.44 per cent of GDP in 2017 and that needs to increase to about 12.6 per cent by 2022. Under this scenario, the real GDP growth increases to 8.4 per cent (average) compared to 4.46 per cent in the base case. The public debt to GDP would decline from 102 per cent in the base case to 75.1 per cent by 2022. One trade-off in this scenario is that this could also result in almost 3 percentage points increase in the CPI inflation, although this could still be within the Central Bank of Egypt's inflation target range of 13 per cent (+/-3). However, the fiscal balance deteriorates from -10.9 per cent to -11.9 per cent during the period. Intrinsically, what is observed is that there appears that the size of multipliers for social investments in health, education and housing (especially when it also includes capital expenditures) could be significantly higher than unity. Hence, any increase in such expenditures need not crowd out private investments and rather it appears to stimulate growth in the economy.

Table 1: Social investments and revenues in various scenarios

	Total revenues/GDP (%)					**Social Investments/GDP (%)**				
	Base case	Scenario-1	Scenario-2	Scenario-3	Scenario-4	Base case	Scenario-1	Scenario-2	Scenario-3	Scenario -4
2017	19.64	19.65	19.65	19.65	19.65	6.44	6.44	6.44	6.44	6.44
2018	19.38	17.81	20.60	20.12	19.25	6.20	6.65	6.23	6.22	6.76
2019	19.39	17.16	22.68	20.01	18.88	6.03	10.23	6.10	8.69	7.56
2020	19.49	16.53	24.80	19.71	18.47	5.88	11.20	6.00	9.07	8.18
2021	19.65	15.88	26.49	19.30	18.11	5.75	12.22	5.89	10.26	8.68
2022	19.84	15.26	27.62	18.63	17.79	5.62	12.57	5.78	11.51	9.09

Note: Scenario-1 – Enhancing social investment; Scenario-2 – Increasing resource mobilization; Scenario-3 – Policy mix of both increasing social investment and resource mobilization, Scenario-4 – policy mix of both increasing social investments and resource mobilization to achieve debt/gdp stabilization at 90 percent.

Table 2: Inflation and fiscal deficit in various scenarios

	CPI Inflation (%)					Fiscal Deficit /GDP (%)				
	Base case	Scenario-1	Scenario-2	Scenario-3	Scenario -4	Base case	Scenario-1	Scenario-2	Scenario-3	Scenario -4
2017	10.84	10.84	10.84	10.84	10.83	-10.69	-10.70	-10.70	-10.70	-10.70
2018	11.10	7.90	10.61	10.64	9.68	-11.07	-10.92	-10.39	-10.66	-11.21
2019	10.88	9.47	11.49	11.29	8.23	-11.13	-12.15	-9.55	-11.25	-11.49
2020	10.85	10.52	11.78	10.27	8.82	-11.09	-12.03	-8.90	-11.16	-11.55
2021	10.81	11.92	11.06	12.01	9.01	-11.01	-11.70	-8.60	-10.78	-11.51
2022	10.79	13.34	11.21	12.42	9.11	-10.94	-11.89	-8.58	-10.45	-11.43

