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Fiscal and Monetary Policy Interactions in Egypt During the Period 2003 to 2018

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Abstract

This research paper teste the interactions between fiscal and monetary policies in the Egyptian Economy using quarterly data through the period Q1 2003 to Q4 2018. The paper tested an econometric model using OLS multiple regression where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate are four independent variables representing fiscal policy and monetary policy targets. The real GDP reflects the stabilization target which is the main aim for both fiscal and monetary policies. A long-run regression equation is obtained on the form;

$$LOG\ RGDPt = -2.9 + 0.25\ LOG\ GOVDET\ t + 0.002\ LOG\ INFRt - 0.09\ LOG\ BUDDEF\ t - 0.32\ LOG\ INTRt + ut$$

The results indicate that there is a static long-run and short-run relationships between the variables where 1% increase in Inflation causes Real GDP to increase by 0.002%, 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars, 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars, 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars.

Finally, the study states that interactions between fiscal and monetary policies in the Egyptian economy exists in both short-run and long-run but it can be considered in a weak shape. There is a need for more coordination between the Central Bank of Egypt (the head of monetary authorities) and the Ministry of Finance (the responsible for fiscal policy) in order to strengthen the impact of interactions between fiscal and monetary policy towards achieving more stabilization in the Egyptian Economy.

Keywords: Fiscal and Monetary Policies Interactions, Egypt, OLS.

Introduction

Achieving the optimal coordination between monetary and fiscal policies is always considered an important point of research for both policy officials and economists. The main target for this coordination is to achieve macroeconomic stabilization. Consequently, the results for coordination can be seen in interest rates, inflation rate, fiscal deficit, and the public debt levels.

In Egypt, the economic situation reflects the lack for this coordination. As a result, the Egyptian economy lost its macroeconomic stability during the last decade and especially during the period 2015/2016 to 2017/2018. Therefore, the Egyptian economy has witnessed huge budget deficit reaching 11% of GDP at June 2017 and two digit annual inflation rate achieving a historic record that reached 35.2% at July 2017. On the same road, monetary authority failed to keep interest rates on one digit level in most cases. Consequently, interest rates on 91-Day treasury bills reached 18.97% in September 2017. Moreover, the Egyptian public debt reached around 131.7% of GDP by December 2016. In USA, the economic situation is totally different. Although the US economy has suffered from a huge budget deficit during the last decade, annual inflation rate reached only 1.7% in July 2017. Moreover, The Federal Reserve left its federal funds rate at 1.25 percent in July 2017. The US economy achieved these wonderful macroeconomic stability after a long period of coordination between monetary and fiscal policies. This remarkable coordination enabled the US economy to get rid of high inflation and interest rates appeared during 1980's decade. In 1980, inflation rate reached 13.58% and interest rate reached 20% which were historical heights for the US economy. This research paper is trying to investigate the reasons behind achieving the US economy this remarkable success to lower both inflation and interest rates. It looks like a trial to get a large

and valuable experience from the US fiscal and monetary interactions. Independent policies and reactions taken by monetary authority may cause conflicting interests with fiscal policies. Consequently, game theory framework can play a crucial rule to resolve this dispute. The goal is to study fiscal and monetary policy interactions using a game theory environment. So, the paper will use three scenarios. The first is the normal form game where policymakers will be allowed to use their instruments without cooperation. The second is the extensive form game where fiscal and monetary authorities move sequentially. The third is the cooperative game where fiscal and monetary authorities use their instruments simultaneously but with cooperation in order to achieve maximum social welfare as a common goal. It is clear that there is a lack of research on fiscal and monetary policy interactions in Egypt. In addition, there is no papers that applied the methodology of game theory on such type of topics. This study is considered the first to investigate this topic using game theory approach. Of course, it is required to add to this field of study in Egypt a research paper on this topic to guide policy makers towards achieving macroeconomic stabilization. This study is aiming to investigate the best scenario for interactions between fiscal and monetary policies in Egypt. Also, the study will apply the game theory approach to perform the analysis. Finally, it will provide policy recommendations to Egyptian policy makers regarding the application of fiscal and monetary policies in Egypt. Finally, this paper will end up with some policy recommendations to the Egyptian policy makers to simulate the US policy makers in achieving this historical success. The remainder of the paper is organized as follows. The next section discusses the macroeconomic model and some aspects of game theory analysis. The third section describes the fiscal and monetary policy games. The fourth section discusses and analyzes the coordination and interactions between fiscal and monetary policy in USA. The Egyptian case and differences

between Egypt and USA are presented and analyzed in the fifth section. Finally, the sixth section is dedicated to the conclusion and policy recommendations to the Egyptian policy makers. The study is intending to ask the following questions; what is the current situation of interactions between fiscal and monetary policies in Egypt? What is the impact of interactions between fiscal and monetary policies on the stabilization of the Egyptian Economy? What are the policy recommendations for the Egyptian policy makers?

Literature Review

Returning back to Backus and Driffill (1985) and Tabellini (1985), the theory of repeated game was used to prove that, under discretionary policymaking, equilibria could appear with low inflation. Engwerda (1998) and Engwerda et al. (1999, 2002) modeled dynamic games among monetary and fiscal authorities. They induced monetary and fiscal authorities to take care of conflicting interests and not to concentrate only on their own goals. Several models of European Central Bank (ECB) and European Monetary Union (EMU) were built in Dixit (2001) to analyze fiscal and monetary policy interactions in some countries. He found that the mechanism of decision making in the ECB achieved moderate stable inflation. Also, he emphasized that unconstrained national fiscal policies play a dangerous role that may undermine the ECB's monetary policy commitment. In addition, a monetary and fiscal policy framework in the EMU area using Engwerda et al. (2002) model was implemented in Van Aarle et al. (2002). He studied various interactions, externalities, and spillovers involving macroeconomic policies under alternative policy regimes. Lambertini and Rovelli (2003) used a game theory approach to study monetary and fiscal policy coordination. In a Stackelberg scenario, they concluded that every policy maker prefers to be the follower. In a strategic game, they claimed that fiscal authorities would behave to take the lead. On the other hand, Favero

(2004) showed that the type of shock hitting the economy may determine the degree of the strategic complementarity or substitutability between monetary and fiscal policy. Moreover, when monetary and fiscal policy rules are inertial and not coordinated, countercyclical fiscal policy may reduce welfare.

Kirsanova et al. (2005) extended the traditional three-equation Taylor-rule New Keynesian model to include fiscal policy and study policy coordination. They used three scenarios to study policy interactions; the first is non-cooperative policies, the second is partially cooperative policies, and the third is benevolent policies. They found the results that under the benevolent scenario, the monetary authority will bear all the burden of the stabilization.

Finally, in Saulo, Rego and Divino (2013) described the optimal monetary and fiscal interactions using three scenarios: normal form game, Stackelberg game, and when authorities behave cooperatively. They found that, in the Brazilian case, Stackelberg solution provided the lowest welfare loss where the monetary policy was the leader and the fiscal policy was the follower. This paper aims to benefit from all of the last described papers to know the optimal coordination between monetary and fiscal policy in Egypt.

Methodology

The study assumes that using game theory approach, fiscal and monetary policies can achieve better interactions in Egypt. This paper will use game theory models to analyze interactions between monetary and fiscal policies in Egypt. There are two individual players. They are the monetary authority which is the Central Bank of Egypt (CBE) and the fiscal authority that is the Ministry of Finance (MOF). Each player has an instrument; interest rate (i) and government spending (g).

The Model

This paper will start with the most recent models that were used in Saulo, Rego and Divino (2013). Therefore, the New Keynesian framework is used to analyze optimal monetary and fiscal policy rules. The paper will use a linear approximation in log form of an Ordinary Least Squares (OLS) model. The OLS model explains fluctuations in economic growth and effects of monetary and fiscal policies. The model consists of the New Keynesian Phillips curve as an aggregate supply equation and the IS curve as an aggregate demand equation. In addition, there is an intertemporal budget constraint.