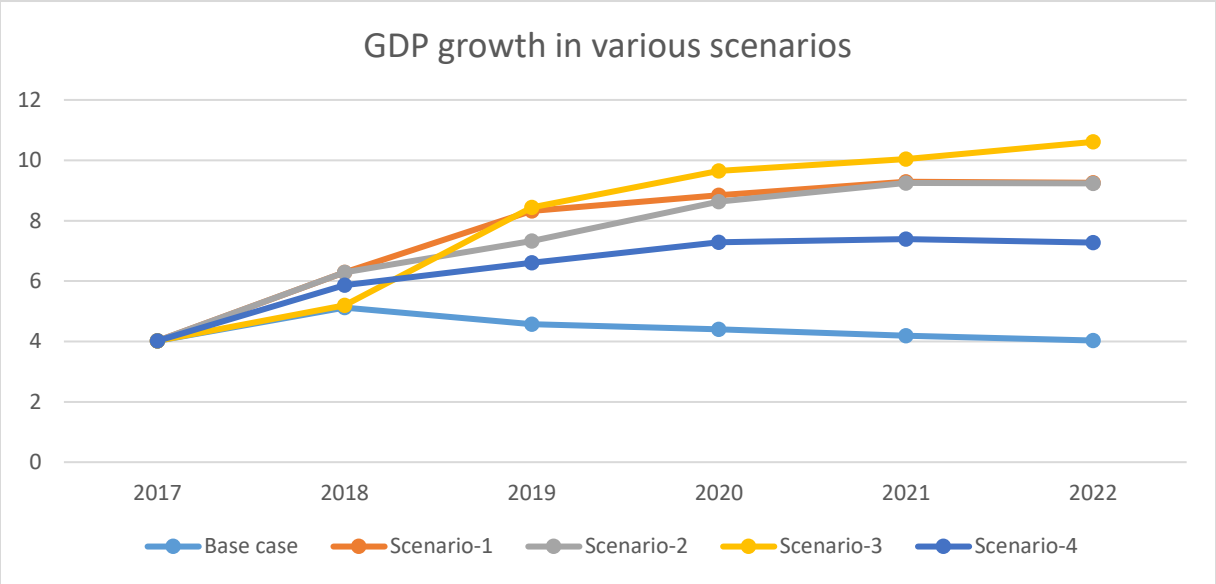
Note: Scenario-1 – Enhancing social investment; Scenario-2 – Increasing resource mobilization; Scenario-3 – Policy mix of both increasing social investments and resource mobilization, Scenario-4 – policy mix of both increasing social investment and resource mobilization to achieve debt/gdp stabilization at 90 percent.

Table 3: Public debt under different scenarios

	Domestic Public Debt/GDP (%)					External Public Debt/GDP (%)				
	Base case	Scenario-1	Scenario -2	Scenario-3	Scenario -4	Base case	Scenario-1	Scenario-2	Scenario-3	Scenario -4
2017	65.76	65.76	65.76	65.76	65.76	29.88	29.88	29.88	29.88	29.88
2018	68.63	64.93	67.29	64.18	68.20	27.97	25.93	27.46	25.65	27.73
2019	71.52	61.02	66.75	62.03	69.71	26.49	21.62	24.80	22.30	25.66
2020	73.04	59.28	63.34	60.43	69.17	26.26	20.31	22.91	21.06	24.60
2021	74.76	58.43	59.21	58.03	68.23	26.04	19.51	20.91	19.64	23.52
2022	76.75	57.41	56.11	56.82	67.94	25.84	18.45	19.08	18.52	22.50

Note: Scenario-1 – Enhancing social investment; Scenario-2 – Increasing resource mobilization; Scenario-3 – Policy mix of both increasing social investments and resource mobilization, Scenario-4 – policy mix of both increasing social investment and resource mobilization to achieve debt/gdp stabilization at 90 percent.

Figure-4: Real GDP growth in various scenarios (in %)



Note: Scenario-1 – Enhancing social investment; Scenario-2 – Increasing resource mobilization; Scenario-3 – Policy mix of both increasing social investments and resource mobilization, Scenario-4 – policy mix of both increasing social investment and resource mobilization to achieve debt/gdp stabilization at 90 percent.

Similarly, one can also work out the option of enhancing the public resources by improving the revenue buoyancies of various direct and indirect taxes. However, the most feasible option for any country that is constrained by the fiscal-monetary trade-off, there is a need for a combination of both expenditure increases in social sector as well as increasing the revenue sources domestically. These policy simulations are discussed below.