Following Saulo, Rego and Divino (2013), in this paper, the IS curve proposed by Woodford (2003) is amended to include the effects of public debt on aggregate demand. So, the paper considers the following IS curve in log-linearized form under a closed economy;

$$X_t = E_t X_{t+1} - \sigma (i_t - E_t \pi_{t+1}) + \alpha b_t + r_t^n \qquad (1)$$

Where X_t is the output gap (difference between actual and potential output), i_t is the nominal interest rate, r_t^n is a demand shock, E_t represents the time t expected value of the next period inflation rate π_{t+1} and output gap X_{t+1}.

b_t is the real stock of government debt, $\sigma > 0$ is the intertemporal elasticity of substitution in private spending, and α measures the sensitivity of the output gap with respect to the debt.

This paper follows Kirsanova et al. (2005) in modeling b_t. Therefore, b_t is a function of the stock of debt in the previous period b_{t-1}, flows of interest payments, government spending, and revenues. This function will be as follows:

$$b_t = (1 + i^*)\, b_{t-1} + B\, i_t + G_t - T\, X_t + \eta_t \qquad (2)$$

Where i^* is the equilibrium interest rate, B accounts for the steady state value of the debt, i_t is the interest rate, G_t represents the government spending, T is the tax rate, X_t denotes the output gap, and η_t is the debt shock.

With regard to aggregate supply (Phillips curve), firms has to take a decision to determine a price that maximizes their profit. Following the assumption of price rigidity (Calvo 1983), it implies that a fraction $0 < \vartheta < 1$ of prices remains fixed during each period. Therefore, the derivation of the (log-linearized) aggregate supply will be as follows:

$$\pi_t = K\, X_t + \beta\, E_t\, \pi_{t+1} + V_t \qquad (3)$$

Where the current inflation rate π_t depends on the expected E_t inflation rate at t +1, and the current output gap X_t.

Following Woodford (2003), V_t is a supply shock. There is a trade-off between inflation versus output gap stabilization. The parameter $\kappa > 0$ measures the sensitivity of inflation with respect to the output gap and β, where $0 < \beta < 1$ is the Intertemporal discount factor.

Therefore, government spending and interest rate stands for monetary policy and fiscal policy variables respectively. In equation (1), monetary policy transmission appears when an increase or decrease in the interest rate is greater than the expected increase or decrease in the inflation rate at t + 1. On the other hand, equation (2) states that an increase or decrease in the government spending raises or lowers the level of debt, which in turn increases (or decreases) the level of activity in the economy which driven in equation (1). Changes in the aggregate demand causes changes in inflation which is driven from equation (3).

Consequently, the basic equilibrium conditions of the model is defined using the equations (1), (2) and (3).

The Econometric Model:

Following (Samuel et al., 2018) the study uses an econometric model based on OLS and co-integration models in order to estimate the relationships and the impact of devaluation on economic growth and other macroeconomic variables in Egypt. Variables are log-transformed to ensure linearity.

The study aims to estimate the following linear regression equation in Egypt using quarterly data for these variables through the period Q1 2003 till Q4 2018;

$$LOGRGDPt=\beta0 + \beta1\ LOGGOVDET\ t + \beta2\ LOGBUDDEF\ t + \beta3\ LOGINFRt + \beta4\ LOGINTR\ t + ut$$

Where;

RGDP = Real Gross Domestic Product,

GOVDET = Government debt as a percentage of GDP,

BUDDEF = Budget deficit as a percentage of GDP,

INFR = Inflation rate,

INTR = Foreign exchange rate,

Ut = Error Term

In this model, Real Gross Domestic Product is the dependent variable where Government debt as a percentage of GDP, Budget deficit as a percentage of GDP, Inflation rate, and Interest rate are the independent variables. The paper will use data retrieved from official resources like Ministry of Finance, central bank of Egypt,

reports of the World Bank, and the international monetary fund to observe the impact before and after the devaluation.