Scenario 2: Growth impact under sole emphasis on improving revenue mobilization

Another option for achieving the IMF prescribed public debt level in the case of Egypt could be through resource mobilization. In the model, there are three policy handles through which resource mobilization could be enhanced. As in the literature, increasing in tax revenues could depend on three factors: tax base, tax rates and tax buoyancy. As the tax base in any economy is largely the nominal GDP and it could not be increased without increasing the demand side (through fiscal stimulus) and this was same as in the previous scenario, here expanding tax base may not be a direct policy option. However, one could enhance revenues either through hiking tax rates or through tax buoyancy. But the relationship between tax rates and tax revenues need not be linear as suggested by the standard Laffer curve. Also, as there is no data on tax rates available for a long time (from 1990s), one feasible policy handle could be improving the tax buoyancy through various policy measures that improves tax elasticity. In the model, we try this policy option to address the public debt issue. But there are also some

indirect effects on the tax base. As the tax buoyancy improves, it is expected to have positive impact on the tax base. Hence, improvement in tax buoyancy is expected to have direct as well as indirect and positive impact on tax revenues.

Under this scenario, public debt is expected to reduce to 75% of GDP by 2022 only when the revenue mobilization increases by 7.8% of GDP compared to base case. (In the base case, the revenue/GDP ratio is expected to be 19.8% while in the scenario of improving tax bouyancies, the revenue/GDP ratio should increase to 27.62%). In this scenario, the GDP is also expected to increase sharply by 3.7% compared to base case (on average). Here the inflation rate also increases marginally, although slightly lower than in the case where only social investment is increased. However, such sharp increases in revenues in a span of five years will need drastic policy measures, which may not be a desirable option.

One plausible option could be to have a combination of improving revenue resource mobilization as well as simultaneous increase in the social investments. In other words, a mix of two scenarios could result in sustainable adjustment in both public debt as well as on the growth-inflation mix.

Scenario 3: Growth impact under policy mix of enhanced social investments and revenue mobilization

As the IMF's public debt target is too tight, one option that Egypt could adopt is increasing the social investments and at the same time, have policies that could improve revenue buoyancy. As discussed earlier, given that the size of fiscal multipliers in the case of social investments is expected to be higher than unity, increase in those expenditures expected to reduce the public debt through growth expansion[15]. However, it is also important to enhance revenue mobilisaiton to adopt fiscal expansion activity. In this scenario, an attempt has been made to increase both social investments and revenue mobilization. In such case, the simulations aimed at keeping fiscal deficit in a stabilizing condition in the medium term in such a way public debt to GDP ratio to decline to 75% by 2022. Here, the GDP growth needs to increase by 4.3%, with an average growth of 8.8% compared to 4.46% in the base case. This is higher than the other two scenarios where average growth was 8.4% and 8.13% under increasing social investment and revenue mobilization scenarios, respectively. In terms of revenues, as a ratio to GDP, to achieve the public debt target, Egypt needs to mobilise about 3% more. At the same time, it needs to increase the social investments by 5.9%. One another significant outcome of this policy mix (of both increasing resource mobilization and social investment) is that compared to the case where only social investment is increased, in this case, the pressure on inflation is also lower, which is predicted to be at 12.4% by 2022.

It is well noted in the literature that higher social expenditure into targeted areas, such as in education or health, has a higher impact on social development outcomes and so too in equity.[16] Therefore, higher growth under Scenario 3 is expected to be more inclusive and

sustainable than the other two scenarios. An emphasis on social investment only would lead to higher fiscal deficits and higher inflation, while an emphasis on sole revenue mobilization would require fiscal reforms to increase revenues as well as to reduce social investment, which is not desirable for achieving social development objectives. A combination of social expenditure along with revenue mobilization efforts brings a balance.

Scenario 4: Revenue mobilization and social expenditure policy mix for debt stabilization

As noted in the previous three scenarios, to achieve the IMF's public debt target of 75% by 2022 there is a need for substantial adjustment either on revenue mobilization or on social investments or on both. The outcomes of such an adjustment could result in sharp instability in the macroeconomic variables. For instance, doubling the social investments could result in inflationary pressure in the economy. In this context, in scenario-4, an attempt has been made to see the conditions under which a debt stabilization can be achieved at round 90% of GDP by 2022.[17] Our argument is that a debt-stabilizing medium term public expenditure framework seems to be more realistic to achieve without significant reforms in expenditures and revenues that may urge hardships for people. In this scenario, there is a need to have policies that could help in reducing the public debt by about 13% in five-year period instead of 26%. The reduction also need to be both on the domestic as well as on the external debt.