Econometric Results and Analysis:

The first step in this econometric analysis is to conduct Dickey Fuller test for the group of variables in this study in order to reach to stability and determine the level of integration among these variables.

Dickey Fuller Test of Unit Root to Test the Stability of Examined Variables:

In Dickey Fuller test, H0 and H1 are formulated as follows:

H0: the variable includes unit root (i.e. it is not stable).

H1: the variable does not include unit root (i.e. it is stable).

Judgment rule is based on level of probability of T-test. If probability is more than 0.05, H0 cannot be rejected (i.e. the variable is stable). If probability is less than or equals 0.05, H0 can be rejected and H1 is accepted (i.e. the variable is not stable). The test can be conducted once again after taking differences of integration degree test of the variable. If the variable becomes stable after taking first differences, the variable is integrated of the first degree. It is represented by the symbol I (1). If the variable becomes stable after taking second difference, the variable is integrated of the second degree. It is represented by the symbol I (2) and so on. Therefore, conducting this test for the study variables, the following results is found;

Table 1
ADF unit root test results for RGDP and
The independent variables

ADF statistics		
Variables	Levels form	First Differenced
RGDP	3.32	-8.959
GOVDET	2.12	-6.559
BUDDEF	0.25	-11.972
INFR	1.02	-5.459
INTR	0.45	-11.369

From the last table 1, it is noted that integration of orders zero is not existed for these variables. Therefore, first differences have been taken in order to reach stationarity for these variables. This means that the alternative hypothesis is rejected which indicates that these variables are integrated of order higher than zero. Consequently, when the first differences were taken for these variables, the null hypothesis that $\alpha 1 = 1$ is rejected for all of them which indicates that these variables are integrated of order one I (1).

Table 2
Co-integration Analysis among Variables

Included observations: 300

Trend assumption: Linear deterministic trend

Series: RGDP GOVDET BUDDEF INFR INTR

Lags interval (in second differences): 1 to 4

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.31	34.07	14.85	0.003
At most 1 *	0.22	22.45	16.7	0.02
At most 2	0.035	2.87	18.4	0.84

Trace test indicates 2 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):

RGDP	GOVDET	BUDDEF	INFR	INTR
-1.36	-0.10	0.89	0.73	0.30
0.24	-0.24	-0.14	-0.31	-0.99
-2.03	0.05	1.41	0.78	0.32
0.44	-0.06	0.82	-0.45	-0.45
-3.03	0.05	1.21	0.68	0.66

Unrestricted Adjustment Coefficients (alpha):

D(RGDP)	0.06	0.008	0.02	0.002
D(GOVDET)	0.04	0.006	0.03	0.001
D(BUDDEF)	0.03	0.006	0.04	0.001
D(INFR)	0.02	0.002	0.01	0.001
D(INTR)	0.05	0.004	0.03	0.002

1 Co-integrating Equation(s): Log likelihood -158.0883

Normalized co-integrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.055	-0.43	-0.58	-0.41
(0.03)	(0.04)	(0.11)	(0.05)	(0.12)
RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.000000	-0.65	-0.59	0.076
(0.02)	(0.01)	(0.12)	(0.06)	(0.03)

Adjustment coefficients (standard error in parentheses)

D(RGDP)	-0.05
	(0.01)
D(GOVDET)	-1.42
	(0.62)
D(BUDDEF)	-0.18
	(0.03)
D(INFR)	0.16
	(0.05)
D(INTR)	-0.03
	(0.02)

2 Cointegrating Equation(s): Log likelihood -125.30

Normalized cointegrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR
1.000000	0.000000	-0.45	-0.50	-0.04
		(0.1210)	(0.0682)	(0.0191)
0.000000	1.000000	-0.052	0.61	0.08
		(0.7491)	(0.3938)	(0.0685)