In this scenario, an increase in the social investment from 6.44% in 2017 to 9.1% by 2022 together with improvement in tax buoyancy is expected to result in an average GDP growth of about 7% between 2018 and 2022, from about 4% in 2017. Such positive impact on GDP growth is expected to result in debt stabilization at about 90% by 2022. In this case, the external debt also reduces from about 30% in 2017 to 22.5% by 2022. Here, while the average GDP growth in this scenario is higher than in the base case, it is lower compared to other scenarios. It is important to understand that transmission from exogenous policy changes to the public debt is through its impact on the growth. Intrinsically, while there is a bi-directional relationship between growth and public debt, the impact of growth on public debt appear to be larger compared to public debt impact on growth.

Summary and conclusions

The paper examines the impact of exchange rate changes on inflation and output and assesses the feasibility of achieving debt stabilization within 2022, taking into account the framework of Libich and Nguyen (2015), in a small structural macroeconomic model. Our empirical analysis on Egypt suggest few major conclusions. Based on SVAR results, inflation in Egypt appears to be less influenced by monetary policy as hikes in interest rates do not show significant intended impact on inflation, rather causality appear to be other way through cost-push. Clearly, exchange rate depreciation found to be inflationary in the short term, however, in the medium term it is inconclusive. In terms of the relation between exchange rates and interest rates, the

causality appears to be from exchange rate to interest rates rather than the other way, thus, suggesting a passive monetary policy.

The results of the macro-fiscal structural model suggest that Egypt could still have space for fiscal policy even within the constraints of reducing public debt. Various simulations suggest that a policy mix of higher resource mobilization together with enhancing social investments could help in reaching the debt targets by 2022. The model also took into fiscal-monetary coordination such that in this case, the inflation remains within the range suggested by the inflation targeting framework and fiscal deficit remains in a stabilizing condition in the medium term. One constraint in this whole analysis is that as the IMF debt target of 74.5% is too stringent, the adjustments on both revenue mobilization as well as on increasing social investment also needs to be rather sharp. Alternatively, our analysis suggest that Egypt could target achieving debt stabilization of about 90 per cent with less stringent adjustments on revenues and social sector expenditures. We argued that a debt-stabilizing scenario seems to be more realistic to achieve without significant reforms in expenditures and revenues that may urge hardships for people. Nevertheless, there is a need for major policy reforms to support inclusive growth with a more sustainable fiscal space.

Annex II

Estimated equations

1. Private Consumption

PVTCON = 1.38e+10 + 0.546*PVTCON(-1) + 0.279*DISY – 4.61E+8*INTRATE +
8..1E+9.9*DUMCPR

(17.27) (18.01) (-0.753) (16.54)

Adj-R^2 = 0.99, D.W Stat =2.46

2. Disposable Income

DISY = -2.04e+9 + 1.089*Y - 0.737*GST + 1.66E+9*DUMDISY

(74.72) (2.91) (13.45)

Adj-R2 = 0.99 D.W Stat =1.23

3. Public Investment

ECAP = -7.44E+7 + 0.446*SOCEXP + 0.351*ECAP(-1) + 3.03E+7*DUMECAP

(9.15) (3.370 (5.91)

Adj-R2 = 0.985 D.W Stat =2.47

4. Discount rate

DISCRATE = -2.906 + 1.039*INTRAT

(11.93)

Adj-R2 = 0.851 D.W Stat =1.67

5. GDP Deflator

GDPDEF = -2.21 + 1.08*CPI + 11.82*DUMGDPDEF

(174.17) (10.51)

Adj-R2 = 0.99 D.W Stat =1.33

6. Consumer Price Index

D(CPI) = 0.436 + 2.63E-11*D(M3) + 0.061*OIL + 3.548*DUMCPI

(11.747) (6.116) (4.038)

Adj-R^2 = 0.916, D.W Stat =1.09

7. Current expenditure (without social investment)

ECURRWSOC = -1.62E+7 + 0.573*ECURRWSOC(-1) + 0.543*TR + 5.67E+7*DUMECURR

(7.24) (6.90) (6.63)

Adj-R2 = 0.997 D.W Stat =1.87

8. Public Expenditure on Education

EDU = -1.01e+8 + 0.861*EDU(-1) + 0.028*TRWG + 8804.68*D(POPU) + 4.22E+7*DUMEDU
(17.64) (3.86) (3.40) (8.046)

Adj-R2 = 0.998 D.W Stat =1.876

9. Public expenditure on Health

HEALTH = -2.25e+09 + 0.668*HEALTH(-1) + 0.013*TRWG + 17935.137*D(POPU) + 7.65e+9*DUMHEALTH
(14.61) (2.45) (8.45) (12.61)

Adj-R2 = 0.996 D.W Stat =1.63

10. Public expenditure on housing

HOUSE = 4.81e+07 + 0.303*HOUSE(-1) + 0.039*TRWG + 4.38e+0.7*DUMHOUSE
(9.48) (24.87) ((23.53)

Adj-R2 = 0.997 D.W Stat =2.24

11. Public expenditure on social protection

PROTECT = 8.92e+.8 + 0.696*TRWG - 1925.771*POPU + 2.51e+8*DUMPROTECT
(26.34) (6.52) (7.62)

Adj-R2 = 0.995 D.W Stat =1.58

12. Exchange rate

ER = 0.059 - 3.03e-11*EXPORT + 2.48e-11*IMPORT + 1.01*ER(-1) + 1.48*DUMER
(-2.62) (2.898) (16.21) (8.79)

Adj-R2 = 0.981 D.W Stat =2.52

13. Exports

EXPORT = -9.52E+9 + 2.88e+9*ER + 4.46e+7*D(WORLD) – 1.03e+8*OPEN + 3.55e+9*DUMEEXPORT
(3.75) (8.69) (-1.033) (11.12)

Adj-R2 = 0.941 D.W Stat =1.818

14. Imports

IMPORT = 3.24e+10+ 0.008*Y + 1.18e+08.202*OIL – 2.42e+06*ER + 0.54*IMPORT(-1) –
(3.02) (4.38) (-3.098) (6.08)

1.22e+08*TARIFF + 8.33e+07*DUMIMPORT
(-3.608) (5.399)

Adj-R2 = 0.992 D.W Stat =2.12

15. Current Account Balance

CAB = 3.88E+07 + 0.823*EXPORT - 0.762*IMPORT – 2.35E+08*ER + 4.42E+10*DUMCAB
(16.282) (-18.18) (-1.13) (8.83)
Adj-R^2 = 0.967, D.W Stat -2.20

16. Government revenues from GST

GST = -308e+10 + 6.06e+08*B4 + 0.059*Y + 9.93e+09*DUMGST
(2.138) (215.9) (14.578)

Adj-R2 = 0.99 D.W Stat =0.918

17. Interest rates

INTRATE = 0.91 + 4.877*D(CPI)/CPI + 0.887*INTRATE(-1) + 4.37*DUMINTRATE
(1.402) (17.26) (6.60)
Adj-R2 = 0.942 D.W Stat =1.25

18. Interest payments

D(IPAYMENT) = -4.12e+07 - 0.116*FD + 3.51e+08*DISCRATE + 1.28e+01*DUMIPAYMENT
(20.417) (1.967) (8.909)

Adj-R2 = 0.965 D.W Stat =2.405

19 Private investments

IPV = 6.31e+10 – 1.22e+10*INTRATE + 2.97e+09*OPEN + 1.489*(ECAP+ECAP(-1))
(-10.728) (9.34) (33.955)

- 0.375*OUTPUTGAP + 6.35e+10*DUMIPV1
(-5.571) (16.789)

Adj-R2 = 0.993 D.W Stat =1.968

20. Broad money supply

M3 = 1.01e+10 + 0.775*Y + 4.02e+9*DUMM3
(56.747) (10386)