RGDP	GOVDET	BUDDEF	INFR	INTR
-0.71	-0.04	-0.52	-0.59	-0.67
(0.02679)	(0.01297)	(0.17310)	(0.05426)	(0.1210)

Adjustment coefficients (standard error in parentheses)

D(RGDP)	-0.03	-0.002
	(0.01)	(0.003)
D(GOVDET)	-1.4	-0.61
	(0.68)	(0.12)
D(BUDDEF)	-0.13	-0.001
	(0.02)	(0.005)
D(INFR)	0.15	0.006
	(0.04)	(0.01)
D(INTR)	-0.04	-0.002
	(0.01)	(0.003)

3 Cointegrating Equation(s): Log likelihood -135.4

Normalized cointegrating coefficients (standard error in parentheses)

RGDP	GOVDET	BUDDEF	INFR	INTR

1.000000	0.000000	0.000000	0.38	-0.113
			(0.26)	(0.02)
0.000000	1.000000	0.000000	0.81	0.15
			(0.32)	(0.06)
0.000000	0.000000	1.000000	1.42	-0.04
			(0.15)	(0.01)
Adjustment coefficients (standard error in parentheses)				
D(RGDP)	-0.06	-0.002	0.049	
	(0.04)	(0.003)	(0.022)	
D(GOVDET)	-1.00	-0.67	0.80	
	(1.65)	(0.13)	(0.75)	
D(BUDDEF)	-0.10	-0.001	0.07	
	(0.07)	(0.005)	(0.03)	
D(INFR)	0.20	0.006	-0.12	
	(0.16)	(0.013)	(0.07)	
D(INTR)	-0.03	-0.002	0.045	
	(0.04)	(0.003)	(0.021)	

In table 2, results of testing for co-integration relationships between the variables are presented. It is the first stage of (Engle and Granger, 1987) two-stage producer which is the static long-run regressions. The results from the ADF unit root tests on the residuals in every bivariate static long-run equation showed in Table 2 indicate that residuals in all static long-run equations are integrated of order one. This means that the variables in every bivariate equation are co-integrated. Therefore, there is a long-run relationship between these variables. In other words, all of series data have a

long-run relationship. As a consequence, they can be modelled as specified before to find out parameter estimate using empirical data. That is assured by results shown in the following Table 3.

Table 3 clarifies the Ordinary Least Squares (OLS) estimates between variables where RGDP is the dependent variable and the other four variables are the independent variables. The results indicate that there is a static long-run relationship between the variables. Coefficients of the independent variables are as follows;

Interest Rate (-0.32) and Budget Deficit (-0.09) reflecting negative relationships between both Real GDP and these two variables. The other two variables have positive coefficients reflecting a positive relationship between RGDP and these two variables. The coefficients are; Government Debt as a percentage of GDP (0.25), and Inflation (0.002). These coefficients can be verified as follows;

- 1% increase in Inflation causes Real GDP to increase by 0.002%,
- 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars,
- 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars,
- 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars,

The last column that represents the probabilities for these coefficients are all less than 0.05 and R-squared and Adjusted R-squared are 0.91 and 0.89 respectively which means that the long-run relationship between these independent variables and Real GDP is highly significant.

Table 3

OLS Estimates between Variables and Static long-run model for the effect of independent Variables on RGDP

Dependent Variable: RGDP

Method: Least Squares

Date: 05/09/19 Time: 20:24

Sample: 1 300

Included observations: 300

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOVDET	**0.25**	1.34	1.7	**0.0483**
BUDDEF	**-0.09**	0.61	0.10	**0.0164**
INFR	**0.002**	0.41	-3.51	**0.0006**
INTR	**-0.32**	0.36	-3.88	**0.0006**
C	**-2.9**	4.16	-0.12	**0.0049**

R-squared	**0.91**	Mean dependent var	0.88
Adjusted R-squared	**0.89**	S.D. dependent var	5.3
S.E. of regression	5.02	Akaike info criterion	4.7
Sum squared resid	256.9	Schwarz criterion	6.85
Log likelihood	-165.04	Hannan-Quinn criter.	4.6
F-statistic	4.15	Durbin-Watson stat	3.4
Prob (F-statistic)	0.003		

Therefore, the regression equation can be written as follows;

$$LOG\ RGDP_t = -2.9 + 0.25\ LOG\ GOVDET_t + 0.002\ LOG\ INFR_t - 0.09\ LOG\ BUDDEF_t - 0.32\ LOG\ INTR_t + u_t$$

Consequently, the analysis must be transferred into the second stage of (Engle and Granger, 1987) to confirm this co-integration relationship through applying the Error Correction (EC) models expressed. Results for this second stage analysis are presented in the coming Table 4.

Table 4
The Error Correction (EC) Model for the Effects of Independent Variables on RGDP

Vector Error Correction Estimates
Date: 05/09/19 Time: 22:28
Sample (adjusted): 4 300
Included observations: 300
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RGDP (-1)	2.6
	(0.31)
	[4.1]

C	-12.62	

Error Correction:	D(GOVDEB)	D(RGDP)
CointEq1	0.002	-0.31
	(0.001)	(0.04)
	[0.56]	[-6.12]
D(GOVDEB(-1))	**-0.05**	0.57
	(0.03)	(2.08)
	[-0.69]	[0.26]
D(INFR)	**-0.02**	-0.40
	(0.02)	(2.12)
	[-0.25]	[-0.19]
C	**-0.38**	-2.8
	(0.12)	(3.1)
	[-3.02]	[-0.90]
BUDDEF	**-0.03**	1.79
	(0.03)	(0.71)
	[-1.1]	[2.3]

INTR	**-0.059**	-0.6
	(0.01)	(0.38)
	[3.8]	[-2.3]
R-squared	**0.75**	0.46
Adj. R-squared	**0.71**	0.55
Sum sq. resids	9.5	125.6
S.E. equation	0.25	6.3
F-statistic	5.51	17.5
Log likelihood	-4.51	-499.9
Akaike AIC	0.16	6.5
Schwarz SC	0.32	6.7
Mean dependent	0.04	-0.23
S.D. dependent	0.28	8.48
Diagnostic tests for the chosen EC model		
ARCH	**0.628**	
	(0.717)	

As presented in Table 4, the model where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate contains Error Correction Model (ECM) which is consistent with the previous results obtained for the static long-rum regression and the ADF unit root tests for the residuals. Moreover, it is showed that the assumptions

behind this EC model are supported by the diagnostic test Autoregressive Conditional Heteroscedasticity (ARCH).

Conclusion:

The paper investigated the interactions between fiscal and monetary policies in the Egyptian Economy using quarterly data through the period Q1 2003 to Q4 2018. The paper tested an econometric model using OLS multiple regression where Real GDP is its dependent variable and Government Debt as a percentage of GDP, Inflation, Budget Deficit as a percentage of GDP, and Interest Rate are four independent variables representing fiscal policy and monetary policy targets. The real GDP reflects the stabilization target which is the main aim for both fiscal and monetary policies. The results indicate that there is a static long-run and short-run relationships between the variables where 1% increase in Inflation causes Real GDP to increase by 0.002%, 1% increase in Government Debt as a percentage of GDP causes Real GDP to increase by 0.25 million dollars, 1% increase in Budget Deficit as a percentage of GDP causes Real GDP to decrease by 0.09 million dollars, 1% increase in Interest Rate causes Real GDP to decrease by 0.32 million dollars.

Finally, the study states that interactions between fiscal and monetary policies in the Egyptian economy exists in both short-run and long-run but it can be considered in a weak shape. There is a need for more coordination between the Central Bank of Egypt (the head of monetary authorities) and the Ministry of Finance (the responsible for fiscal policy) in order to strengthen the impact of interactions between fiscal and monetary policy towards achieving more stabilization in the Egyptian Economy.

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