Adj-R2 = 0.994 D.W Stat =1.927

21. Non tax revenue

NTAX = 4.29e+09 + 0.019*Y + 0.648*NTAX(-1) + 2.91e+10*DUMNTAX
(4.545) (7.608) (8.142)
Adj-R2 = 0.983 D.W Stat =1.653

22. Other revenues

OTHREV = 5.13e9 + 0.114*Y + 0.423*OTHREV(-1) + 4.06e+10*DUMOTHREV
(13.41) (7.93) (15.71)
Adj-R2 = 0.998 D.W Stat =2.02

23. Grants

GRANTS = 2.33e+8 + 0.051*GRANTS(-1) + 9.27E+10*DUMGRANT
(3.485) (67.02)
Adj-R2 = 0.995 D.W Stat =2.04

24. Personal income tax

PERTAX = -7.75e+8 + 3.72e+8*B1 + 0.012*D(Y) + 1.062*PERTAX(-1)
(5.95) (3.025) (28.94)

Adj-R2 = 0.997 D.W Stat =1.867

25. Income from customs

D(CUSTOMS) = 45296792.8437 + 8.51E+8*B3 + 0.025*D(IMPORT) + 4.50E+9*DUMCUSTOM
(22.08) (2.104) (18.87)

Adj-R^2 = 0.975 D.W Stat =2.00

26. Income from corporate tax

D(CORTAX) = -2.56E+8 + 3.81E+11*B2 + 0.0235*D(Y) + 1.09E+10*DUMCORTAX
(6.765) (3.207) (4.343)
Adj-R^2 = 0.967, D.W Stat -2.20

27. Tax revenues without grants

TRWG = -2.26e+8 + 0.995*TR + 1.13e+8*DUMTRWG
(429.48) (44.49)
Adj-R2 = 0.999 D.W Stat =2.16

28. External public debt

D(EDEBT) = -1.51e+11 -0.192*FD+2.93e*10*ER +6.53e+10*DUMEDEBT
(-4.143) (3.483) (5.478)

29. Interest payment on external debt

D(IPEDEBT) = -5582649 +0.00123*D(DEBT) +24028782*FEDRATE
(3.886) (2.423)

List of variables used in the model

ZY	Real GDP at 2010 prices
Y	Nominal GDP
WORLD	World Output at 2010 prices
TRWG	Total Revenues without grants
TR	Total Revenues without grants
TAX	Tax revenues
TARIFF	Average Tariff rates
SOCEXP1	Social investments (education, Health and Housing)
PVTCON	Private Consumption
PROTECT	Public expenditure on social protection
POPU	Population
PERTAX	Personal Tax
OUTPUTGAP1	Output gap derived through HP filter
OTHREV	Other revenues
OPEN	Openness
OIL	World Oil prices (Brent)
NTAX	Non tax revenue
M3	Broad Money supply
IPV	Private Investment
IPAYMENT	Interest Payments
INTRATE	Interest rates
IMPORT	Imports
HOUSE	Expenditure on Housing
HEALTH	Expenditure on health
GST	Revenues from GST
GRANTS	Total Grants

GDPDEF	GDP Deflator
FDG	Fiscal deficit to GDP ratio
FD	Fiscal Deficit
EXPORT	Exports
ER	Exchange rate
EDU	Expenditure on education
ECURRWSOC	Current expenditure without social investment
ECURR	Total current expenditure
ECAP	Public investment
DISY	Disposable incomes
DISCRATE	Discount rate
DEBTGDP	Public Debt to GDP ratio
DEBT	Public Debt to GDP ratio
CUSTOMS	Revenues from Customs
CPI	Consumer Price Index
CORTAX	Income from Corporate Tax
CAB	Current Account Balance
B5	Tax Buoyancy for overall tax
B4	Tax Buoyancy of GST
B3	Tax Buoyancy for customs
B2	Tax Buoyancy for corporate tax
B1	Tax buoyancy of personal income tax
EDEBT	External Public Debt
FEDRATE	Federal Fund Rate (USA)

Annex II

SVAR methodology

The use of a structural vector autoregressive (SVAR) model allows us to examine the dynamic impacts (shocks) of changes in nominal exchange rate on other macroeconomic variables, and it also enables us to examine the interactions among the variables. The application of a SVAR is essentially an extension of the unrestricted VAR in which theoretical restrictions on some of the parameters are imposed to address the issue of contemporaneous relationships between the variables in the model. The VAR can be written as follows:

$$AX_t = \alpha + \sum_{i=1}^{p} B_i X_{t-i} + u_t$$

In reduced form:

$$X_t = A^{-1}\alpha + \sum_{i=1}^{p} A^{-1}B_i X_{t-i} + A^{-1}u_t = A_0 + \sum_{i=1}^{p} A_i X_{t-i} + v_t$$

Where X_t is the vector of variables, A_0 is the vector of constants, i is the optimal lag up to p, t is time and $v_t \sim N\ (0, \Omega)$. Unless the A matrix is an identity matrix, the residuals in the reduced form will be contemporaneously correlated, depending upon the structure of the variance-covariance matrix Ω. In the unrestricted VAR we do not care about it. But that can bias the impulse response functions (IRFs). In SVAR, we identify it by putting restrictions on the components of the A matrix (coefficients of the contemporary relationships of variables), based on some theoretical justifications.

We used a five variable VAR: nominal exchange rate, inflation, nominal interest rate, output gap and a measure of fiscal stance (fiscal balance to GDP). The ordering is used based on theoretical literature and past studies on economies in the Arab region, including Egypt. Nominal exchange rate used to be determined by policy action, as evident in case of Egypt until it was floated in November 2016. Changes in nominal exchange rate has a dynamic impact on inflation rate. The effect is noted in the literature for Egypt, mainly caused by the low price elasticity of import demand and high propensity to import.[18] The dynamic impact of inflation on nominal interest rate is expected if the economy has an active monetary policy and it uses interest rate as an anchor for price stabilization. Therefore, we order the variables as follows: first, nominal exchange rate (e), which is transformed to change in nominal exchange rate that corrects stationarity; second, inflation rate (π), measured by the change in CPI; and third, nominal interest rate (i), measured by the change in lending interest rate[19].

Finally, the change in output gap (x), measured by the log difference between actual and potential output, and change in cyclically adjusted fiscal balance (g) are taken as autonomous, based on empirical assessments for Egypt.[20] It is expected that interest rate could be correlated with output growth, but its impact on output gap is more complex to determine. Fiscal balances are set by discrete actions by governments, largely being influenced by unplanned government expenditure and borrowings without much adherence to fiscal rules. In that sense, fiscal balance or primary balance are set autonomously. It may be noted that fiscal consolidation has been the primary macroeconomic objective of most countries in the region, as they adopted IMF financing packages.[21] That requires setting fiscal and primary balances targets to the extent possible.[22] Given this context, the identification of restrictions can be written as:

$$v_1^e = u_1^e$$
$$v_2^\pi = C_{21} v_t^e + u_2^\pi$$
$$v_3^i = C_{32} v_t^\pi + u_3^i$$
$$v_4^x = u_4^x$$
$$v_5^g = u_5^g$$

where u's are observed residuals from the equations and v's are unobserved innovations that are derived from SVAR model after imposing the above restrictions. The selected model has gone through statistical tests including selection of lag length, indicators and their transformation, stability of the model, checking contemporaneous correlations of endogenous variables, Granger causality and cointegration among the indicators.[23]

The VAR model uses quarterly data for 34 periods, between 2008 and 2016, using data from the Central Bank of Egypt. The year 2017 data on inflation turned out to be an outlier. The quarterly data shows significant jumps in inflation rates from 8 percent in the Q4 of 2016 to a maximum of 34 percent in Q4 of 2017 (figure 2). It sharply declines thereafter to reach about 13 per cent in Q3 2018. For these exceptional movements in the recent few quarters, these periods were excluded from the estimation and the VAR relied on the data until 2016 quarter 2. Another issue is that due to relatively limited number of observations, the model has not been able to look into separate exchange rate regimes in Egypt, such as in the early 2000s or during the mid-2000s, where there were some exchange rate pressures and consequent policy interventions. However, these interventions didn't impact the exchange rate significantly as that impacted during 2016.

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Endnotes

[1] Elbadawi and Soto, 2011; Nabli, Keller and Veganzones, n.d.
[2] Sarangi and El-Ahmadieh 2017.
[3] ESCWA 2017.
[4] IMF (2018) Article IV.
[5] See Clarida, R., Gali, J., & Gertler, M. (1999).
[6] See Libich, J. and Nguyen, D. (2015)
[7] See Khodeir (2012). Towards Inflation Targeting in Egypt: The Relationship Between Exchange Rate And Inflation. *SAJEMS NS* 15, No 3, pp325-332.
[8] IMF (2014). Subsidy Reform in the Middle East and North Africa: A Summary of Recent Progress and Challenges.
[9] IMF (2018). Article IV: Egypt, January 2018.
[10] For these exceptional movements in the recent few quarters, these periods were excluded from the estimation and the VAR relied on the data until 2016 quarter 2. Another issue is that due to relatively limited number of observations, the model has not been able to look into separate exchange rate regimes in Egypt, such as in the early 2000s or during the mid-2000s, where there were some exchange rate pressures and consequent policy interventions. However, these interventions didn't impact the exchange rate significantly as that impacted during 2016.
[11] See Khodeir (2012). Towards Inflation Targeting in Egypt: The Relationship Between Exchange Rate And Inflation. *SAJEMS NS* 15, No 3, pp325-332.
[12] See Reinhart, C., & Rogoff, K. (2009)
[13] In the equations the notation convention adopted is to denote all exogenous variables with a bar, all policy variables with a hat, and growth rates with a dot.
[14] According to a cross-country analysis of fiscal policy response to public debt in Arab middle-income countries, the marginal response of primary balance to lagged debt increases after a threshold of around 90 percent, which is largely due to fiscal reforms associated with adoption of IMF packages to reduce public debt (Sarangi and El Ahmadieh 2017).
[15] In addition to these three scenarios, we also attempted a scenario where government increases public capital expenditures to enhance growth as well as bring down the public debt. In this scenario, while public capital expenditures, which is currently at about 4.6% of GDP in 2016, needs to be enhanced by about 7.6% by 2022 compared to the base case. However, what is observed in this scenario is while this will have positive impact on GDP (with an average growth of 11.2%), this could also result in higher CPI inflation, higher than the Central Bank's targeted inflation. (By 2022, the CPI inflation is expected to be at 17.96%, while the target is 13% with +/-3%)
[16] See Sarangi and von Bonin 2017; Baldacci et al 2008; Gupta et al 2002.
[17] See Sarangi and El Ahmadieh 2017.

[18] See Khodeir (2012). Towards Inflation Targeting in Egypt: The Relationship Between Exchange Rate And Inflation**.** *SAJEMS NS* 15, No 3, pp325-332.
[19] We also tried with discount rate of central bank, deposit lending rate. The three variables are highly correlated. The results are along the same line. The reason for including lending interest rate is that we would like to see its impact of shocks to lending interest rate on output gap in the economy.
[20] See Sarangi and El-Ahmadieh (2017). Fiscal Policy Response to Public Debt in the Arab Region. ESCWA Working Paper. E/ESCWA/EDID/2017/WP.6
[21] Egypt, Jordan, Morocco and Tunisia have resorted to IMF borrowings, under the Special Borrowing Arrangement (SBA) and thereafter under the Extended Fund Facility (EFF) support, to finance the rising primary deficits as well as rising debt servicing needs, in addition to adopting significant expenditure reform (Sarangi and El-Ahmadieh 2017).
[22] There is no strong evidence of strict fiscal dominance (FD) in Egypt, where primary balance or fiscal balance are set as a rule. The balances are rather determined discretely depending upon discrete choice of spending and borrowing every year.
[23] The test statistics will be reported in the full paper.